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AI ADOPTION AND NATIONAL ECONOMIC COMPETITIVENESS: A COMPARATIVE STUDY OF INDUSTRIAL AND ECONOMIC LEADERSHIP IN PAKISTAN AND THE UK

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Abstract

Artificial intelligence (AI) has emerged as a strategic driver of industrial competitiveness and national economic competitiveness. This study comparatively examines AI adoption and its influence on industrial and economic leadership in Pakistan and the United Kingdom. Guided by the Technology–Organization–Environment (TOE) framework, the study employed an interpretivist qualitative research design. Semi-structured interviews were conducted with 18 industry leaders, policymakers, AI specialists, and academics, and the data were analysed using reflexive thematic analysis. Five themes emerged: AI integration for industrial competitiveness, workforce readiness and AI capability, policy and regulatory support, innovation and national economic leadership, and structural barriers to AI adoption. The findings reveal that the United Kingdom benefits from mature AI ecosystems, coordinated governance, advanced digital infrastructure, and strong workforce development, enabling greater industrial competitiveness. Conversely, Pakistan demonstrates significant AI potential but faces challenges related to infrastructure, investment, workforce capability, and institutional coordination. The study concludes that sustainable AI-driven competitiveness depends on aligning technological capability, organizational readiness, human capital, and supportive policy environments. These findings provide theoretical and practical insights for governments, industries, universities, and policymakers seeking to strengthen AI-enabled industrial transformation and long-term national economic competitiveness.

Keywords: Artificial Intelligence, Economic Competitiveness, Industrial Leadership, AI Adoption, Industry 4.0

1. Introduction

1.1 Background of the Research

Artificial intelligence (AI) has emerged as a transformative technology reshaping the global economy by enhancing productivity, innovation, and long-term economic competitiveness. Through machine learning, predictive analytics, automation, and intelligent decision-making, AI enables organizations to improve efficiency while creating new opportunities for industrial development and digital transformation. Consequently, governments and industries increasingly recognize AI as a strategic resource that supports

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economic modernization, strengthens global competitiveness, and influences national development strategies (Butt, 2024; Horwitch, 2024).

The rapid advancement of AI has accelerated the transition toward Industry 4.0, where technologies such as the Internet of Things, cloud computing, robotics, big data analytics, and cyber-physical systems are transforming traditional industries into intelligent manufacturing ecosystems. AI serves as the core enabling technology by supporting predictive maintenance, automated quality control, optimized supply chains, and data-driven decision-making, thereby improving operational efficiency, reducing costs, and enhancing organizational performance (Rahman et al., 2022; Horwitch, 2024). At the national level, widespread AI adoption contributes to higher productivity, greater innovation capacity, stronger export competitiveness, and sustainable economic growth, particularly in countries investing strategically in AI research, infrastructure, education, and innovation ecosystems (Butt, 2024; Tanveer et al., 2025; Turan, 2026).

Despite its growing importance, AI adoption remains uneven across developed and developing economies. Developed countries generally benefit from advanced digital infrastructure, robust regulatory frameworks, sustained research investment, and strong collaboration among government, academia, and industry. In contrast, many developing economies continue to face infrastructural limitations, skill shortages, financial constraints, and fragmented policy implementation, reducing their ability to leverage AI for industrial competitiveness and economic development (Shukla et al., 2023; Zhang & Khaskheli, 2025; Rasheed & Ali, 2026).

Pakistan and the United Kingdom provide contrasting yet complementary contexts for examining these differences. While Pakistan is gradually expanding AI initiatives to support digital transformation, its progress is constrained by institutional and infrastructural challenges. Conversely, the United Kingdom has established a mature AI ecosystem supported by comprehensive national strategies, innovation-driven policies, and strong industry–academia collaboration (Tanveer et al., 2025). Comparing these two countries provides valuable insights into how institutional environments, workforce readiness, and policy support shape AI adoption and national economic competitiveness.

1.2 Problem Statement

Artificial intelligence (AI) has become a key driver of industrial competitiveness and national economic performance, yet its adoption remains highly uneven across countries. Developed economies have integrated AI across major sectors through advanced infrastructure, strong innovation ecosystems, and coordinated policy support, whereas many developing economies continue to face challenges related to limited infrastructure, investment, institutional capacity, and skilled human resources. These disparities contribute to differences in productivity, innovation, and global competitiveness (Badghish & Soomro, 2024; Schwaeke et al., 2025). Although many countries have introduced national AI strategies, significant variations persist in policy implementation, governance effectiveness, and institutional coordination, particularly between developed and developing economies (Ahmed & Fatima, 2025; Demaidi, 2025; Hasan, 2024).

Existing research has primarily employed quantitative approaches to examine AI adoption, emphasizing organizational performance and technology acceptance, while offering limited qualitative evidence on the experiences of industry leaders and policymakers across different national contexts (Badghish & Soomro, 2024; Schwaeke et al., 2025). Moreover, comparative studies between Pakistan and the United Kingdom remain scarce despite their contrasting levels of technological maturity and industrial development. This study addresses these gaps by comparatively examining stakeholder perspectives on AI adoption, workforce readiness, policy support, and institutional environments to better understand how these factors influence national economic competitiveness and to generate evidence-based recommendations for AI-driven industrial development (Khalid & Qureshi, 2020; Atta & Khan, 2025).

1.3 Research Questions

RQ1. How does AI adoption influence industrial competitiveness in Pakistan and the United Kingdom?
RQ2. How do workforce readiness and AI capabilities affect national economic competitiveness?
RQ3. What role do AI policies and regulatory frameworks play in industrial leadership?
RQ4. What barriers limit AI adoption in Pakistan and the United Kingdom?

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RQ5. What strategies can improve AI-driven economic competitiveness?

1.4 Research Objectives

- To examine AI adoption across industries in Pakistan and the United Kingdom.
- To compare workforce readiness for AI implementation.
- To evaluate policy and regulatory support for AI.
- To identify barriers affecting AI adoption.
- To develop recommendations for strengthening national economic competitiveness.

1.5 Significance of the Research

Academic significance. This study contributes to the expanding literature on artificial intelligence, digital transformation, and national economic competitiveness by providing a comparative qualitative perspective on AI adoption in a developed and a developing economy. Unlike many existing studies that rely primarily on quantitative methods or single-country analyses, this research captures the lived experiences and strategic perspectives of policymakers, industry leaders, and economic experts. The findings enrich theoretical understanding of how technological capability, institutional readiness, workforce development, and governance collectively influence AI-driven competitiveness, while extending knowledge on comparative AI adoption across different economic contexts.

