



THE EFFECTS OF EMBRACING ARTIFICIAL INTELLIGENCE FOCUS ON CORPORATE SUSTAINABILITY PERFORMANCE: THE MEDIATING EFFECT OF DIGITAL INNOVATION

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Abstract

Under the rapid growth of economy and society, enterprises are paying more and more attention to environmental and social sustainability besides economic benefits. As a crucial engine for technological innovation, the effective use of artificial intelligence (AI) to improve business sustainability performance has received much attention from academics and industry. This research investigates the influence of the degree of AI adoption on corporate sustainability performance with an emphasis on the mediation effect of digital innovation. The empirical analytic approach was used in this study. The study obtained 451 employee survey responses from manufacturing businesses. The results show that the intensity of AI adoption significantly facilitates corporate sustainability performance, which is represented in the complete improvements of economic, environmental, and social advantages. Moreover, the digital innovation proved is an important mediating factor between AI adoption and sustainability performance. Moreover, this study empirically analyses in depth the application paths and mechanisms of AI in corporate sustainability, providing theoretical basis and practical guidance for corporate managers in strategy and policy making.

Keywords: Corporate Sustainability Performance, Digital Innovation, AI adoption intensity,

1. Introduction

In recent years, the attention of world leadership and business management has moved from simple economic growth to a more holistic search for sustainability, especially in environmental and social fields (Suharyono et al., 2023). Initiatives like the United Nations “2030 Agenda for Sustainable Development” are urging nations and companies to embrace sustainable practices at all levels of production and consumption. Manufacturing is a major contribution to economic stability and is critical to attaining these aims, especially in Pakistan where it is a cornerstone of the economy (Din et al., 2024). In order to achieve high-quality development, manufacturing businesses should embed environmental and social obligations into their economic activities (Baquero, 2024). At the same time, the digital economy is altering industries, with artificial intelligence (AI) emerging as a revolutionary technology with the potential to boost creativity, efficiency and sustainability across sectors (Mentzas et al., 2024). This is of particular importance to the large-scale manufacturing industries in Pakistan, which are traditional and vital to the integration of the digital and real economies. Corporate sustainability increasingly requires the use of AI in order to optimize operations, reduce costs and enhance competitive advantages. Although their great potential, the research on the specific



intersection of AI adoption and sustainability is limited, especially on the impact of AI adoption intensity on corporate sustainability performance in organizational transformations (Rammer et al., 2022).

Existing literature mainly focuses on AI or sustainability separately, but not on their intersection in depth. This creates a huge vacuum in our understanding of how AI adoption intensity influences sustainability outcomes, particularly as it relates to digital innovation (van Wynsberghe, 2021). The adoption of AI needs to be explored in terms of how it can contribute to corporate sustainability by improving operational efficiency and environmental and social performance. Moreover, little research has been done on the mediating effect of digital innovation on this relationship, therefore, it is important to examine the mediating effects of digital innovation (Khin & Ho, 2019a).

Based on the research background, this study aims to answer the following critical questions related to these research questions. First, what is the impact of the intensity of AI deployment on corporate sustainability performance and what are the mechanisms behind it? Second, what is the mediating role of DI in the association between AI adoption intensity and corporate sustainability performance? The key goals of this study in asking these research questions are as follows. We intend to explore the intensity of AI deployment in the Pakistani organizational setting and to elaborate the causal relationship by its impact on the corporate sustainability performance. Furthermore, we not only verify the impact of AI adoption intensity on corporate sustainability performance but also explain the mechanism that induces corporate sustainability performance. Here, we attempt to elucidate the indirect effect of digital innovation on the relationship between the intensity of AI deployment and corporate sustainability performance. Therefore, we focus on the identification of one critical route through which AI adoption intensity affects corporate sustainability performance and tests the mediation role of DI. Finally, this study intends to synthesize AI adoption, DI and corporate sustainability performance into a unified framework, thus providing both theoretical implications and practical recommendations for manufacturing enterprises, especially in Pakistan where AI is the core of digital and intelligent transformation.

