

FROM TECHNOLOGY ACCEPTANCE TO ARTIFICIAL INTELLIGENCE ADOPTION: COMPARATIVE INSIGHTS FROM THE UNITED STATES, SOUTH KOREA AND TURKIYE

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ABSTRACT

Purpose- This study explores the conceptual transition from the Technology Acceptance Model (TAM) toward emerging Artificial Intelligence acceptance perspectives while comparatively examining technological development and its associations with sustainability indicators in the United States, South Korea and Turkiye. Despite growing literature on AI adoption, cross-country assessments linking AI capacity with environmental performance remain limited. This study addresses this gap by evaluating the alignment between national AI development trajectories and sustainability outcomes.

Methodology- The research adopts a comparative descriptive design based on secondary data from internationally recognized reports and statistical databases. Country-level indicators related to AI investment, innovation capacity, carbon intensity, renewable energy use and environmental performance are systematically compared. The study does not aim to establish causal relationships but rather to identify associative patterns across countries at different stages of technological development.

Findings- Results suggest that higher levels of AI investment and technological capacity are descriptively associated with improvements in energy efficiency, reductions in carbon emissions and enhanced environmental performance. However, the strength of this relationship varies according to national technological readiness and institutional capacity. The United States shows the strongest alignment between AI development and sustainability improvement, South Korea demonstrates moderate progress, and Turkiye shows ongoing technological development, although sustainability gains remain comparatively limited due to structural and implementation challenges.

Conclusion- The study extends technology acceptance discussions beyond the individual level by presenting a comparative national framework linking AI adoption with sustainable development outcomes. Findings indicate that technological investment alone is insufficient; effective sustainability performance requires institutional capacity and coordinated policy implementation. The results offer practical insights for policymakers seeking to align digital transformation strategies with long-term sustainability goals, while future research should broaden comparative scope and examine sectoral and long-term impacts of AI adoption on sustainability performance.

Keywords: Artificial intelligence, artificial intelligence acceptance, sustainability, technology acceptance model, cross-country comparison.

JEL Codes: C33, O33, Q56

1. INTRODUCTION

Artificial intelligence (AI) technologies have become increasingly influential in shaping productivity, innovation capacity and sustainable development strategies worldwide. Recent global assessments suggest that AI-driven applications have the potential to generate significant economic and environmental benefits, reinforcing their strategic importance in long-term development planning (McKinsey Global Institute, 2023; World Economic Forum, 2023). However, the pace and scope of AI development vary considerably across countries with different technological infrastructures and institutional capacities, including the United States, South Korea and Turkiye (OECD, 2024). The Technology Acceptance Model (TAM) has long served as a foundational framework for explaining individual technology adoption behavior (Davis, 1989). While TAM provides strong explanatory power at the individual level, it has been criticized for its limited capacity to account for institutional, structural and policy-driven determinants influencing technology diffusion at broader organizational and national levels (Venkatesh et al., 2016). As AI systems increasingly operate within complex socio-technical environments, understanding technology adoption requires moving beyond individual behavioral intentions toward macro-level perspectives that incorporate governance capacity, digital infrastructure and innovation ecosystems. In response to these limitations, emerging artificial intelligence acceptance perspectives seek to extend traditional acceptance models by integrating dimensions such as institutional readiness, national technological capacity, digital infrastructure and regulatory frameworks (Shankar & Datta, 2022). Macro-level technology diffusion, particularly in the case of AI, is shaped not only by user perceptions but also by structural and institutional determinants that influence how technological capabilities translate into broader developmental outcomes.

Recent international statistics illustrate significant differences in AI investment and innovation capacity across countries. The United States leads global AI research investment, reaching approximately USD 330 billion in 2023 (Stanford AI Index, 2024). South Korea allocates nearly 4.9% of its GDP to research and development, positioning itself among the most research-intensive economies globally (OECD, 2024). Türkiye has also strengthened its institutional and strategic framework through the implementation of its National Artificial Intelligence Strategy (TÜBİTAK, 2023). These differences in technological capacity are reflected in environmental indicators: over the past decade, carbon intensity has declined at varying rates across the three countries, while renewable energy consumption has shown differentiated growth patterns (World Bank, 2024; IEA, 2024). Despite the expanding literature on AI adoption, most empirical studies focus primarily on firm-level or individual-level acceptance processes. Cross-country analyses examining how national AI development capacity corresponds with sustainability performance remain comparatively limited (Dwivedi et al., 2021). Whether advancements in AI systematically align with improvements in environmental performance remains an open empirical question, particularly across countries with diverse institutional and economic structures. Accordingly, the aim of this study is to comparatively examine how national AI development capacity corresponds with sustainability performance in the United States, South Korea and Türkiye, based on internationally reported indicators covering the last decade and including the most recent available data. The study seeks to address the following research question: *How does national AI development capacity correspond with sustainability outcomes across countries with different technological and institutional characteristics?* This study contributes to literature in three main ways. First, it contributes to extending technology acceptance discussions from individual-level behavioral models toward a macro-national comparative perspective. Second, it integrates AI development indicators with sustainability performance measures within a structured cross-country analytical framework. Third, it provides policy-relevant insights that may support the alignment of digital transformation strategies with environmental and energy transition objectives.