Policy significance. The study offers evidence-based insights that can support governments in designing more effective AI policies and national digital transformation strategies. By comparing institutional practices in Pakistan and the United Kingdom, policymakers can better understand how regulatory frameworks, public investment, educational initiatives, and cross-sector collaboration influence successful AI implementation. The findings may assist governments in developing policies that encourage innovation, strengthen digital infrastructure, promote responsible AI governance, and improve national competitiveness within the global digital economy.

Industrial significance. For industry stakeholders, the research identifies organizational practices that facilitate successful AI integration and improved industrial performance. The comparative findings highlight how AI can enhance operational efficiency, innovation capability, productivity, and competitive advantage while identifying common implementation barriers faced by organizations. These insights provide practical guidance for firms seeking to accelerate digital transformation and strengthen their position in increasingly technology-driven markets.

Managerial significance. The findings provide managers and organizational leaders with practical knowledge regarding AI adoption, workforce development, strategic investment, and organizational readiness. Understanding how leadership, employee capabilities, technological infrastructure, and policy environments interact enables managers to make more informed decisions regarding AI implementation and digital transformation initiatives. The recommendations generated by this study may assist organizational leaders in developing long-term AI strategies that improve innovation, resilience, and sustainable competitive performance.

2. Literature Review

2.1 Theoretical Framework

This study adopts the Technology–Organization–Environment (TOE) framework as its primary theoretical foundation to explain AI adoption and its influence on national economic competitiveness. The TOE framework argues that technology adoption is shaped by three interrelated dimensions: technological readiness, organizational capability, and the external environment. The technological dimension considers the availability and benefits of AI technologies, the organizational dimension emphasizes leadership, resources, culture, and workforce capability, while the environmental dimension highlights the influence of government policies, regulatory frameworks, infrastructure, and competitive pressures. Given that AI implementation requires simultaneous technological, organizational, and institutional transformation, the TOE framework provides an appropriate basis for comparing AI adoption in Pakistan and the United Kingdom (Badghish & Soomro, 2024).

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To strengthen this perspective, the study also incorporates the National Innovation Systems (NIS) approach, which emphasizes collaboration among governments, industries, universities, and research institutions in promoting innovation and technological competitiveness (Khan et al., 2016). Additionally, the Digital Transformation perspective explains how AI enables organizations to redesign processes, improve decision-making, and enhance competitiveness through intelligent technologies (Rahman, 2025). Finally, the Dynamic Capabilities perspective highlights organizations' ability to sense opportunities, adapt resources, and sustain competitive advantage in rapidly evolving technological environments. Collectively, these complementary perspectives provide a comprehensive conceptual foundation for understanding how technological, organizational, and institutional factors shape AI adoption and national economic competitiveness (Jamil et al., 2025; Rahman, 2025).

2.2 AI Adoption, Industrial Digitalization and Organizational Competitiveness

Artificial intelligence (AI) has evolved into a strategic organizational capability that enhances productivity, innovation, and competitive performance across manufacturing, logistics, healthcare, finance, and service industries. By enabling intelligent automation, predictive analytics, and data-driven decision-making, AI improves operational efficiency, resource allocation, and customer engagement, making it a key driver of organizational competitiveness (Badghish & Soomro, 2024). Its rapid adoption is closely linked with Industry 4.0, where AI integrates with technologies such as the Internet of Things, cloud computing, robotics, and big data analytics to support predictive maintenance, quality assurance, supply chain optimization, and intelligent manufacturing, thereby strengthening industrial modernization and operational flexibility (Rahman, 2025; Waseel et al., 2024).

AI adoption is increasingly important for both large organizations and SMEs, although successful implementation depends on technological readiness, leadership commitment, financial resources, organizational culture, and supportive institutional environments. The Technology–Organization–Environment framework highlights the importance of technological compatibility, organizational capability, and external support in facilitating AI adoption, particularly among SMEs (Badghish & Soomro, 2024; Schwaeke et al., 2025). Moreover, AI functions as a core enabler of digital transformation by reshaping business processes, decision-making, and customer relationships through integration with cloud platforms and enterprise systems (Soomro et al., 2024). Organizations that combine AI investment with continuous learning, innovation, and adaptive leadership achieve stronger competitive advantages, entrepreneurial capability, and sustainable performance, reinforcing AI's role as a strategic resource rather than merely an operational technology (Jamil et al., 2025; Wu et al., 2026).

2.3 Workforce Readiness, Human Capital and AI Capability

Successful artificial intelligence (AI) adoption depends not only on technological infrastructure but also on a skilled workforce capable of developing, implementing, and managing AI systems. Human capital has become a strategic asset, enabling organizations to integrate AI effectively, foster innovation, and sustain competitiveness. In contrast, shortages of AI-related expertise and technical skills significantly hinder digital transformation, particularly in developing economies (Ali et al., 2024). Workforce readiness therefore requires advanced digital competencies, including data analytics, machine learning, programming, cloud computing, cybersecurity, and digital problem-solving, making continuous skill development essential for national productivity and economic competitiveness (Ali et al., 2024).

Higher education institutions play a pivotal role in developing AI capability by integrating emerging technologies into curricula, research, and industry partnerships. AI-enabled learning systems, interdisciplinary education, and curriculum modernization strengthen graduates' technical and analytical competencies while supporting lifelong learning (Ahmed & Meraj, 2024). However, successful educational integration also requires ethical guidelines, institutional support, and continuous professional development for educators (Rehmat et al., 2025). Organizations further enhance AI capability through continuous learning, knowledge sharing, and reskilling initiatives that improve adaptability and innovation (Yaseen et al., 2026). Moreover, university–industry collaboration promotes technology transfer, collaborative research, internships, and curriculum development, reducing the gap between academic knowledge and industrial needs. Digital

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communication platforms further facilitate continuous learning and knowledge exchange, collectively strengthening national AI capability and long-term economic competitiveness (Noor, 2026; Noor et al., 2026).

2.4 Policy, Governance and National AI Strategies

National policy and institutional governance are fundamental to successful artificial intelligence (AI) adoption and its contribution to economic competitiveness. While organizations implement AI operationally, governments create the regulatory, financial, educational, and technological environments that facilitate innovation. Countries with advanced AI ecosystems typically possess comprehensive national AI strategies supported by investments in research, digital infrastructure, workforce development, and public–private collaboration, enabling responsible innovation and industrial transformation (Horwitch, 2024; Demaidi, 2025).