Finally, most of the previous studies have focused on the factors influencing corporate sustainability performance, such as stakeholder pressure and responsible innovation (Opoku Mensah et al., 2021), firm value (Alsayegh et al., 2023), ESG criteria (Jing & Zhang, 2024), and organizational culture (Shin et al., 2023). However, the research topic of corporate sustainability performance is quite scarce on the topic of AI adoption. Moreover, most of the studies only focus on the exploration of antecedent factors affecting corporate sustainability performance. This is a missing link in previous studies. Thus, this research finds the role of AI adoption intensity as a new factor that enhances the level of corporate sustainability performance and a mediating research model on how to enhance the sustainability performance of the corporation. In general, we expect to broaden the research of corporate sustainability performance and supplement the previous studies to some extent, thus contributing to the academic field of corporate sustainability performance.

This study offers a number of significant insights from Pakistan's point of view. This study offers empirical evidence demonstrating that the implementation of artificial intelligence (AI) improves corporate sustainability performance within Pakistan's manufacturing sector, thereby addressing the scarcity of evidence from emerging economies. The study points to the fact that digital innovation is a key intermediary mechanism through which AI contributes to the performance of the economy, environment, and society, thereby enriching business understanding of the digital transformation process in Pakistani companies. Third, it proposes and validates a coherent theoretical model linking the level of AI adoption, digital innovation, and corporate sustainability performance, which offers a context-specific model that can be transferred to emerging economies with similar institutional environments.

The results provide real-world insights for managers, policy makers, and industrial stakeholders in Pakistan, demonstrating the potential of AI-enabled digital innovations to contribute to sustainable industrial development, operational efficiencies, and national sustainability efforts within the digital transformation journey. The study contributes to the public policy by providing evidence and insights that can help the government agencies in devising AI adoption policies, digital innovation policies, and sustainability policies to strengthen the competitiveness of industrial industry in Pakistan. This research addresses a significant



contextual gap in the international literature by concentrating on Pakistan, as most prior studies have been undertaken in developed economies, thereby enhancing the worldwide comprehension of AI-enabled business sustainability in emerging markets.

2. Theoretical Background and Hypotheses

2.1. Intensity of AI Adoption and Digital Innovation

AI adoption intensity is the frequency of the use of AI systems to understand, learn, and continuously upgrade based on the external data to achieve specific goals (Enshassi et al., 2025). Furthermore, the dynamic nature of AI calls for continuous learning and agility on the part of the work-force and thereby redefine traditional roles and responsibilities in organizations. However, dynamic capabilities theory offers a theoretical foundation to explain the trigger of digital innovation through AI adoption, allowing firms to continually adjust to technological advances and market dynamics. When AI techniques are introduced, they cascade through the organization, leading to incremental changes in organizational structures and processes. The early adopters along the diffusion curve get the time advantage by being first to benefit from operational efficiencies and from decision making based on data. In addition, advancements in AI implementation will likely drive further innovation and transformation within organizations. The dynamic capabilities theory Wang & Ahmed (2007) also provides another perspective to grasp the connection between AI adoption and organizational change. This theory posits that dynamic capabilities help companies embed new technologies like AI into their business workflows. The adoption of AI can be regarded as a 'capability of the organization', a capacity that enables the organization to configure and restructure its internal resources and processes in an ongoing process to become competitive in a changing environment. The successful adoption of AI technologies plays a crucial role in organizational transformation, helping companies meet customer needs more effectively, save resources, and innovate.

Digital innovation uses new and advanced digital technologies to improve organizational processes, goods, services, and business models to boost efficiency and competitiveness (Khin & Ho, 2019a). AI helps organizations automate, make smart decisions, and analyses data in real time (van Wynsberghe, 2021). AI solutions help firms improve production operations, save costs, improve quality, and maximize resources. AI-driven automation and smart production systems reduce industrial errors and waste. AI can also learn from massive amounts of data, helping organization's improve goods, processes, and services (Khin & Ho, 2019a). These attributes foster companies to apply new digital solutions, upgrade business operations and boost their innovation capabilities. Consequently, AI can enable digital innovation, helping to align with market trends and optimize for sustainable long-term performance. This study proposes that the intensity of AI adoption is significant and positively related to digital innovation, so this study assumes that H1 is true. For this reason, this study assumes that H1 is valid, namely the intensity of the adoption of AI has a significant positive effect on digital innovation. The present study, thus, poses the following hypothesis:

H1: AI adoption is positively correlated with DI.