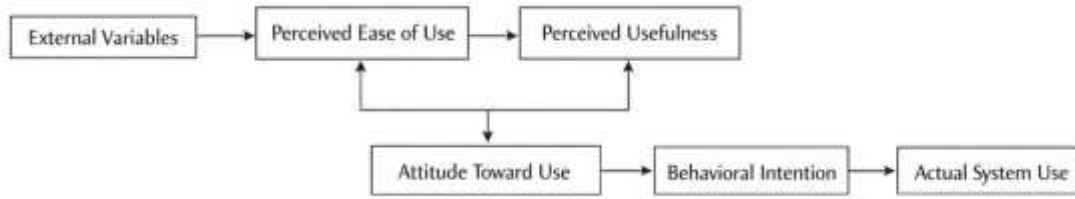
2. LITERATURE REVIEW

2.1. Theoretical Framework and Technology Acceptance Model (TAM)

Technology acceptance has emerged as a central research field seeking to explain how individuals adopt, use and integrate new technologies into their daily and professional practices. Among the most influential theoretical frameworks in this domain is the Technology Acceptance Model (TAM), originally proposed by Davis (1989). TAM posits that technology adoption is primarily determined by two core perceptions: perceived usefulness and perceived ease of use. These perceptions shape users' behavioral intentions, which in turn influence actual technology utilization (Venkatesh & Davis, 2000).

Over time, TAM has been extended to accommodate more complex technological and social environments. TAM2 introduced additional determinants such as social influence and cognitive instrumental processes, while the Unified Theory of Acceptance and Use of Technology (UTAUT) integrated constructions including facilitating conditions, performance expectancy, effort expectancy and social norms (Venkatesh et al., 2003). These extensions enhanced the explanatory power of technology acceptance models, particularly in organizational contexts. Despite their robustness at the individual level, TAM and its extensions have been criticized for their limited capacity to explain technology diffusion at broader structural levels. Large-scale technological transformations are influenced not only by user perceptions but also by institutional frameworks, regulatory environments, national innovation systems and infrastructural readiness (Venkatesh et al., 2016). In macro-level contexts, technology adoption is shaped by policy coordination mechanisms, governance capacity and socio-economic structures that extend beyond individual behavioral determinants. These limitations become particularly evident in the context of artificial intelligence. Unlike earlier information systems, AI technologies often involve autonomous decision-making processes, algorithmic opacity and data-intensive infrastructures. Such characteristics introduce governance, ethical and societal implications that cannot be fully captured through traditional usability and perception-based constructs (Dwivedi et al., 2021). Trust in algorithms, transparency of decision systems, accountability mechanisms and institutional oversight become central determinants influencing AI diffusion across sectors and national systems. With the increasing prevalence of digitalization, automation and data-driven systems, technology acceptance frameworks have gradually evolved to encompass so-called "smart technologies," emphasizing dimensions such as trust, transparency, ethical responsibility and system autonomy (Marangunić & Granić, 2015; Shankar & Datta, 2022). However, understanding AI adoption requires moving beyond individual-level acceptance models toward multi-level frameworks that incorporate individual, organizational, institutional and societal dimensions simultaneously. Therefore, while TAM provides a valuable conceptual foundation for understanding technology adoption behavior, its explanatory scope remains limited when addressing national-level AI development and sustainability outcomes. The present study builds upon this theoretical foundation while extending the analytical perspective toward macro-level technological capacity and its potential alignment with environmental performance indicators. To illustrate the conceptual roots of technology adoption research, the core components of TAM are presented in Figure 1.