Government support extends beyond strategic planning through research funding, innovation incentives, startup support, digital infrastructure development, and collaborative research initiatives that reduce implementation risks and encourage technology adoption (Atta & Khan, 2025). Equally important are regulatory frameworks that address privacy, transparency, accountability, algorithmic bias, and data protection while maintaining a balance between innovation and ethical governance. Comparative studies suggest that flexible, risk-based regulatory approaches are more effective than restrictive models, particularly for developing economies adapting international best practices to local contexts (Ahmed & Fatima, 2025; Hasan, 2024).

Institutional readiness further determines the effectiveness of AI strategies by ensuring policy coordination, stakeholder engagement, and consistent implementation across government, industry, and academia. Strong institutions and integrated educational reforms enhance research collaboration, digital infrastructure, and workforce development, thereby strengthening national innovation systems and industrial competitiveness (Khalid & Qureshi, 2020; Khan et al., 2026). Overall, effective governance provides the enabling environment through which AI adoption translates into sustainable national economic growth.

2.5 AI, Innovation and National Economic Competitiveness

Artificial intelligence (AI) has become a strategic driver of innovation and national economic competitiveness by enhancing productivity, accelerating technological advancement, and strengthening industrial leadership. Innovation ecosystems that promote collaboration among governments, industries, universities, and research institutions create favorable conditions for AI commercialization, knowledge creation, and the development of innovative products and business models, thereby improving national competitiveness in global markets (Butt, 2024; Shaukat et al., 2025).

One of the most significant economic benefits of AI is its ability to improve productivity through intelligent automation, optimized resource utilization, predictive analytics, and evidence-based decision-making. These capabilities increase industrial output, labor efficiency, and organizational performance, contributing directly to sustainable economic growth and stronger global competitiveness (Tanveer et al., 2025; Rasheed & Ali, 2026). AI also strengthens industrial leadership by accelerating research and development, fostering continuous innovation, identifying market opportunities, and enhancing export competitiveness, particularly in countries with well-developed innovation ecosystems (Ali, 2026; Rahman et al., 2022).

National competitiveness further depends on the interaction of technological capability, institutional quality, digital infrastructure, and effective policy implementation. Countries with mature AI ecosystems attract greater investment, strengthen innovation networks, and participate more actively in global value chains (Zhang & Khaskheli, 2025). However, differences in institutional maturity, workforce capability, and policy coordination influence how effectively nations convert AI investments into economic outcomes, highlighting AI competitiveness as a multidimensional phenomenon shaped by technological, organizational, and institutional factors (Turan, 2026; Zhuang et al., 2025).

2.6 Gaps in Existing Research

Despite the rapid expansion of AI-related research, several important gaps remain within the existing literature. First, the majority of empirical studies rely predominantly on quantitative methods, including

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surveys, structural equation modelling, and technology acceptance frameworks, to examine organizational AI adoption and performance outcomes. Although these approaches provide valuable statistical evidence, they often overlook the contextual experiences, institutional complexities, and strategic perspectives that influence AI implementation across different national environments (Badghish & Soomro, 2024; Jamil et al., 2025).

Second, comparative research examining AI adoption between developed and developing economies remains limited. Existing studies frequently investigate AI implementation within individual countries or specific industries, restricting opportunities to understand how institutional differences influence national competitiveness. Comparative evidence involving Pakistan and the United Kingdom is particularly scarce despite their contrasting technological capabilities, governance systems, and innovation ecosystems. Such comparisons are essential for identifying transferable practices while recognizing context-specific barriers affecting AI adoption.

Third, qualitative evidence exploring AI adoption through the perspectives of policymakers, industry leaders, and economic experts remains relatively underdeveloped. Much of the current literature emphasizes organizational performance indicators rather than the institutional decision-making processes that shape successful AI implementation. Leadership perspectives are particularly valuable because strategic decisions regarding technological investment, workforce development, policy coordination, and innovation are typically made at executive and governmental levels.

Finally, existing research rarely integrates technological, organizational, workforce, and policy dimensions within a single comparative framework. Most studies examine these factors independently, limiting understanding of how they interact to influence national economic competitiveness. Recent mixed-method investigations acknowledge the complexity of AI adoption but continue to call for more comprehensive qualitative analyses capable of capturing institutional dynamics across diverse national contexts (Hameed et al., 2026). Addressing these gaps, the present study adopts a comparative qualitative approach to examine AI adoption in Pakistan and the United Kingdom through the integrated perspectives of industry leaders, policymakers, and economic experts. By simultaneously investigating technological readiness, organizational capability, workforce development, policy support, and institutional environments, the study contributes a holistic understanding of AI-driven industrial competitiveness and national economic development.

3. Methodology

3.1 Research Design

This study adopted a qualitative comparative research design within an interpretivist paradigm to examine how artificial intelligence (AI) adoption influences industrial leadership and national economic competitiveness in Pakistan and the United Kingdom. A qualitative approach enabled an in-depth understanding of participants' experiences and perceptions, while the comparative design facilitated analysis of two countries with contrasting levels of AI maturity, institutional readiness, and industrial development.

3.2 Sampling Strategy

Purposive sampling, supported by maximum variation sampling, was used to recruit information-rich participants with expertise in AI, digital transformation, innovation, and economic policy. The final sample comprised 18 participants, including nine from Pakistan and nine from the United Kingdom, representing manufacturing, information technology, finance, academia, consulting, research organizations, and government institutions. Their diverse professional backgrounds ensured comprehensive perspectives on AI adoption and national competitiveness.

3.3 Data Collection

Primary data were collected through semi-structured interviews lasting approximately 45–60 minutes using online and face-to-face formats. The interview guide explored AI implementation, workforce readiness, policy support, innovation, and industrial competitiveness. To enhance data triangulation, interview findings were supplemented through document analysis of national AI strategies, government policy documents, industrial reports, and institutional publications from both countries.

3.4 Data Analysis

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The data were analysed using reflexive thematic analysis following the approach proposed by Braun et al. (2022), Braun et al. (2023), and Clarke and Braun (2017). Interview transcripts were repeatedly reviewed, inductively coded, and organized into broader categories before developing overarching themes. A cross-country comparison was subsequently conducted to identify similarities and differences between Pakistan and the United Kingdom in relation to AI adoption, workforce capability, governance, and industrial competitiveness.

