The Role of Artificial Intelligence in
Achieving Economic Development and Enhancing Job Opportunities in
The Kingdom's Vision 2030 in Light of the Challenges and Risks

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Abstract

This research aims to explore the vital role that artificial intelligence plays in achieving sustainable economic development and enhancing economic growth in the Kingdom of Saudi Arabia, and its role in providing and creating new job opportunities. The research also seeks to understand the challenges and risks facing the application of artificial intelligence technologies in order to achieve the goals of the Kingdom's Vision 2030, as 66 out of 96 goals of the vision depend on artificial intelligence and big data. The research addresses the importance of artificial intelligence as a strategic tool to stimulate innovation and develop various economic sectors, by analyzing the literature related to its role in supporting the Saudi economy. In addition, it highlights studies that have addressed the ability of artificial intelligence to create new jobs in the Saudi market, whether through developing existing industries or opening innovative economic fields. On the other hand, the research focuses on the challenges and risks that may hinder the application of these technologies, such as the lack of specialized competencies, weak technological infrastructure, cybersecurity risks, and the impact of artificial intelligence on privacy and ethical considerations. Using the descriptive analysis methodology and a systematic review of previous research, the current status of the adoption of artificial intelligence in various sectors is assessed, with recommendations provided to help overcome obstacles and effectively achieve the goals of Vision 2030. The research aims to provide a comprehensive vision that enables decision-makers to develop supportive policies and strategies that balance the great opportunities offered by artificial intelligence and the risks associated with its application in the Saudi.

***Keywords**: Artificial Intelligence, Economic Growth, Challenges, Risks, Vision 2030.*

Introduction

Artificial Intelligence (AI) has become one of the most important topics in research and development over recent decades, revolutionizing various industrial and technological sectors. However, definitions of AI have varied significantly among researchers, organizations, and specialists in the field. This variation arises from the multitude of approaches and methodologies used to understand and apply AI, as well as the differing goals and research orientations of various entities. In 1950, Alan Turing proposed the Turing Test as a criterion to determine whether a machine possesses intelligence comparable to humans. This test involves a machine's ability to simulate human behavior in a way that is indistinguishable from that of a human (Turing, 1950). Since McCarthy (1956) introduced AI as the science and engineering of creating intelligent machines, numerous definitions aligned with this concept have emerged. For example, Waterman, (1985) defined AI as a branch of computer science that develops intelligent computer programs. Similarly, Feigenbaum, (1977) described AI as

a research field aimed at understanding and developing intelligence in machines. These early definitions portrayed AI as a science concerned with studying intelligence in machines and programs without specifying the nature of this intelligence, how it operates, or its objectives. As AI evolved, new definitions emerged, emphasizing the simulation of human intelligence. AI came to be seen as the imitation of human abilities in thinking, behavior, and cognitive processes. For instance, Tripathi, (2021) described AI as replicating human intelligence in machines capable of thinking and acting like humans. Zanol, (2022) referred to AI as a technology aimed at replicating human intelligence in machines. Kasemsap, (2017) defined AI as a branch of science that enables machines to solve complex problems in a human-like manner. Academic institutions have defined AI as the study and design of systems capable of performing tasks that require human intelligence, such as learning, reasoning, and decision-making (Russell & Norvig, 2009). On the other hand, some technology companies have focused on AI as a technology to enhance efficiency and performance in business and production processes. For instance, IBM defines AI as a set of technologies that enable machines to learn from data and make intelligent decisions (IBM, 2021). Other definitions have emphasized AI's ability to perform human tasks, reflecting its capacity to handle activities previously exclusive to humans. For example, Dwivedi et al. (2021) described AI as the ability of machines to perform tasks and activities traditionally done by humans. Similarly, Alan (1988) defined AI as a technology enabling machines to think, understand, and perform tasks once carried out by humans. Some definitions have highlighted AI's cognitive capabilities, such as thinking, learning, and problem-solving. Kaplan and Haenlein, (2019) defined AI as a system's ability to correctly interpret external data, learn from it, and use that knowledge to make decisions. Another definition describes AI as the intelligence exhibited by machines, mimicking human cognitive functions such as thinking, learning, and problem-solving, enabling them to perform tasks once exclusive to humans, like perception and execution (Fr. Oswald and Mascarenhas, 2018).