Figure 1: Technology Acceptance Model (TAM)



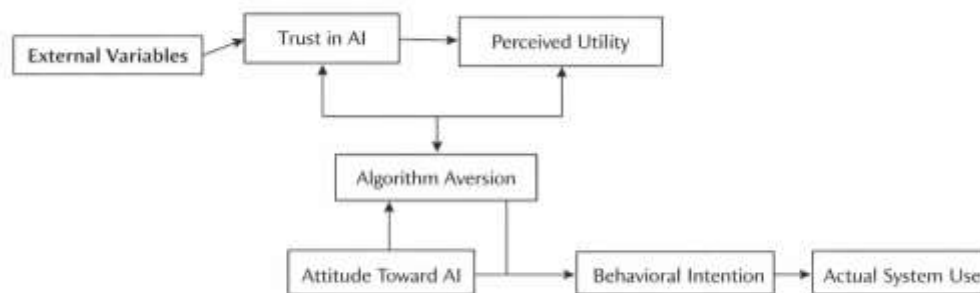
Source: (Davis, 1989).

2.2. Theoretical Framework and Artificial Intelligence Acceptance Model (AIAM)

The Artificial Intelligence Acceptance Model (AIAM) represents an emerging conceptual extension within technology acceptance research that seeks to address the distinctive characteristics of AI-driven systems. Rather than constituting a fully institutionalized or standardized theoretical model, AIAM reflects an evolving body of literature that adapts traditional acceptance frameworks to the specific features of artificial intelligence technologies. Unlike earlier information systems, AI-based technologies involve algorithmic autonomy, data-intensive infrastructures and often opaque decision-making processes. These characteristics introduce new determinants of acceptance that extend beyond perceived usefulness and ease of use. Research increasingly emphasizes the role of trust in algorithms, perceived fairness, explainability, accountability mechanisms and ethical awareness in shaping individuals’ willingness to adopt AI systems (Glikson & Woolley, 2020; Longoni et al., 2022). When AI-generated decisions are perceived as transparent, reliable and aligned with ethical standards, acceptance levels tend to increase. A key analytical distinction between traditional technology acceptance models and emerging AI acceptance perspectives lies in their scope. While TAM and its extensions primarily focus on individual-level perceptions and behavioral intentions, AI acceptance increasingly requires multi-level consideration. The diffusion of AI technologies is influenced not only by user cognition but also by institutional readiness, digital infrastructure capacity, regulatory frameworks and national innovation ecosystems (OECD, 2024). In this context, AI adoption reflects governance capacity, policy coordination and the broader socio-technical environment within which AI systems operate. This multilevel dimension is particularly important because AI technologies frequently shape critical infrastructures, including energy systems, public administration, healthcare and financial services. At the macro level, AI capacity may influence sustainability performance through data-driven resource optimization, smart grid management, predictive environmental monitoring and efficiency-enhancing automation. However, such outcomes depend on institutional capacity, strategic alignment and regulatory oversight rather than on technological investment alone. Empirical studies applying AI acceptance perspectives have predominantly examined sectoral contexts such as banking, healthcare, education and public services (Sturm et al., 2023).

Yet, cross-country investigations exploring how national AI development capacity corresponds with sustainability performance remain limited. This gap is particularly relevant because AI-driven transformation may generate heterogeneous environmental outcomes depending on governance structures and technological maturity levels. Accordingly, AIAM should be understood as an evolving conceptual framework that extends traditional technology acceptance theories by integrating algorithmic characteristics, ethical considerations and institutional determinants. In the context of the present study, AI acceptance is approached not solely as an individual behavioral phenomenon but as a national-level capacity embedded within broader innovation and governance systems. The conceptual structure of the Artificial Intelligence Acceptance Model (AIAM) is presented in Figure 2.

Figure 2: Artificial Intelligence Acceptance Model (AIAM)



Source: (Glikson & Woolley, 2020; Longoni et al., 2022).