3.5 Ethical Considerations

Ethical procedures included obtaining informed consent, ensuring voluntary participation, maintaining confidentiality and anonymity through participant codes, and securely storing interview data. Participants were informed of their right to withdraw at any stage without consequence.

3.6 Participants' Profile

The study included 18 participants from Pakistan and the United Kingdom representing government, industry, academia, consulting, finance, manufacturing, and technology sectors. Their varied organizational roles, AI expertise, professional experience, and educational backgrounds provided rich comparative insights into AI adoption, workforce development, policy implementation, and industrial competitiveness across both national contexts.

Table 1

Participant Profiles

Participant	Country	Sector	Organization Type	Position	Experience (Years)	AI Expertise
P1	Pakistan	Information Technology	Private Technology Firm	AI Solutions Manager	12	Machine Learning and AI Strategy
P2	Pakistan	Manufacturing	Large Manufacturing Company	Operations Director	18	Industrial Automation
P3	Pakistan	Government	Ministry/Public Agency	Policy Advisor	15	National AI Policy
P4	Pakistan	Higher Education	Public University	Professor	20	AI Research and Innovation
P5	Pakistan	Financial Services	Commercial Bank	Digital Transformation Manager	13	AI in Banking
P6	Pakistan	Consulting	Technology Consulting Firm	Senior Consultant	11	Digital Transformation
P7	Pakistan	Telecommunications	Telecom Company	Innovation Manager	14	Data Analytics and AI
P8	Pakistan	Research	Research Institute	Senior Research Fellow	17	AI Policy and Innovation
P9	Pakistan	SME	Technology Startup	Founder and CEO	9	AI Product Development
U1	United Kingdom	Information Technology	AI Technology Company	Head of AI	16	Enterprise AI Solutions

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Participant	Country	Sector	Organization Type	Position	Experience (Years)	AI Expertise
U2	United Kingdom	Manufacturing	Global Manufacturing Firm	Digital Operations Director	21	Smart Manufacturing
U3	United Kingdom	Government	Government Department	AI Policy Specialist	17	AI Governance
U4	United Kingdom	Higher Education	Research University	Professor	22	AI and Innovation
U5	United Kingdom	Financial Services	International Bank	Chief Data Officer	18	AI Analytics
U6	United Kingdom	Consulting	Global Consulting Firm	Partner	20	Digital Strategy
U7	United Kingdom	Healthcare	National Health Organization	Digital Innovation Lead	15	Healthcare AI
U8	United Kingdom	Research	Innovation Centre	Director of Research	23	AI Policy and Commercialization
U9	United Kingdom	SME	AI Startup	Chief Executive Officer	10	Generative AI Applications

4. Findings and Discussion

4.1 Theme 1: AI Integration as a Driver of Industrial Competitiveness

The first and most prominent theme revealed that AI integration has become a strategic driver of industrial competitiveness in both Pakistan and the United Kingdom. Participants agreed that AI is no longer viewed as merely an emerging technology but as a capability that enhances organizational efficiency, strategic decision-making, and competitive advantage. However, UK participants described AI as deeply embedded within industrial operations, whereas respondents from Pakistan indicated that adoption remains concentrated in technologically advanced organizations.

Participants consistently emphasized that AI-powered automation improves manufacturing efficiency by reducing repetitive tasks, minimizing operational errors, and optimizing production processes. A UK participant explained, *"AI is now embedded into almost every operational process. Production planning, quality inspection, inventory management, and predictive maintenance are increasingly handled through intelligent systems rather than manual intervention"* (U2). Conversely, a Pakistani manufacturing executive noted, *"Large organizations are moving forward, while many SMEs still rely heavily on conventional production systems because AI investment requires significant financial resources"* (P2). Participants also highlighted AI's growing role in supporting evidence-based decision-making through predictive analytics, customer segmentation, demand forecasting, fraud detection, and supply chain optimization. As one UK respondent stated, *"The greatest advantage of AI is not automation alone. It is the ability to make better decisions based on continuous analysis rather than assumptions"* (U3), while a Pakistani participant observed that fragmented data systems continue to limit analytical capabilities (P5).

Interviewees further reported that AI improves operational efficiency by optimizing resource utilization, reducing downtime, and strengthening customer service. A UK executive explained, *"AI continuously monitors operational performance. Problems are detected before they become costly failures"* (U5), whereas a Pakistani consultant acknowledged that industrial benefits remain localized because adoption is still limited across sectors (P6). Participants from both countries also viewed AI as a catalyst for broader

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industrial transformation requiring redesigned workflows and new business models. A UK participant remarked, *"Industrial competitiveness today is determined less by machinery and more by intelligence embedded within organizational processes"* (U8), while a Pakistani policymaker emphasized that AI fundamentally changes how organizations compete and innovate (P3). These findings reinforce previous evidence linking AI with Industry 4.0, operational excellence, organizational innovation, and sustainable competitive advantage (Badghish & Soomro, 2024; Rahman, 2025; Schwaeke et al., 2025; Waseel et al., 2024; Wu et al., 2026).

4.2 Theme 2: Workforce Readiness and AI Capability

The second major theme highlighted workforce readiness as a critical determinant of successful AI adoption and national competitiveness. Participants from both Pakistan and the United Kingdom agreed that technological investment alone is insufficient without a workforce possessing strong digital competencies, AI literacy, and continuous learning capabilities. However, the comparison revealed that the United Kingdom has more mature institutional mechanisms for developing AI talent, while Pakistan continues to face shortages of specialized expertise and structured workforce development.

Participants consistently emphasized the growing demand for skills in machine learning, data analytics, programming, cloud computing, cybersecurity, and digital problem-solving. A UK academic noted, *"Organizations no longer recruit employees based solely on technical knowledge. They increasingly require professionals who can collaborate with AI systems and interpret complex analytical outputs"* (U4). In contrast, a Pakistani participant stated, *"We have talented graduates, but demand for AI specialists is growing much faster than universities can currently produce them"* (P4), reinforcing the importance of sustainable digital skill development (Ali et al., 2024). Beyond technical expertise, respondents stressed the importance of AI literacy, arguing that employees must understand AI capabilities and limitations to reduce resistance and support responsible implementation. As one UK executive explained, *"Every employee does not need to become an AI engineer, but everyone must understand how intelligent systems influence their daily decisions"* (U1), while a Pakistani respondent observed that misconceptions about AI replacing employees continue to hinder adoption (P7), supporting Ahmed and Meraj (2024).