2.2. Digital innovation and CSP

CSP helps organization's create long-term value while promoting economic growth, environmental conservation, and social responsibility (Faiza Irum & Awan, 2024). Using precious, uncommon, and inimitable resources and competencies to gain a sustained competitive position improves performance. Digital innovation may optimize corporate operations, boost resource efficiency, and produce sustainable value, making it a strategic facilitator of organizational sustainability. The Corporate Social Responsibility (CSR) Theory states that organizations are responsible to shareholders, employees, customers, suppliers, communities, and nature, which explains the positive relationship between DI and corporate sustainability performance. Digital innovation helps organization's satisfy stakeholder duties such sustainable production, environmental management, employee wellness, and stakeholder engagement (Wang & Yan, 2023). Thus, organization's that embrace digital innovation can improve their economic, environmental, and social performance, enhancing their sustainability. Digital innovation also uses advanced digital technology, business process innovation, intelligent systems, and data-driven decision-making to improve operational efficiency, organizational cooperation, and market and environmental responsiveness (Lin et al., 2025).



Technology helps organizations use resources more efficiently, reduce waste and emissions, increase product and service quality, and practice sustainable business. The organization's ability to embed sustainability in its daily activities, produce sustainable solutions, and satisfy changing stakeholder expectations increases its learning and innovation capacity (R. Li et al., 2024). Continuous learning with digital technology boosts technological growth, product innovation, and competitive advantage in changing corporate environments. Thus, it is proposed:

H2: CSP links positively DI.

2.3 AI Adoption Intensity & CSP

AI adoption can boost economic performance by optimizing resource use and production efficiency, lowering operational costs and increasing profits (Kelley, 2022). AI's predictive analytics can help firms better foresee market demands and consumer trends, optimizing production schedules and marketing tactics for economic success (Enshassi et al., 2025). Thus, as organization's implement AI, they consume more resources and benefit more, ensuring sustainability. Technology, organization, and environment (Pigola et al., 2021) also affect AI adoption. Adopting AI can help organization's improve operational efficiency, restructure internal processes and resources, and satisfy regulatory and market needs. AI solutions help organizations comply with environmental laws, reduce resource use, and meet customer demand for sustainability, improving economic, environmental, and social sustainability.

The resource-based approach (RBV) views AI adoption intensity as a crucial organizational competency that can give enterprises a durable competitive advantage (Mikalef & Gupta, 2021). Valuable, scarce, inimitable, and non-substitutable resources generate long-term corporate performance, says the RBV. AI technology helps companies optimize operations, allocate resources, and improve environmental and social effects. For instance, AI's data-driven decision-making helps organization's reduce waste and optimize resources (Chen et al., 2022). This advantage helps organization's realize economic gains while addressing environmental and social issues, improving their sustainability performance. AI adoption intensity helps organization's meet their social duties and strengthen stakeholder connections, improving social performance. AI analyses customer feedback and behaviours data to personalize products and services, increasing customer satisfaction and loyalty (Li & Jin, 2024). Additionally, AI in personnel management might boost job happiness and experience. AI-driven performance evaluation and training platforms can help employees improve professionally by identifying and developing talent (Akram et al., 2025). Thus, higher AI adoption intensity improves economic, environmental, social, and corporate sustainability. This study suggests the following hypothesis:

H3: AI adoption intensity positively influences CSP.

2.4. Digital innovation Mediating Effect

Li & Jin (2024) state that AI adoption demands major organizational changes. As it alters corporate processes, decision-making systems, and personnel roles, AI adoption frequently requires major organizational and cultural adjustments. RBV theory also stresses the significance of managing these changes to integrate AI technology into the organization's daily operations, which improves business sustainability (Jiacong, 2025). Digital innovation handled well helps organization's integrate AI's promise with sustainability goals, improving environmental, social, and economic benefits. Previous studies also show how external influences like rules and public expectations shape organizational behaviours, supporting digital innovation (Pigola et al., 2021; Tang et al., 2025). Environmental regulations, social responsibility, and market expectations drive companies to use AI technologies. DI helps organization's respond to external expectations by redesigning internal processes to meet social and regulatory standards. Thus, past studies show that digital innovation is crucial for transforming AI capabilities into sustainability (Akram et al., 2025; Sjödin, 2023). Sustainability as a dynamic organizational skill that improves flexibility and creativity facilitates digital innovation and corporate sustainability performance (Jiacong, 2025).