2.3. Relationship between Artificial Intelligence and Sustainability

Artificial intelligence (AI) has increasingly been recognized as a transformative technological force with the potential to influence multiple dimensions of sustainable development. International organizations emphasize that AI applications may contribute directly or indirectly to a substantial number of Sustainable Development Goals (SDGs), particularly in areas such as energy efficiency, climate action, industrial innovation and responsible resource management (United Nations, 2023; UNESCO, 2023). However, the extent to which AI contributes to sustainability depends on structural, institutional and technological conditions within national contexts. From a functional perspective, AI technologies may support sustainability through several mechanisms. First, data-driven optimization systems can enhance energy efficiency by improving demand forecasting and enabling smart grid management. Second, predictive analytics may assist in monitoring carbon emissions, detecting environmental risks and optimizing industrial production processes. Third, AI-based automation can increase resource efficiency by minimizing waste and improving operational precision (IEA, 2024). These mechanisms suggest a potential alignment between technological advancement and environmental performance. Nevertheless, the relationship between AI and sustainability is not automatically positive. AI infrastructures themselves require substantial computational power and energy consumption, particularly in large-scale data centers. Moreover, unequal access to digital infrastructure and advanced technical skills may limit the sustainability benefits of AI in developing or structurally constrained economies (World Bank, 2024). Therefore, AI's environmental contribution is mediated by governance quality, regulatory oversight, digital maturity and institutional coordination capacity. Cross-country differences illustrate this variability. According to the Stanford AI Index (2024), AI-related research and development expenditures reached approximately USD 330 billion in the United States in 2023, compared to roughly USD 47 billion in South Korea and about USD 6.5 billion in Türkiye. These disparities reflect varying national capacities to integrate AI into industrial systems, energy infrastructures and environmental management processes. In technologically advanced contexts, AI-supported systems are more frequently associated with improvements in energy efficiency and emission monitoring, whereas in emerging economies structural constraints—such as limited digital infrastructure, restricted data accessibility and shortages of advanced digital skills—may weaken this association. In Türkiye, for instance, although strategic initiatives and policy frameworks related to artificial intelligence have expanded in recent years (TÜBİTAK, 2023), the integration of AI into production systems and environmental governance mechanisms remains comparatively gradual. Consequently, improvements in carbon intensity and environmental performance indicators appear more moderate relative to technologically mature economies. Taken together, the relationship between AI and sustainability should be understood as conditional rather than deterministic. AI development capacity may correspond with improved sustainability performance when supported by institutional readiness, coordinated policy implementation and adequate digital infrastructure. This conditional perspective aligns with emerging AI acceptance frameworks that emphasize multi-level determinants of technology diffusion, extending analysis beyond individual adoption toward national-level structural capacities.

2.4. Comparative Analysis of the US, South Korea and Türkiye

The United States, South Korea and Türkiye represent three distinct positions within the global technological landscape, offering analytically meaningful variation in terms of innovation capacity, digital infrastructure and institutional maturity. The selection of these cases enables structured comparison across advanced, research-intensive and emerging technological contexts, thereby facilitating examination of how national AI development trajectories correspond with sustainability performance under differing structural conditions. The United States maintains a leading global position in artificial intelligence innovation, accounting for more than 40% of worldwide AI-related patents and demonstrating high levels of scientific publication output (OECD, 2024). Its advanced digital infrastructure, mature capital markets and strong university–industry collaboration systems provide a conducive environment for large-scale AI deployment. South Korea similarly ranks among the world's most research-intensive economies, with research and development expenditures reaching approximately 4.9% of GDP (OECD, 2024). The country combines strong industrial policy coordination with advanced manufacturing capabilities and rapidly expanding digital ecosystems, positioning it as a technologically sophisticated yet structurally distinct case from the United States.

Türkiye, by contrast, represents an emerging technological economy undergoing institutional and infrastructural transformation. Through the implementation of the National Artificial Intelligence Strategy (TÜBİTAK, 2023), Türkiye has sought to strengthen its AI ecosystem, expand digital competencies and enhance innovation capacity. However, differences in research intensity, technological infrastructure and capital availability distinguish Türkiye from the two more research-intensive economies. These structural differences are particularly relevant in the context of sustainability alignment. Advanced technological capacity may facilitate the integration of AI into energy systems, industrial efficiency processes and environmental monitoring mechanisms. However, the translation of AI investment into sustainability outcomes depends on institutional coordination, governance quality and digital readiness. Therefore, cross-country comparison provides an opportunity to examine whether higher AI development capacity systematically corresponds with stronger sustainability performance or whether contextual factors mediate this relationship. Existing studies frequently focus on sector-specific AI adoption patterns or firm-level analyses (Dwivedi et al., 2021; Longoni et al., 2022), while comparative national-level examinations remain limited. By positioning these three countries within a common analytical framework grounded in macro-level technology acceptance perspectives, the present study contributes to understanding how AI development capacity interacts with sustainability performance across heterogeneous institutional

contexts. A comparative summary of technological capacity, AI investments and sustainability-related indicators for the three countries examined in this study is presented in Table 1.