Continuous reskilling also emerged as essential because AI technologies evolve rapidly. A UK participant emphasized, *"Continuous professional learning has become essential"* (U8), whereas a Pakistani respondent acknowledged that employee training often begins only after technology implementation (P6), consistent with Rehmat et al. (2025) and Yaseen et al. (2026). Participants further highlighted university–industry collaboration as vital for developing AI capability. A Pakistani professor stated, *"Greater collaboration would accelerate AI innovation considerably"* (P4), while a UK participant emphasized joint research and innovation partnerships (U4). These findings reinforce the importance of collaborative knowledge ecosystems in strengthening workforce capability and national innovation systems (Noor et al., 2026; Khan et al., 2026).

4.3 Theme 3: Policy and Regulatory Support

The third major theme underscored the importance of policy and regulatory support in enabling AI adoption and enhancing national economic competitiveness. Participants from both Pakistan and the United Kingdom agreed that organizational AI initiatives require supportive government policies, effective regulation, financial incentives, and institutional coordination. However, UK respondents described a more mature and coordinated policy ecosystem, whereas Pakistani participants acknowledged progress but highlighted implementation challenges.

Participants emphasized that comprehensive national AI strategies provide long-term direction for industries, universities, and investors. A UK government specialist explained, *"A national AI strategy provides more than policy direction. It gives businesses confidence that government priorities, research funding, education, and regulation are moving toward the same long-term objective"* (U3). Similarly, a Pakistani policymaker stated, *"Pakistan has acknowledged AI as a national priority, but effective implementation requires stronger coordination among ministries, universities, industries, and technology organizations"* (P3), supporting the importance of coordinated AI strategies (Demaidi, 2025). Respondents

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also highlighted government support through digital infrastructure, research grants, startup incentives, and public–private partnerships. While UK participants viewed government as an active facilitator of innovation, Pakistani respondents emphasized the need for greater financial and technical assistance, particularly for SMEs (Atta & Khan, 2025).

Funding availability emerged as another important factor influencing AI implementation. UK participants reported accessible funding through research agencies and innovation programs, whereas Pakistani respondents identified financial constraints as a major barrier to technological investment. Participants further stressed the importance of AI governance to ensure transparency, accountability, and responsible implementation. A UK expert remarked, *"AI governance builds trust because organizations know how algorithms should be developed, monitored, and evaluated"* (U3), while a Pakistani consultant argued that governance frameworks remain fragmented (P6), consistent with Horwitch (2024). Ethical regulation was also viewed as essential for addressing privacy, cybersecurity, transparency, and algorithmic bias. Participants emphasized that balanced regulatory frameworks should encourage innovation while safeguarding societal interests, reinforcing previous research on AI governance and policy development (Ahmed & Fatima, 2025; Hasan, 2024; Khalid & Qureshi, 2020).

4.4 Theme 4: Innovation and National Economic Leadership

The fourth theme examined how AI contributes to innovation, industrial leadership, and national economic competitiveness. Participants from both Pakistan and the United Kingdom consistently described AI as a strategic resource that enhances productivity, stimulates innovation, strengthens competitiveness, and improves global economic positioning. While UK respondents emphasized mature innovation ecosystems, Pakistani participants highlighted significant opportunities to accelerate economic development through strategic AI investment.

Participants frequently identified productivity gains as a major outcome of AI adoption. AI was reported to improve operational efficiency through automation, optimized workflows, predictive analytics, and evidence-based decision-making. A UK executive explained, *"Our productivity gains are not simply the result of faster computers. They come from better decisions, improved coordination, and continuous optimization driven by AI"* (U5), while a Pakistani manufacturing executive noted that organizations implementing AI consistently experience lower operating costs and higher productivity (P2), supporting findings by Butt (2024). Respondents also emphasized AI's role in driving innovation by accelerating research, product development, service innovation, and entrepreneurial activity. A UK research director stated, *"Innovation today depends on how effectively organizations transform data into knowledge and knowledge into competitive products"* (U8), whereas a Pakistani startup founder observed that AI enables smaller firms to compete through intelligent solutions rather than financial resources alone (P9), consistent with Tanveer et al. (2025).

Participants further agreed that AI has become a strategic determinant of organizational and national competitiveness. A UK respondent remarked, *"Competitive advantage increasingly depends upon how quickly organizations learn from data rather than how large they are"* (U6), while a Pakistani policymaker stressed that AI competitiveness requires investment in education, infrastructure, and industrial policy (P3), reinforcing Rasheed and Ali (2026). Finally, respondents highlighted AI's growing importance in enhancing countries' global positioning through increased investment attraction, export competitiveness, and participation in international innovation networks, supporting previous studies on AI-driven economic development and industrial leadership (Zhang & Khaskheli, 2025; Zhuang et al., 2025; Turan, 2026).

4.5 Theme 5: Structural Barriers to AI Adoption

The fifth theme identified the structural barriers limiting effective AI adoption across Pakistan and the United Kingdom. Participants agreed that AI implementation is constrained not only by technology but also by institutional, financial, organizational, and governance challenges. While UK respondents viewed these barriers as issues of scaling and optimization, Pakistani participants described them as broader systemic constraints affecting national AI readiness.

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Participants consistently identified digital infrastructure as the foundation for successful AI implementation. UK respondents emphasized that reliable cloud services, high-speed connectivity, secure data centers, and advanced computing resources enable organizations to deploy AI efficiently. In contrast, Pakistani participants highlighted inconsistent internet connectivity, limited cloud infrastructure, and outdated digital systems as significant obstacles. As one participant noted, *"Many organizations are willing to adopt AI, but inconsistent internet connectivity and outdated digital systems slow implementation considerably"* (P6). These findings support evidence linking digital infrastructure with organizational AI readiness (Soomro et al., 2024).

Investment was another major concern. UK participants discussed prioritizing AI investments for strategic value, whereas Pakistani respondents emphasized that implementation costs, limited venture capital, and insufficient government incentives often prevent organizations, particularly SMEs, from adopting AI. These findings align with Soomro et al. (2025).

Participants also emphasized organizational culture, arguing that AI adoption requires leadership commitment, innovation-oriented cultures, and employee acceptance. Resistance to change, fear of job displacement, and limited AI literacy frequently delayed implementation. One UK participant observed, *"Technology changes quickly, but organizational culture often changes much more slowly"* (U7). These observations support Jamil et al. (2025).