During transformation, organization's optimize organizational structure, managerial procedures, and innovation culture to meet external environmental changes and challenges. AI can help organization's estimate market demand and client behaviors, improving product development and marketing tactics (Pigola



et al., 2021). This boosts economic performance, resource efficiency, and environmental protection, boosting company sustainability. Digital innovation improves personnel management and customer service, which boosts a company's social image and brand value (Akram et al., 2025). According to RBV theory, digital innovation mediates the gap between AI adoption intensity and corporate sustainability performance. Digital innovation enhances the relationship between AI use and business sustainability performance. AI technology spurred digital innovation and improved business sustainability. Thus, this study hypothesizes:

H4: AIAI influences CSP through DI.

Figure 1

Conceptual Framework



3. Research Methodology

This study used positivist research paradigm with quantitative research method, which focuses on the causal relations between Artificial Intelligence (AI) adoption intensity, digital innovation, and corporate sustainability performance. According to positivist philosophy, reality is objective, measurable and independent of researcher, so that the relationship between variables can be tested empirically by using statistical technique. The methodology used is suitable for assessing the hypothesized relationships and provides empirical evidence concerning the sustainability transformation enabled by AI in the manufacturing industry of Pakistan. The present study is to test pre-established hypotheses implied by the existing theories and to assess the magnitude and significance of relationship between the latent constructs, therefore quantitative research approach was considered as the most appropriate research approach.

Cross-sectional design was used because all the data was collected at one time. Cross-sectional surveys are common in many organizational and management studies, as they offer a quick way to investigate organizational, technological and behavioural phenomena over a short period of time. Moreover, this design enables the researcher to examine several variables at once and use a structural equation model to statistically analyse direct and indirect relationships. The questionnaire was piloted with academic and industry experts who have experience in AI utilization and corporate sustainability to ensure its clarity, ease of reading and contextual relevance prior to the final survey. Some minor wording changes were made but not affecting the conceptual meaning of the original items.

3.1 Population and Sampling

The study population consisted of the employees of the manufacturing industries in Pakistan. The manufacturing organizations were chosen as they are one of the biggest contributors to the Pakistan economy and are highly adopting AI technologies to use in their production process, supply chain management, quality control, predictive maintenance, and business decision making. Such organizations are also increasingly expected to become more environmentally, economically and socially sustainable, providing a suitable context to discuss AI based sustainability performance. The unit of analysis was the employee level. But only those who had the requisite knowledge about the implementation of AI and organizational innovation were deemed eligible to participate. The respondents ranged from production managers, operations managers, IT managers, engineering managers, sustainability managers, quality assurance managers, department heads, supervisors, and senior executives who were directly involved in the implementation of AI, digital transformation initiatives, or strategic decision making.

Due to the lack of a complete sampling frame of manufacturing workers who are implementing AI, convenience sampling was used. This method of sampling is quite applicable in the organizational and management area of research, especially when the subjects involved have specialized knowledge that is not



easily identified through probability sampling. Data were gathered from the manufacturing companies in the main industrial cities of Pakistan by using printed questionnaires and online survey forms.

3.2 Measurement of Variables

3.2.1 Intensity of AI adoption measurement. The rate of AI adoption is the extent to which a system understands and learns from external data, continually upgrading to meet certain goals and tasks. The present study employs a unidimensional scale of the intensity of AI adoption developed by (Braganza et al., 2021) with four items. Sample items include “AI is a mainstream technology that will dominate our industry” and “AI is well accepted by the top management in our company”. The Cronbach’s alpha for this scale was 0.87.

3.2.2 CSP Measurement. Corporate sustainability performance is usually measured by economic, environmental and social dimensions based on the “triple bottom line” theory. In this study, CSP was measured through a six-item unidimensional scale developed by Munir et al. (2019). These items are scored on a 7-point Likert scale. Sample items are “The company attaches great importance to environmental protection” and “The company’s economic performance is outstanding in comparison with its peers”. The Cronbach’s alpha for this scale was .91.

3.2.3 Digital Innovation. Digital innovation is the application and utilization of cutting-edge digital technologies to optimize processes, products, services and business models, which helps organizations be more efficient and competitive. The present study employs a unidimensional scale of digital innovation developed by Khin & Ho (2019b) with five items. These items are rated using the 7-point Likert scale. Examples of sample items are: Our company often uses new digital technologies to enhance our business processes and operations and Digital technologies help our organization create new products or services. Cronbach's alpha recorded 0.89.