Table 1: Comparative Indicators of AI and Innovation Capacity: United States, South Korea and Turkiye

Latest Available Data	United States	South Korea	Turkiye
Share in Global AI Patents (%)	>40%	High global ranking	Limited share
R&D Expenditure (% of GDP)	≈3.5%	≈4.9%	≈1.3%
AI R&D Investment (2023, USD)	≈330 billion	≈47 billion	≈6.5 billion
AI Policy Framework	Advanced national AI ecosystem and strong private sector leadership	Strong state-led innovation and digital transformation policies	National AI Strategy implemented in 2021
Industrial AI Integration	Extensive adoption across sectors	Strong adoption in manufacturing and digital industries	Integration expanding but still limited
Renewable Energy Growth (2010–2022)	+20%	+14%	+10%
Carbon Intensity Change (2010–2022)	–18%	–9%	–5%
Overall Position in Study	Technological leader	Innovation-intensive economy	Emerging digital economy

Source: OECD (2024), Stanford AI Index (2024), World Bank (2024), IEA (2024), TÜBİTAK (2023); compiled by the authors.

3. DATA AND METHODOLOGY

This section outlines the research design, data sources, sampling strategy and analytical procedures employed to examine the relationship between national artificial intelligence (AI) development capacity and sustainability performance. The study adopts a structured comparative approach based entirely on secondary macro-level data obtained from internationally recognized institutions. The methodological framework is designed to ensure cross-country comparability, conceptual consistency with the theoretical framework and analytical transparency.

3.1. Research Design and Data Collection

This study employs a structured comparative descriptive research design to examine how national artificial intelligence (AI) development capacity corresponds with sustainability performance across countries at different stages of technological maturity. The objective is not to test causal hypotheses but to identify associative patterns and structural differences at the macro level. The comparative approach enables systematic evaluation of cross-country variations in AI investment, innovation capacity and sustainability indicators. Such macro-level comparative analyses are widely used in technology policy and sustainability research to assess developmental trajectories across heterogeneous institutional contexts (Ragin, 2014). The United States, South Korea and Turkiye were selected purposively to represent distinct technological profiles: a global innovation leader, a research-intensive industrial economy and an emerging technological economy undergoing institutional transformation.

3.2. Data Sources and Variables

This study is based on macro-level secondary indicators related to national artificial intelligence (AI) development and sustainability performance. Rather than defining a conventional statistical population, the research draws upon internationally reported country-level datasets that enable cross-national comparison. The analytical sample consists of three purposively selected countries: the United States, South Korea and Turkiye. These countries were chosen to represent different levels of technological maturity, AI development capacity and institutional readiness. The United States reflects a globally leading innovation ecosystem characterized by high R&D intensity and extensive AI-driven industrial applications (Stanford AI Index, 2023). South Korea represents a research-intensive economy with advanced digital infrastructure and strong governmental coordination in AI strategy (OECD, 2024; IEA, 2024). Turkiye is included as an emerging technological economy strengthening its AI capacity through national strategies and institutional reforms (TÜBİTAK, 2023; World Bank, 2024).

This purposive case selection enables structured comparison across heterogeneous technological contexts, allowing examination of how differences in AI development capacity correspond with sustainability performance. The use of internationally standardized indicators ensures cross-country comparability and enhances the reliability of the analytical framework.

3.3. Limitations

The study has several limitations. First, the study relies exclusively on secondary international datasets, limiting the scope of variables to publicly reported indicators. Second, the inclusion of only three countries restricts broader generalization. Third, sustainability assessment focuses primarily on environmental indicators, while economic and social sustainability dimensions are addressed to a more limited extent. Finally, variations in reporting periods across international databases may introduce minor temporal inconsistencies. Despite these limitations, the selected cases provide analytically meaningful variation for examining how AI development capacity corresponds with sustainability performance across different institutional contexts.

3.4. Data Analysis Methods

In this study, data analysis was conducted using a structured cross-country comparative approach. This method is appropriate for examining macro-level differences in artificial intelligence (AI) development capacity and sustainability performance across countries with heterogeneous technological and institutional characteristics. The analysis relies on standardized country-level indicators obtained from internationally recognized databases (OECD, 2024; World Bank, 2024; IEA, 2024; Stanford AI Index, 2023). Indicators were selected to represent two primary analytical dimensions:

- AI development capacity (e.g., R&D intensity, AI investment levels, patent output, technological readiness)
- Sustainability performance (e.g., carbon intensity trends, renewable energy consumption share, environmental performance indicators).

The analytical procedure consisted of three stages. First, AI-related indicators were compiled and harmonized to ensure cross-country comparability. Second, sustainability indicators were comparatively examined to identify relative positioning and directional trends across countries. Third, a qualitative alignment assessment was conducted to evaluate whether higher levels of AI development capacity correspond with stronger sustainability performance. The study does not employ econometric modeling or causal inference techniques. Instead, it relies on structured comparative interpretation of macro-level indicators. Accordingly, the findings reflect associative and conditional patterns rather than causal relationships.