Another recurring issue was data governance. Respondents stressed that AI effectiveness depends on secure, accurate, and well-governed data. Weak governance frameworks reduce AI reliability and organizational trust, particularly in Pakistan where standardized practices remain underdeveloped.

Finally, participants highlighted broader implementation challenges, including shortages of AI talent, fragmented institutional coordination, cybersecurity risks, legal uncertainty, and weak university–industry collaboration. A UK respondent remarked, *"Implementing AI is rarely a technical problem alone"* (U8), while a Pakistani participant emphasized that education, infrastructure, investment, and policy must progress together (P8). These findings correspond with Hameed et al. (2026), Shahzad and Khan (2024), and Farid and Sarwar (2024). Overall, the findings indicate that overcoming these interconnected barriers through coordinated infrastructure development, investment, governance, and organizational transformation is essential for strengthening AI-driven industrial competitiveness.

4.6 Synthesis of Findings

The comparative findings indicate that AI adoption is a multidimensional process shaped by technological capability, workforce readiness, institutional governance, innovation ecosystems, and structural conditions rather than technology alone. Across all five themes, participants emphasized that sustainable AI-driven competitiveness depends on coordinated collaboration among governments, industries, universities, and research institutions. The United Kingdom demonstrated a more mature AI ecosystem characterized by advanced infrastructure, supportive policies, skilled human capital, and stronger institutional coordination, enabling broader AI integration across industries. In contrast, Pakistan showed considerable potential but continued to face interconnected challenges related to infrastructure, investment, workforce capability, organizational readiness, and policy implementation.

The findings further revealed that AI strengthens national competitiveness through multiple pathways, including intelligent automation, improved decision-making, innovation, productivity enhancement, and organizational adaptability. Participants consistently stressed that technological investment must be accompanied by continuous workforce development, leadership commitment, effective governance, and university–industry collaboration to achieve sustainable outcomes. These findings reinforce existing literature highlighting the importance of collaborative innovation ecosystems, institutional support, and human capital in AI-enabled economic development (Ashraf et al., 2025; Bhatti et al., 2026; Imtiaz et al., 2026; Khan et al., 2026; Ali & Rasheed, 2026; Lai et al., 2025; Abrar & Amjad, 2026; Iqbal et al., 2025). Overall, the synthesis suggests that AI should be viewed as a strategic national capability requiring integrated technological, organizational, and institutional development to strengthen long-term economic competitiveness.

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Table 2

Thematic Analysis of Findings

Theme	Subtheme	Representative Codes	Description
Theme 1: AI Integration as a Driver of Industrial Competitiveness	Automation	Intelligent automation, robotic processes, process optimization, automated production	AI automates repetitive operational tasks, improving production speed, consistency, and efficiency across industries.
	Decision intelligence	Predictive analytics, data-driven decisions, real-time insights, forecasting	AI enhances managerial decision-making by generating evidence-based insights and predictive intelligence.
	Operational efficiency	Cost reduction, productivity improvement, resource optimization, quality enhancement	AI improves operational performance through optimized resource allocation and workflow management.
	Industrial transformation	Industry 4.0, digital transformation, business model innovation, smart manufacturing	AI drives comprehensive industrial modernization by reshaping production systems and organizational processes.
Theme 2: Workforce Readiness and AI Capability	Digital skills	Technical competence, programming, analytics, digital proficiency	Availability of AI-related technical skills determines organizations' ability to adopt intelligent technologies successfully.
	AI literacy	Technology awareness, AI understanding, employee acceptance, digital awareness	General understanding of AI among employees reduces resistance and promotes responsible adoption.
	Workforce reskilling	Continuous learning, employee training, professional development, upskilling	Organizations continuously develop employee capabilities to meet evolving AI requirements.
	University–industry partnerships	Academic collaboration, internships, joint research, knowledge transfer	Collaboration between universities and industries strengthens AI talent development and innovation capacity.
Theme 3: Policy and Regulatory Support	National AI strategy	Strategic planning, long-term vision, policy coordination, national priorities	Comprehensive AI strategies provide strategic direction for national technological development.
	Government support	Public investment, innovation incentives, digital infrastructure, institutional support	Government interventions encourage AI adoption through funding, infrastructure, and policy initiatives.

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Theme	Subtheme	Representative Codes	Description
	Funding mechanisms	Research grants, venture capital, financial incentives, innovation funding	Financial resources facilitate organizational AI investment and reduce implementation risks.
	AI governance	Accountability, transparency, governance framework, compliance	Governance mechanisms ensure responsible AI implementation and institutional oversight.
	Ethical regulation	Privacy, fairness, cybersecurity, algorithmic bias, responsible AI	Ethical frameworks protect public interests while encouraging sustainable AI innovation.
Theme 4: Innovation and National Economic Leadership	Productivity	Efficiency gains, output growth, process improvement, performance enhancement	AI increases productivity by improving organizational efficiency and operational effectiveness.
	Innovation capability	Product innovation, service innovation, research, creativity	AI accelerates innovation by supporting knowledge creation and technological advancement.
	Industrial competitiveness	Competitive advantage, organizational agility, market responsiveness	AI strengthens firms' ability to compete through intelligent decision-making and innovation.
	Global economic positioning	International competitiveness, investment attraction, export capability, economic leadership	AI enhances countries' global competitiveness through technological leadership and innovation ecosystems.
Theme 5: Structural Barriers to AI Adoption	Digital infrastructure	Connectivity, cloud computing, computing capacity, digital ecosystem	Limited technological infrastructure restricts effective AI implementation, particularly in developing economies.
	Financial investment	Budget constraints, implementation cost, return on investment, resource limitations	High investment requirements delay AI adoption, especially among SMEs and resource-constrained organizations.
	Organizational culture	Resistance to change, leadership support, innovation culture, organizational readiness	Organizational attitudes and leadership commitment significantly influence AI adoption success.
	Data governance	Data quality, data security, privacy management, information standards	Reliable data governance is essential for trustworthy and effective AI systems.
	Implementation challenges	Skill shortages, institutional coordination, legal uncertainty, technology integration	AI implementation involves complex organizational, technological, regulatory, and human resource challenges requiring coordinated solutions.