3.3 Data Analysis Technique

Systematic multi-stage data analysis was done on IBM SPSS Statistics Version 27 and AMOS Version 24. Firstly, the data set was checked for missing values, duplicate responses, data entry errors and outliers. The descriptive statistics were then calculated to give an overview of the data collected and the demographic information of the respondents. Then, the assumptions in multivariate analysis such as normality, linearity, and multicollinearity and homoscedasticity were checked. Skewness and kurtosis statistics were used to assess data normality, VIF values below 5 confirmed absences of multicollinearity. Cronbach's Alpha and Composite Reliability were used for reliability analysis to check the internal consistency of the measurement items. CFA was then used to validate the measurement model, and to assess the construct validity. The accepted goodness-of-fit indices were used to evaluate model fitness: Chi-square/df (CMIN/DF), CFI, TLI and RMSEA.

3.4 Common Method Bias

A number of Podsakoff et al. (2003) questionnaire design procedures were followed. To reduce evaluation-apprehension and social-desirability bias, respondents were told the survey was voluntary and anonymous. Confidentiality assurances encouraged honest reporting. The questions were not too complicated, lengthy, or technical, reducing uncertainty and the inclination for respondents to answer similarly or systematically. The Common Method Bias was statistically analyzed using Harman's Single-Factor Test. Unrotated principal component analysis and exploratory factor analysis were performed on all measurement items. Factor 1 accounted for less than 50% of the variance, hence the common method variance in this study was not a concern. Discriminant validity among constructs further corroborated the observed correlations' lack of common method bias. Thus, the procedural safeguards and statistical test results indicate that Common Method Bias did not significantly affect the study outcomes.

4. Results

4.1 Demographic Examination

Among the survey 451 sample, Table 1 shows demographic details. Males’ responders were (309, 68.5%) while females (142, 31.5%). Most respondents belonged to the 31-40 years (35.7%) followed by 41-50 years (27.5%) & 21-30 years (24.4%). The group with the lowest number of respondents was the above 50 years group (12.4%). Regarding education, 40.5% had a master degree, 34.6% had bachelor degree, while remaining percentage belong to Ph.D., and other qualifications. Among experience respondents had 6-10



years of experience (32.8%) and were Department Managers (28.4%), followed by 11-15 years of experience (29.5%) and Supervisors (25.3%). This means that the sample was dominated by experienced employees working in managerial and supervisory positions.

Table 1

Demographic Detail

Variable	Category	n	%
Gender	Male	309	68.5
	Female	142	31.5
Age (Years)	21–30	110	24.4
	31–40	161	35.7
	41–50	124	27.5
	Above 50	56	12.4
Education	Bachelor's	156	34.6
	Master's	203	45.0
	MPhil/MS	69	15.3
	PhD	23	5.1
Work Experience	Less than 5 Years	85	18.8
	6–10 Years	148	32.8
	11–15 Years	133	29.5
	Above 15 Years	85	18.9
Job Position	Supervisor	114	25.3
	Department Manager	128	28.4
	Operations Manager	70	15.5
	IT/Sustainability Manager	55	12.2
	Senior Executive	84	18.6

4.2 Reliability Test and Confirmatory Factor Analysis

Confirmatory factor analysis can be used to verify the applicability of the model. The confirmatory factor analysis results are as follows. The absolute fit indices were χ^2 (p) = 341.467 (0.000), χ^2/df = 1.518 and RMSEA = 0.034. Secondly, the incremental fit indices were IFI = 0.982 and CFI = 0.982. Third, the parsimonious adjusted indexes were PNFI = 0.845 and PGFI = 0.765. Moreover, the present study examined AVE and CR values. The AVE values were 0.691, 0.676, & 0.664 for AI adoption intensity, DI & CSP, respectively, which were all above the threshold of 0.5. CR values regarding AI adoption intensity were 0.770, digital innovation was 0.828, and CSP was 0.770. All values were greater than 0.7. AVE > 0.5 and CR > 0.7 show that the measurements have sufficient. Moreover, this study also evaluated the Cronbach's value. The α Cronbach was 0.887 for AIAI, 0.905 for DI, 0.895, and 0.908 for CSP, shows Cronbach's alpha higher than 0.7 indicates high reliability. Results are presented in Table 4.