4. FINDINGS AND DISCUSSIONS

This section presents the comparative findings of the study based on internationally reported indicators related to artificial intelligence development and sustainability performance across the selected countries. First, differences in AI development capacity among countries are examined. Second, sustainability performance indicators are compared. Finally, the alignment between technological development and sustainability outcomes is evaluated to identify similarities and divergences among countries. Accordingly, Table 2 presents a comparative overview of the AI and innovation capacities of the United States, South Korea and Turkiye, forming the basis for interpreting subsequent sustainability performance differences across countries.

Table 2: Comparative Overview of the AI and Innovation Capacities

	United States	South Korea	Turkiye
Share in Global AI Patents	Over 40% of global AI patents	High global ranking	Limited share
R&D Expenditure (% of GDP)	≈ 3.5%	≈ 4.9%	≈ 1.3%
AI R&D Investment (2023)	≈ USD 330 billion	≈ USD 47 billion	≈ USD 6.5 billion
National AI Policy Framework	Advanced AI ecosystem with strong private sector leadership	Strong state-supported innovation and digital transformation policies	National AI Strategy implemented in 2021
Industrial AI Integration	Extensive cross-sector adoption	Strong integration in manufacturing and digital industries	Expanding but still limited integration
Overall Innovation Capacity	Very high	High	Developing

Table 2 demonstrates clear differences among the three countries in terms of artificial intelligence and innovation capacity. The United States maintains a leading global position, particularly in AI patent production and investment levels, reflecting a mature and innovation-driven ecosystem supported by strong private sector involvement. South Korea also exhibits strong innovation performance, especially through its high R&D expenditure relative to GDP and strong industrial integration of advanced technologies. In contrast, Turkiye represents an emerging AI ecosystem where investments and institutional frameworks have recently expanded, yet industrial-level adoption and innovation outputs remain comparatively limited. These differences suggest that the countries operate at distinct stages of technological maturity, which is likely to influence how effectively AI technologies

contribute to sustainability outcomes examined in subsequent analyses. Accordingly, Table 3 presents a comparative overview of sustainability performance indicators for the selected countries.

Table 3: Comparative Sustainability Performance Indicators

Indicator	United States	South Korea	Turkiye
Carbon Intensity Change (2010–2022)	–18%	–9%	–5%
Renewable Energy Consumption Growth (2010–2022)	+20%	+14%	+10%
Environmental Performance Trend	Continuous improvement	Moderate improvement	Gradual improvement
Integration of Clean Energy Technologies	High adoption level	Increasing adoption	Developing adoption level
Overall Sustainability Performance	High	Moderate	Developing

Table 3 compares sustainability performance indicators across the selected countries and reveals differing levels of environmental progress. The United States demonstrates the strongest improvement in both carbon intensity reduction and renewable energy expansion, reflecting broader adoption of clean energy technologies and environmental management policies. South Korea also shows measurable progress, although reductions in carbon intensity and renewable energy expansion remain more moderate compared to the United States. Turkiye exhibits gradual improvements; however, sustainability performance gains remain comparatively limited, partly due to ongoing structural and energy transition challenges. Overall, the results suggest that countries with stronger technological and innovation capacities tend to achieve more significant sustainability improvements, although progress remains uneven across national contexts. Accordingly, Table 4 presents a comparative assessment of the alignment between AI development capacity and sustainability outcomes in the selected countries.

Table 4: Alignment Between AI Development Capacity and Sustainability Outcomes

Country	AI Development Capacity	Sustainability Improvement Level	Alignment Assessment
United States	High	Strong improvement	Strong alignment
South Korea	High	Moderate improvement	Partial alignment
Turkiye	Developing	Limited improvement	Emerging alignment

Table 4 illustrates how differences in AI development capacity correspond to sustainability performance across countries. The United States demonstrates both high AI capacity and strong improvements in sustainability indicators, suggesting a strong alignment between technological advancement and environmental performance. South Korea also exhibits high AI development capacity; however, sustainability improvements appear more moderate, indicating partial alignment between technological development and sustainability outcomes. In contrast, Turkiye’s developing AI ecosystem corresponds with more limited sustainability progress, reflecting an emerging but not yet fully realized alignment between technological development and environmental performance. These findings indicate that while higher AI capacity often coincides with better sustainability outcomes, the strength of this relationship varies depending on institutional capacity, policy implementation and structural conditions. Accordingly, Table 5 presents a general comparative summary combining technological and sustainability performance indicators.