The diversity in AI definitions can be attributed to several factors: Rapid technological advancements: The continuous and rapid evolution of AI technologies leads to new and varied understandings and applications, resulting in diverse definitions. Diverse application fields: AI definitions vary depending on the fields in which it is applied, such as medicine, industry, education, and entertainment. Varied research objectives: Differences in research goals and priorities between academic institutions and technology companies lead to variations in definitions and concepts.

The fact that different definitions of artificial intelligence exist demonstrates the importance of this science and its increasing influence on modern civilization. It also helps to better focus AI research and applications to meet the demands of society and contemporary advancements. As a result, the researcher defines artificial intelligence (AI) as a field of computer science that aims to create devices and software that can mimic human intelligence in thinking, learning, and decision-making, among others.

Saudi Arabia Vision 2030

On April 25, 2016, the Kingdom of Saudi Arabia announced Vision 2030, a strategic plan aimed at achieving a prosperous and sustainable future for the Kingdom. This vision aims to enhance the Kingdom's position regionally and internationally by diversifying the economy, reducing dependence on oil, and strengthening non-oil sectors. The goals of Vision 2030 include: First, diversifying the economy, as the vision aims to reduce dependence on oil as a major source of national income, as the Kingdom seeks to strengthen other economic sectors such as: tourism and entertainment, as the Kingdom focuses on developing major projects such as the "Qiddiya" and "Red Sea" projects to attract tourists from all over the world. Industry, as the Kingdom works to develop local industries and encourage innovation and reliance on modern technologies. Foreign and local investment, as the Kingdom attracts investments from abroad and develops a competitive business environment locally. Second, improving the quality of life, as the vision includes initiatives to improve the lives of citizens and residents through: developing infrastructure,

improving the education and health sectors, and increasing job opportunities. Third, empowering citizens and companies, as the vision focuses on enhancing the role of youth and women in the economy, and enabling small and medium-sized enterprises to grow to become an essential part of the national economy. Vision Initiatives and Programs

To implement the goals, the Kingdom has launched several programs and initiatives, including the National Transformation Program (NTP), which aims to build institutional capacities and improve government performance. The Quality of Life Program, which promotes cultural and sports activities and improves the living environment. The Public Investment Fund (PIF), which develops major projects and diversifies sources of income.

Since the launch of the vision, the Kingdom has achieved many accomplishments, such as the significant growth of the tourism sector with the issuance of tourist visas, diversification of energy sources through renewable energy projects, the Kingdom's progress in global competitiveness indicators, and improving the investment environment (Saudi Vision, 2030).

Artificial Intelligence (AI) technology plays a crucial role in achieving the goals of Saudi Arabia's Vision 2030, which seeks to diversify the economy and boost non-oil sectors. AI can be seen as a key enabler in achieving this vision through several key areas: enhancing non-oil economic sectors such as using AI to improve industrial processes, increase production efficiency, and reduce costs. For example, AI can be used to improve quality control and analyze industrial data. AI can be used to analyze tourist data and provide personalized experiences, improve destination management, and enhance marketing campaigns. Improving the quality of life such as healthcare where AI can improve medical diagnosis, health resource management, and remote healthcare delivery, contributing to improving the quality of healthcare available to citizens. Education where AI can be used to develop personalized learning technologies, provide tailored educational content, and analyze student data to improve educational performance. Innovation and enhancing the digital economy where AI encourages innovation by providing new and sustainable solutions to economic and social challenges. Startups can use AI to develop innovative products and services. Improving government services, as artificial intelligence can be used to improve the efficiency of government work, provide smart government services, and increase transparency (Saudi Vision, 2030).

The development and application of artificial intelligence (AI) technologies present significant challenges and risks across various sectors. Ethical Concerns specialy Algorithmic Bias, AI systems can perpetuate existing biases, leading to unfair treatment in areas like hiring and law enforcement(Kotyal et al., 2024, Naaresh & Aadityan, 2024). Privacy Issues where the collection and use of personal data raise significant privacy concerns, necessitating robust regulatory frameworks (Xu et al., 2023). Economic Implications such as Job Displacement because automation threatens to displace a significant number of jobs, exacerbating economic inequality and concentrating wealth among a few (Chander, 2024, Nigmatov & Pradeep, 2023). and Cybersecurity Risks, AI systems can be vulnerable to attacks, posing risks to national security and personal data integrity(Naaresh & Aadityan, 2024). and Legal and Regulatory Challenges such as Lack of Accountability, the opacity of AI decision-making processes complicates accountability and responsibility in cases of harm or error (Xu et al., 2023). Need for Regulation effective governance is essential to mitigate risks associated with AI, including the establishment of ethical frameworks and standards (Naaresh & Aadityan, 2024). These challenges encompass ethical, economic, and legal dimensions, which can adversely affect social structures and individual rights. Understanding these complexities is crucial for ensuring that AI serves the public interest. Conversely, while AI poses substantial risks, it also offers transformative potential for improving efficiency and innovation across sectors. Balancing these aspects is vital for harnessing AI's benefits while minimizing its negative impacts.