Table 4

CR, AVE & F.L

Construct	Item	Factor Loading	AVE	CR	α
AIAI	AIAI1	0.841	0.691	0.899	0.887
	AIAI2	0.857			
	AIAI3	0.812			
	AIAI4	0.824			
DI	DI1	0.846	0.676	0.912	0.895
	DI2	0.831			



Construct	Item	Factor Loading	AVE	CR	α
CSP	DI3	0.818	0.664	0.922	0.908
	DI4	0.792			
	DI5	0.825			
	CSP1	0.814			
	CSP2	0.827			
	CSP3	0.853			
	CSP4	0.819			
	CSP5	0.792			
	CSP6	0.808			

Model-fit: IFI = 0.982, χ^2/df = 1.518, CFI = 0.982, & RMSEA = 0.034.

4.3 Descriptive Statistics and Correlation Analysis

Table 5 shows AIAI, DI, and CSP descriptive statistics and Pearson correlation coefficients. The mean values are 3.41–3.44, indicating moderate agreement between respondents, and the standard deviations are 1.12–1.36. Results indicate a significant positive correlation ($p < 0.001$) among all constructs. In instance, AIAI shows a positive correlation with both DI ($r = 0.376^*$) and CSP ($r = 0.377^*$), but the strongest positive correlation between DI and CSP ($r = 0.435^*$) is found between DI and AIAI. Because all correlation coefficients are less than 0.80, the data set is suitable for SEM analysis without multicollinearity.

Table 5

Mean, S.D & correlation coefficient

Variable	Mean	SD	1	2	3
1. AIAI	3.44	1.36	1.000		
2. DI	3.43	1.12	0.376*	1.000	
3. CSP	3.41	1.35	0.377*	0.435*	1.000

4.4 Hypothesis Testing

The study tested predicted connections among corporate sustainability performance, digital innovation, and artificial intelligence (AI) adoption intensity utilizing SEM & AMOS 24. The reliability and validity of the measurement model was established before the evaluation of the structural model. The significance of each hypothesis was determined by standardized path coefficient (β) values, Critical Ratios (C.R.) and p-values. Results showed that all the hypothesized scenarios were confirmed. To test H1, the results show that AI Adoption Intensity has a positive significant impact on Digital Innovation ($\beta = 0.524$, C.R. = 10.816, $p < 0.001$). The discovery indicates that companies with high AI adoption rates are more apt to improving their digital innovation capabilities with the efficient use of intelligent technologies and data-driven decision making.

Moreover, Digital Innovation has a significant and positive effect on Corporate Sustainability Performance ($\beta = 0.431$, C.R. = 8.392, $p < 0.001$) thus supporting H2. The findings suggest that digital innovations can be implemented in an organization that results in better economic, environmental and social sustainability outcomes by having better operational efficiency and innovation capabilities. H3 was also supported by the positive and statistically significant relationship between AI Adoption Intensity and CSP ($\beta = 0.318$, C.R. = 6.517, $p < 0.001$). This discovery indicates that AI technologies have a direct impact on improving organizational sustainability performance, by increasing productivity, resource use and strategic decisions.



Table 6

Results of Direct Hypotheses Testing

Hypothesis	Structural Path	Standardized β	C.R.	p-value	Decision
H1	AI Adoption Intensity $\rightarrow$ Digital Innovation	0.524	10.816	<0.001	Supported
H2	Digital Innovation $\rightarrow$ Corporate Sustainability Performance	0.431	8.392	<0.001	Supported
H3	AI Adoption Intensity $\rightarrow$ Corporate Sustainability Performance	0.318	6.517	<0.001	Supported

4.5 Mediating Effect of Digital Innovation

Digital Innovation was examined as a mediator between AIAI and CSP using bootstrapping with 5,000 samples and 95% bias-corrected confidence intervals. Since bootstrapping doesn't assume normality for indirect effects, it can test mediation. The results indicate that the indirect effect of AIAI on CSP through DI is positive and significant (Indirect Effect = 0.226, Boot SE = 0.038, 95% CI = [0.154, 0.304], $p < 0.001$). Statistics show the indirect effect is significant (confidence interval excludes zero). However, the direct path from AI Adoption Intensity to CSP remained significant with the mediator included ($\beta = 0.318$, $p < 0.001$), demonstrating that Digital Innovation partially mediates this relationship. H4 supported.