Table 5: General Comparative Summary of AI Development and Sustainability Performance

Country	AI Development Capacity	Innovation Performance	Sustainability Performance	Overall Development Pattern
United States	High	Very high	High improvement	Technological and sustainability leader
South Korea	High	High	Moderate improvement	Innovation-driven transition economy
Turkiye	Developing	Moderate	Limited improvement	Emerging digital transformation economy

Table 5 summarizes the comparative positions of the three countries examined in the study. The United States demonstrates strong performance in both technological development and sustainability outcomes, positioning it as a leader in aligning innovation capacity with environmental performance. South Korea shows strong innovation capacity but more moderate

sustainability improvements, indicating an ongoing transition toward stronger sustainability outcomes. Türkiye, while making progress in technological development through national AI strategies and digital transformation initiatives, still exhibits comparatively limited sustainability improvements. Overall, the comparison suggests that technological capacity and sustainability performance tend to evolve together, yet the pace and effectiveness of this alignment differ according to countries' institutional, economic and policy conditions. The findings obtained in this study indicate that there is a meaningful relationship between artificial intelligence (AI) development capacity and sustainability performance at the country level. When the table results are evaluated together, it becomes evident that countries with higher AI investments and stronger innovation capacity achieve more visible progress in sustainability indicators. In particular, the strong performance of the United States in both AI patent production and investment capacity, as well as in reducing carbon intensity and increasing renewable energy use, demonstrates that technological development can progress in parallel with environmental performance. Similar trends are also observed in the literature. Reports published by the OECD and the World Bank indicate that digitalization and AI investments in developed countries contribute positively to improvements in energy efficiency, production optimization and resource utilization. Likewise, Dwivedi et al. (2021) emphasize that advanced digital technologies generate transformative effects not only economically but also environmentally. Similarly, IEA reports show that smart energy management systems and data-driven optimization play an important role in reducing energy consumption. However, the results of the study also reveal that technological capacity does not automatically translate into sustainability performance. In the case of South Korea, despite high R&D expenditure and strong digital infrastructure, improvements in sustainability indicators are not as rapid as those observed in the United States. This suggests that not only technological capacity but also energy policies, sectoral structure and implementation processes play decisive roles. In the case of Türkiye, despite national AI strategies and ongoing digital transformation policies, improvements in sustainability performance remain comparatively limited. This finding confirms the importance of factors frequently emphasized in literature, such as infrastructure readiness, data management, technology adaptation and institutional implementation capacity. As noted by Longoni et al. (2022), technology adoption is not only a matter of technological investment but is also closely related to institutional and societal acceptance processes. Overall, the discussion demonstrates that the relationship between AI investments and sustainable development is not linear but is shaped by factors such as policy implementation, institutional capacity and economic structure. Although technological capacity represents an important tool for sustainability, it is not sufficient on its own.

5. CONCLUSION AND IMPLICATIONS

This study comparatively examined how national artificial intelligence (AI) development capacity corresponds with sustainability performance in the United States, South Korea and Türkiye. By integrating indicators related to AI investment, innovation intensity and environmental performance, the analysis aimed to provide a macro-level perspective on the alignment between technological transformation and sustainability outcomes. The findings suggest that higher levels of AI development capacity are generally associated with stronger sustainability performance; however, this relationship is conditional rather than automatic. The United States demonstrates a relatively strong alignment between technological advancement and environmental improvement. South Korea exhibits high innovation capacity, yet sustainability gains appear more moderate, indicating that technological sophistication alone may not guarantee proportional environmental outcomes. Türkiye, while strengthening its institutional AI framework, shows comparatively gradual sustainability improvements, reflecting structural and infrastructural constraints. Across cases, the results highlight that institutional capacity, regulatory coordination, digital infrastructure and energy transition policies play a critical mediating role in translating technological investment into environmental performance. The relationship between AI development and sustainability is therefore neither linear nor uniform. Rather, it depends on the extent to which innovation strategies are integrated with environmental and sectoral transformation policies. From a policy perspective, AI investment should be considered not only as a competitiveness strategy but also as a component of long-term sustainability planning. Coordinated policy frameworks that align digital transformation with environmental regulation and green transition objectives appear more likely to generate balanced technological and sustainability outcomes. The study contributes to the literature by extending technology acceptance discussions beyond individual and organizational contexts toward national-level technological transformation and sustainability alignment. Nevertheless, the findings should be interpreted within the limits of a descriptive comparative design. The analysis identifies associative patterns rather than causal relationships. Future research may expand the comparative scope, incorporate additional countries and apply longitudinal or econometric methods to further investigate the mechanisms linking AI development and sustainability performance. In conclusion, artificial intelligence represents a strategic opportunity for sustainable development. However, effective alignment between AI capacity and environmental progress requires integrated governance structures, institutional readiness and coordinated long-term policy frameworks.