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4.7 Discussion

The findings demonstrate that AI has become a strategic enabler of industrial competitiveness and national economic leadership, supporting earlier research that positions AI as a catalyst for productivity, innovation, and digital transformation (Butt, 2024; Tanveer et al., 2025; Turan, 2026). Consistent with Badghish and Soomro (2024) and Rahman (2025), participants emphasized that AI creates value through intelligent automation, enhanced decision-making, operational efficiency, and organizational transformation rather than through technology adoption alone. The comparison further revealed that the United Kingdom has progressed from AI experimentation to large-scale integration, whereas Pakistan remains in a transitional stage characterized by growing adoption but constrained institutional capacity.

The findings also reinforce previous studies highlighting workforce readiness as a critical determinant of AI success (Ali et al., 2024; Ahmed & Meraj, 2024; Noor et al., 2026). Participants consistently argued that digital skills, AI literacy, continuous reskilling, and university–industry collaboration are essential for translating technological investments into competitive advantage. These results extend earlier work by demonstrating that human capital and organizational learning are equally important in both developed and developing economies, although the supporting institutional mechanisms differ considerably.

Another important finding concerns the role of policy and governance. Consistent with Ahmed and Fatima (2025), Demaidi (2025), and Hasan (2024), participants emphasized that comprehensive AI strategies, government support, funding mechanisms, and ethical regulation create an enabling environment for sustainable AI adoption. The UK's coordinated governance framework contrasted with Pakistan's evolving policy landscape, highlighting how institutional maturity influences AI implementation and innovation outcomes.

The study further confirms that structural barriers, including infrastructure limitations, investment constraints, organizational resistance, and weak data governance, continue to hinder AI adoption, particularly in developing economies. These findings align with Soomro et al. (2024), Jamil et al. (2025), and Hameed et al. (2026), who argue that AI implementation requires coordinated technological and institutional development.

Overall, the findings support the Technology–Organization–Environment framework by demonstrating that AI-driven competitiveness emerges from the interaction of technological readiness, organizational capability, and supportive external environments. The comparative evidence suggests that strengthening national competitiveness requires integrated investment in infrastructure, human capital, governance, and innovation ecosystems rather than isolated technological initiatives.

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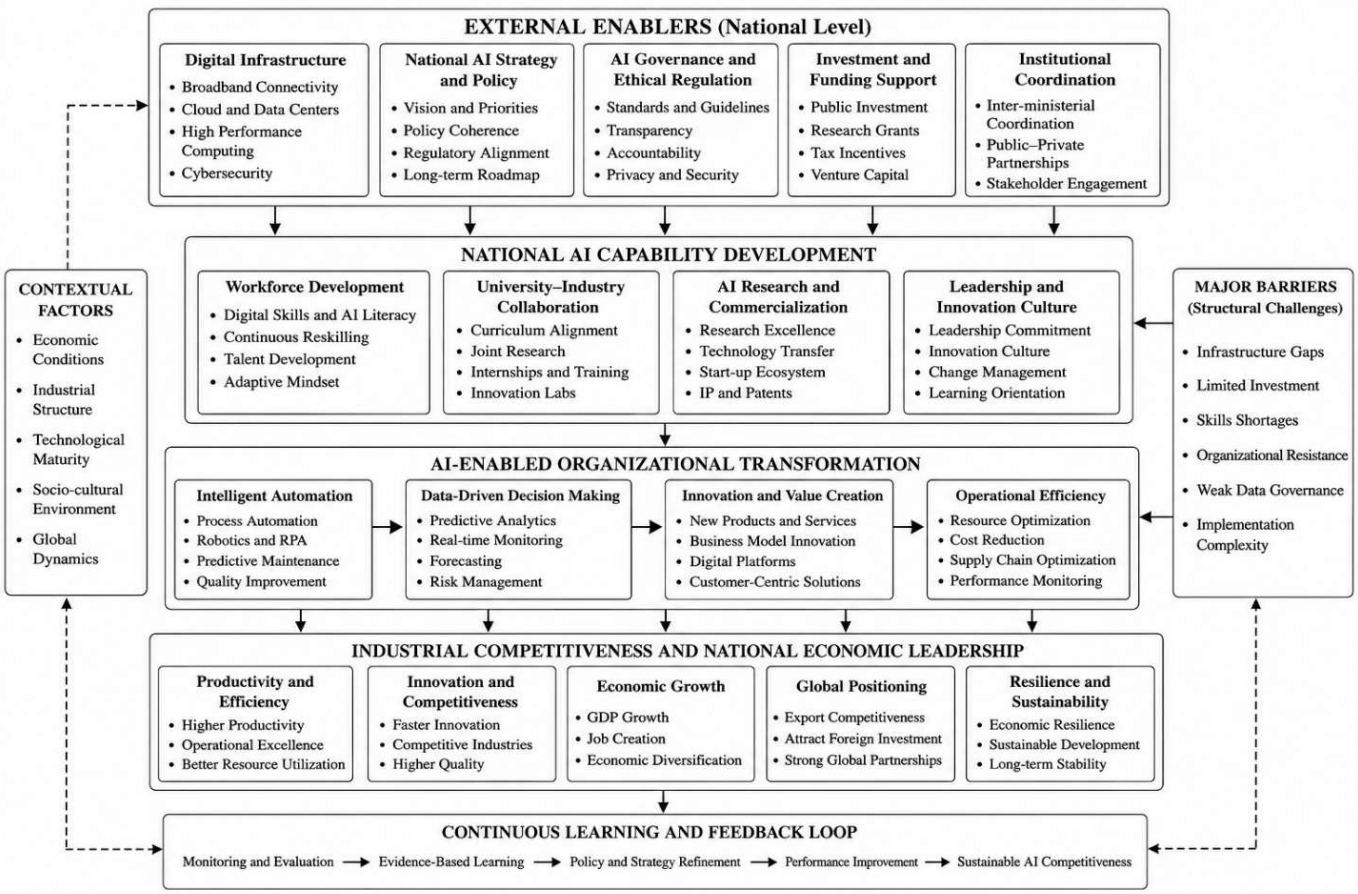
Figure 1

Proposed Action Framework for AI-Enabled Industrial Competitiveness and National Economic Leadership



5. Conclusion

5.1 Conclusion

This study examined the relationship between artificial intelligence (AI) adoption and national economic competitiveness through a comparative qualitative analysis of Pakistan and the United Kingdom. Drawing upon semi-structured interviews with industry leaders, policymakers, and economic experts, the study explored how AI integration influences industrial competitiveness, workforce readiness, policy support, innovation capability, and structural barriers to adoption. The findings demonstrate that AI has evolved beyond a technological innovation into a strategic national capability that significantly shapes industrial leadership and long-term economic performance.