5. Discussion

The current study examined the relationship between the intensity of AI adoption and Corporate Sustainability Performance (CSP) with mediating role of Digital Innovation (DI) in the setting of manufacturing companies in Pakistan. The results verified all the four hypotheses, indicating that AI has a positive impact on digital innovation and corporate sustainability performance, and digital innovation plays a partially mediating role in the relationship between AI and corporate sustainability performance. The results support the research framework, which suggests that strong technological capability enables organizations to effectively integrate and deploy resources for sustainable competitive advantage (Wang & Ahmed, 2007).

The results show a positive relationship between AI adoption and digital innovation and thus support H1. The findings indicate that companies that invest in advanced artificial intelligence (AI) technologies are better able to create new digital products, services and processes. AI helps companies grow and digitally transform using automation, predictive analytics, machine learning, and data driven decisions. The results are consistent with the previous research of Khin and Ho (2019) that digital technologies have positive effects on organizational innovative potential. AI adoption can help the organization's redesign processes and create digital solutions; high adoption intensity drives innovation and technological advancement. The findings support the agreement that AI is a key technology for digital innovation in organizations.

The study shows that digital innovation has a significant effect on corporate sustainability performance, which supports H2. Having a strong digital innovation capability allows organizations to improve operational efficiency, optimize the use of resources, reduce waste in production, improve environmental management, and engage stakeholders effectively. These improvements contribute to better economic, environmental and social outcomes. The results support Khin and Ho (2019) and show that digital innovation has a positive impact on organizational competitiveness and long-term performance. Wang and Yan (2023) suggest that digital innovation helps organizations achieve sustainability through enhanced environmental responsibility and operational efficiency. Lin et al. (2025) and Li et al. (2024) reported that digitally innovative firms are better at integrating sustainability into their strategy and operations. The findings provide further evidence of the importance of digital innovation for corporate sustainability.

The results also substantiate the hypothesis H3, as the intensity of AI adoption is positively correlated with the sustainability performance of corporations. This indicates that AI technologies are directly supporting sustainable organizational development by enhancing production efficiency, cutting down on operational costs, optimizing energy usage, facilitating intelligent resource allocation, and enhancing environmental



performance. AI-based predictive analytics and intelligent automation also empower businesses to make more informed decisions quickly, boosting their long-term organizational sustainability. The results align with Mikalef and Gupta (2021) who found that AI can be a strategic asset for the organization that can provide a sustainable competitive advantage. Similarly, Chen et al. (2022) found that AI can improve the environmental performance of the implementation by optimizing the use of resources and reducing waste, and Kelley (2022) found that AI adoption can improve economic performance by increasing operational efficiency. Moreover, Akram et al. (2025) found that AI technologies can improve the management of employees and organizational efficiency, which can support the social aspect of corporate sustainability. Thus, the present results corroborate prior empirical data showing that the use of AI can have a direct effect on the sustainable performance of an organization. Moreover, the mediation analysis results showed that the relationship between intensity of AI adoption and corporate sustainability performance was partially mediated by digital innovation, supporting H4.

The discovery highlights how AI technologies can enhance sustainability by directly impacting the organization and also by bolstering companies' digital innovation capabilities. Organizations that do successfully convert their AI investments into innovative digital products, services, and business processes, are more likely to obtain better sustainability results than organizations who only implement AI. The mediation result is in line with the Resource-Based View (RBV) of the firm which asserts that technological resources only can be used to sustain competitive advantage in the market when they are complemented by the organizational capabilities that can effectively convert technological resources into valuable organizational outcomes (Barney, 1991). Khin & Ho (2019b) found the same result and contend that digital innovation is a critical mechanism which connects advanced digital technologies with organizational performance. Similarly, AlNuaimi et al. (2022) reported that AI is a tool which will enable the transformation of an organization but only through continuous digital innovation to unlock maximum business performance and Ghaleb et al. (2023) found that digital innovation is turning AI into sustainable competitive advantage. The present study thus builds on previous studies in two ways: First, it empirically establishes digital innovation as an important mediating variable between intensity of AI adoption and the performance of companies with regard to corporate sustainability in the manufacturing sector in Pakistan.

5.1 Theoretical Implications

This research has several significant theoretical contributions to the literature on Artificial Intelligence, digital transformation and corporate sustainability. The study contributes to the body of theory by empirically proving the linkage between AI adoption intensity and as a strategic organizational capability to continuously reconfigure internal resources for firms to enhance their digital innovation capability, which eventually improves their corporate sustainability performance (Hsiao, 2024). Past research has focused on AI as an operational technology, but the present findings indicate that AI is actually a dynamic organizational capability that can create long-term strategic value. Second, this study is a welcome addition to the emerging body of research on digital innovation, as it highlights Digital Innovation as a pivotal intervening variable between degree of AI adoption and corporate sustainability performance. While prior research has investigated the adoption of AI and the outcomes of sustainability performance separately, few studies have attempted to explain the mechanism by which AI creates sustainability outcomes.