Future Research Directions

- Future research could utilize panel data models covering longer time periods to assess the long-term impacts of AI investments on sustainability.
- Studies may analyze AI acceptance using sector-specific datasets (e.g., energy, agriculture, finance, healthcare) to uncover micro-level differences.

- National AI strategies could be examined alongside green transformation policies to evaluate the effects of policy alignment on sustainability outcomes.
- Future studies could conduct causality analyses by comparing firms' levels of AI acceptance with their environmental performance.
- The mediating roles of cultural values, governance quality and institutional trust in the relationship between AI acceptance and sustainability could be investigated. Exploring both economic and socio-cultural determinants of AI adoption would provide a significant contribution to the literature.

REFERENCES

- Davis, F. D. (1989). Perceived usefulness, perceived ease of use and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340.
- Dwivedi, Y. K., Hughes, D. L., Ismagilova, E., et al. (2021). Artificial intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities and agenda for research, practice and policy. *International Journal of Information Management*, 57, 101994. <https://www.elsevier.com/research-intelligence>
- Glikson, E., & Woolley, A. W. (2020). Human trust in artificial intelligence: Review of empirical research. *Academy of Management Annals*, 14(2), 627–660.
- IEA. (2024). World energy statistics 2024. International Energy Agency. <https://www.iea.org/reports/world-energy-statistics-2024>
- Longoni, C., Bonezzi, A., & Morewedge, C. K. (2022). Resistance to medical artificial intelligence. *Journal of Consumer Research*, 48(6), 1057–1078.
- Marangunić, N., & Granić, A. (2015). Technology acceptance model: A literature review from 1986 to 2013. *Universal Access in the Information Society*, 14(1), 81–95.
- McKinsey Global Institute. (2023). The economic potential of generative AI: The next productivity frontier. McKinsey & Company. <https://www.mckinsey.com/mgi>
- OECD. (2024). AI investment indicators 2024. OECD Publishing. <https://www.oecd.org/sti/ai-investment-indicators-2024.pdf>
- OECD. (2024). OECD digital economy outlook 2024. OECD Publishing.
- Shankar, R., & Datta, B. (2022). Artificial intelligence acceptance model: Exploring user trust and ethics in AI adoption. *Technological Forecasting and Social Change*, 183, 121880.
- Ragin, C. C. (2014). *The comparative method: Moving beyond qualitative and quantitative strategies* (2nd ed.). University of California Press.
- Stanford University. (2023). AI Index Report 2023. Stanford Institute for Human-Centered AI.
- Stanford University. (2024). AI index report 2024. Stanford Institute for Human-Centered Artificial Intelligence. <https://aiindex.stanford.edu>
- Sturm, R., Müller, A., & Schneider, T. (2023). Artificial intelligence adoption models in organizational contexts: A review of applications across sectors. *Journal of Technology Management*, 40(2), 123–145.
- UNESCO. (2023). Artificial intelligence and sustainable development goals. UNESCO Publishing. <https://www.unesco.org/en/ai-sdg>
- United Nations. (2023). Sustainable development report 2023. United Nations. <https://sdgs.un.org>
- United Nations. (2023). Science, technology and innovation report 2023. UNCTAD. <https://unctad.org/publication/science-technology-and-innovation-2023>
- Venkatesh, V., & Davis, F. D. (2000). A theoretical extension of the technology acceptance model: Four longitudinal field studies. *Management Science*, 46(2), 186–204.
- Venkatesh, V., Morris, M. G., Davis, G. B., & Davis, F. D. (2003). User acceptance of information technology: Toward a unified view. *MIS Quarterly*, 27(3), 425–478.
- Venkatesh, V., Thong, J. Y. L., & Xu, X. (2016). Unified theory of acceptance and use of technology: A synthesis and the road ahead. *Journal of the Association for Information Systems*, 17(5), 328–376.
- TÜBİTAK. (2023). Ulusal yapay zekâ stratejisi (2021–2025) izleme raporu. Türkiye Bilimsel ve Teknolojik Araştırma Kurumu. <https://www.tubitak.gov.tr>
- World Bank. (2024). World development indicators 2024. The World Bank. <https://databank.worldbank.org/source/world-development-indicators>
- World Economic Forum. (2023). Global future council on artificial intelligence for humanity report. Geneva: WEF. <https://www.weforum.org/reports/global-future-council-ai>