The comparative analysis revealed substantial differences between the two countries in terms of AI maturity, institutional readiness, and technological capability. The United Kingdom possesses a well-developed AI ecosystem supported by advanced digital infrastructure, comprehensive national AI strategies, strong regulatory frameworks, sustained investment in research and development, and continuous workforce reskilling initiatives. These institutional strengths enable organizations to integrate AI effectively into operational processes, improve productivity, foster innovation, and maintain global industrial competitiveness.

In contrast, Pakistan is undergoing a gradual transition toward AI-enabled industrial development. Participants acknowledged increasing awareness of AI's strategic importance and highlighted encouraging developments in digital entrepreneurship, university research, and government interest in technological

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transformation. However, AI adoption remains constrained by infrastructural limitations, shortages of skilled professionals, fragmented policy implementation, insufficient investment, and organizational readiness challenges. These barriers collectively reduce the pace of digital transformation and limit AI's contribution to industrial productivity and national competitiveness.

The findings indicate that successful AI adoption depends upon the interaction of multiple institutional and organizational factors rather than technological capability alone. AI integration, workforce preparedness, effective governance, innovation ecosystems, and structural readiness collectively determine whether countries can translate technological investment into sustainable economic growth. Consequently, strengthening national competitiveness requires coordinated collaboration among governments, industries, universities, research institutions, and private-sector organizations.

The study successfully addressed all five research objectives. It compared AI adoption across industries in Pakistan and the United Kingdom, evaluated workforce readiness for AI implementation, examined policy and regulatory support, identified structural barriers affecting adoption, and developed practical recommendations for strengthening AI-driven national competitiveness. Overall, the study concludes that AI represents a strategic driver of industrial transformation whose successful implementation requires integrated national policies, sustained investment in human capital, supportive governance structures, and innovation-oriented institutional ecosystems.

5.2 Theoretical Implications

This study makes several important theoretical contributions to the literature on artificial intelligence adoption, digital transformation, and national economic competitiveness. First, it extends the Technology–Organization–Environment (TOE) framework by demonstrating that AI adoption should be understood not only at the organizational level but also within broader national institutional contexts. While the traditional TOE framework explains how technological, organizational, and environmental factors influence innovation adoption, the comparative findings illustrate that national competitiveness is shaped by interactions among governmental policies, industrial ecosystems, educational institutions, workforce capabilities, and organizational readiness. This broader interpretation enhances the explanatory power of the TOE framework for comparative studies involving developed and developing economies.

Second, the study contributes to the growing body of research on digital transformation by demonstrating that AI implementation represents a multidimensional organizational and institutional transformation rather than a purely technological initiative. The findings reveal that digital transformation requires simultaneous development of infrastructure, governance mechanisms, workforce capabilities, innovation systems, and collaborative institutional networks. These findings complement perspectives from National Innovation Systems and Dynamic Capabilities by emphasizing that sustainable competitive advantage emerges from coordinated institutional adaptation rather than isolated technological investments.

Finally, the study contributes to the literature on national economic competitiveness by providing qualitative evidence explaining how AI adoption influences industrial leadership across contrasting economic environments. Unlike previous studies that primarily employ quantitative methods, this research offers rich stakeholder perspectives illustrating how organizational experiences, institutional arrangements, and policy environments collectively shape AI-driven economic development.

5.3 Practical Recommendations

The findings generate several practical recommendations for key stakeholders involved in national AI development.

For government policymakers, comprehensive national AI strategies should be accompanied by consistent implementation mechanisms, investment incentives, modern regulatory frameworks, and strengthened public-private partnerships. Governments should prioritize digital infrastructure development, AI research funding, ethical governance, and coordinated institutional collaboration to accelerate technological adoption.

Industry leaders should view AI as a long-term strategic investment rather than a short-term operational tool. Organizations should integrate AI into core business strategies while simultaneously

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investing in employee training, organizational change management, cybersecurity, and responsible AI governance. Leadership commitment and innovation-oriented organizational cultures are essential for successful digital transformation.

Universities should modernize academic curricula by incorporating AI, data science, digital analytics, and interdisciplinary technological education across multiple disciplines. Stronger university-industry collaboration through joint research projects, internships, innovation laboratories, and technology commercialization initiatives will enhance workforce readiness and national innovation capacity.

AI developers should prioritize the development of transparent, explainable, secure, and ethically responsible AI systems that address organizational and societal needs. User-centered design, algorithmic fairness, cybersecurity, and compliance with evolving regulatory standards should become central components of AI development processes.

Investment agencies should increase financial support for AI startups, technology incubators, innovation clusters, and SME digital transformation initiatives. Greater access to venture capital, research commercialization funding, and technology development grants will encourage broader AI adoption and stimulate sustainable economic growth, particularly within developing economies such as Pakistan.

5.4 Limitations and Future Research Directions

Despite its contributions, this study has several limitations that should be considered when interpreting the findings. First, the qualitative research design emphasizes in-depth understanding rather than statistical generalization. Although the interview data provided rich contextual insights, the findings cannot be generalized to all industries or organizations within Pakistan and the United Kingdom.

Second, the study relied on a purposive sample of eighteen participants. While the sample included diverse stakeholders from industry, government, academia, and policy institutions, a larger sample involving additional sectors and organizational levels could provide broader perspectives regarding AI adoption and national competitiveness.

Third, the cross-sectional nature of the study captures stakeholder perceptions at a single point in time. Given the rapid evolution of AI technologies, policies, and industrial practices, future studies should employ longitudinal research designs to examine how AI adoption and competitiveness evolve over time.

Future research should also employ mixed-method approaches that combine qualitative interviews with large-scale quantitative surveys to validate and extend the present findings. Comparative investigations involving additional developed and developing economies would further strengthen theoretical understanding of AI adoption across different institutional environments. Researchers may also explore sector-specific AI implementation within manufacturing, healthcare, education, financial services, agriculture, and public administration to identify industry-specific success factors and barriers. Finally, future studies should examine emerging topics such as generative AI governance, responsible AI implementation, AI ethics, digital resilience, and the socioeconomic implications of AI-driven industrial transformation. Such investigations will continue advancing scholarly understanding of AI as a strategic driver of national economic competitiveness and sustainable development.

Contribution of Authors

All the authors participated in the ideation, development, and final approval of the manuscript, making significant contributions to the work reported.

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

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Data Availability

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

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