The present study confirms the mediating effect of digital innovation, thereby enhancing the theory of the organizational transformation through digitalization with the help of AI. Third, this work brings together three concepts of the adoption of AI, digital innovation, and corporate sustainability performance in a coherent conceptual framework based on the Resource Based View (RBV). The integrated framework illustrates that technological resources are not enough on their own to increase sustainability; however, the organizations must also have complementary innovation resources with which they can convert investments in these technologies into valuable organizational results (Barney, 1991). Finally, the study has been useful in filling the void of empirical literature in the emerging economy context due to evidence from Pakistan's manufacturing industry. Most of the previous AI and sustainability studies are conducted in the developed countries (Braganza et al., 2021; Munir et al., 2019), which limits the external validity of the existing theories,



yet the present findings validate the applicability of the existing theories within the context of a developing country, in which rapid industrial digitalization has taken place.

5.2 Practical Implications

This study has several practical implications for the management and policymaking, as well as organizational leadership, engaged in digital transformation and sustainable development. Firstly, managers realize adopting AI as long-term investment. Also, optimal sustainability results, incorporate AI in production systems, SCM, CRM, predictive maintenance, & strategic decision-making. Second, and most significant, is the importance of digital innovation as a mediating variable, which implies that organizations will need to invest in digital innovation capacity, digital competencies of employees, organizational learning, and digital infrastructure. Without ongoing innovation in digital processes and business models, having access to AI technologies is not enough to create sustainable performance. This suggestion aligns with (Mahotra & Majchrzak, 2024) who noted that the successful realization of digital technologies to add business value depends on organizational innovation. Third, national policies should be developed to promote the use of AI and digital innovations in Pakistan's manufacturing sector by providing research funding, tax incentives, building digital infrastructure, and implementing Industry 4.0. More effective links between tertiary education institutions, research institutes, technology suppliers and industry will accelerate the sustainable transformation of industries and enhance national competitiveness. Lastly, educational institutions and professional training providers should increase educational programs, digital innovation initiatives, and workforce development initiatives that focus on AI, to boost the technological skills of workers. The ability to provide a highly skilled workforce will help organizations implement AI technologies and enhance corporate sustainability performance in the future.

5.3 Limitations & future direction

Though this study is significant, it has several limitations that could be addressed in future studies. The study employed cross-sectional research approach which does not allow AI deployment and sustainability performance changes over time. Longitudinal studies are required to explore long-term AI-enabled digital transformation influence. Second, it was only limited to manufacturing companies in Pakistan. While manufacturing is one of the key areas of economic activity in the country, findings may not be directly applied to service industries or other organizations within other institutional settings. Future studies should replicate the proposed framework across different industries and countries to improve external validity. Third, data were collected using self-reported questionnaires from individual respondents. Although procedural and statistical remedies were applied to minimize common method bias, future research may combine survey data with objective organizational indicators such as ESG performance, environmental reports, financial performance, or AI investment records to strengthen empirical validity.

Fourth, the present study examined only the mediating role of digital innovation. Future research could investigate additional mediators, including organizational learning, knowledge management capability, digital transformation maturity, innovation capability, and organizational resilience. Moreover, future researchers may introduce moderating variables such as organizational culture, leadership style, environmental uncertainty, technological readiness, government support, firm size, or organizational agility to better understand the conditions under which AI adoption enhances sustainability performance. Finally, future studies may employ advanced analytical techniques such as multi-group structural equation modelling, longitudinal SEM, multilevel analysis, machine learning prediction models, or mixed-method approaches to further explore AI-enabled organizational sustainability and validate the proposed framework across different organizational contexts.

Author Contributions

All authors participated in ideation, development, and writing the manuscript. All authors read and approved the final manuscript.

Conflict of Interest Statement

The authors declare that there is no conflict of interest regarding the publication of this article.



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Informed Consent

Informed consent was obtained from all participants.

Data Availability

The datasets generated during and analysed during the current study are available from the corresponding author on reasonable request.

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