Analyzing challenges and risks enables a framework for critical thinking on the sustainable and responsible integration of AI into the fabric of everyday life.[14] The importance of this approach lies in its

ability to formulate effective policies and strategies to manage challenges and maximize the benefits of AI while minimizing the risks associated with it (Andersen, 2018 & Russell & Norvig, 1995).

Study Problem

Despite the intensive efforts made by the Saudi government to achieve comprehensive and sustainable economic development within the framework of the Kingdom's Vision 2030, the heavy reliance on artificial intelligence technologies to achieve 66 out of the 96 goals of the vision poses a major challenge. This reliance highlights the importance of artificial intelligence in promoting economic growth and creating new job opportunities, but at the same time it poses many challenges and risks associated with adopting these AI-related technologies that may significantly hinder the achievement of these goals. Accordingly, there is a need for an in-depth study to determine the role of artificial intelligence in promoting economic growth and creating new job opportunities and the extent to which these challenges impact the achievement of the goals of Vision 2030 and explore possible solutions to overcome them. Accordingly, this study aims to identify the role of artificial intelligence in creating and providing new job opportunities and the impact of using artificial intelligence technologies on economic growth, and to analyze and address the challenges and risks that may hinder the application of artificial intelligence within the framework of the Kingdom's Vision 2030. Through a comprehensive research approach, the study seeks to answer the following main question: What is the impact of artificial intelligence in enhancing economic growth and creating and providing new job opportunities in Saudi Arabia? What are the main challenges and risks facing the application of artificial intelligence in achieving the goals of the Kingdom's Vision 2030?

The Objectives of the Study

The main objective of this study is to identify the impact of artificial intelligence in enhancing economic growth and creating and providing new job opportunities in Saudi Arabia, and to understand the main challenges and risks facing the application of artificial intelligence in achieving the goals of the Kingdom of Saudi Arabia's Vision 2030, and to develop a proposed model that includes a comprehensive classification of the role of artificial intelligence in enhancing economic growth and creating job opportunities and identifying challenges and risks with the aim of providing a reference framework that helps decision-makers and officials understand the main issues and determine the necessary measures to deal with them effectively. Therefore, the objectives of this study are as follows:

1- The role of artificial intelligence in creating and providing new job opportunities in the Kingdom of Saudi Arabia
2- The role of using artificial intelligence technologies to enhance economic growth
3- The extent to which these challenges and risks affect achieving the goals of the Kingdom of Saudi Arabia's Vision 2030

Research Methodology:

The researcher used the descriptive analytical approach to the role of artificial intelligence in creating and providing new job opportunities and its role in economic growth in Saudi Arabia and studying the challenges and risks of artificial intelligence using the method of systematic review of the literature that addressed the challenges and risks of artificial intelligence facing governments, in addition to critical analysis of the secondary data available on the goals of the Kingdom of Saudi Arabia's Vision 2030 and the strategy for using artificial intelligence and big data.

Study Limits and Data Collection:

The data was collected from the Saudi Digital Library, which has many partnerships with the largest global research databases. Through studies that addressed the role of artificial intelligence in creating

and providing new job opportunities and its role in economic growth in Saudi Arabia. While studying the challenges and risks of artificial intelligence, 23 studies were obtained that addressed the challenges and risks of artificial intelligence, which were published from 2018 to 2024, which is the period that witnessed development in the application of artificial intelligence technologies as well as in the research that addressed the research topic (Table 1)

This research was confined in its objective scope to examining the challenges and risks faced by governments and the public sector due to the adoption of artificial intelligence. Its temporal scope was restricted to the period from 2018 to 2024, a timeframe that witnessed significant advancements in AI applications as well as an increase in research on this topic.

Table 1: Studies that addressed the challenges and risks of artificial intelligence in this study, which were published from 2018 to 2024

Authors	Title of the Study
Wirtz, Bernd W., Jan C. Weyerer & Carolin Geyer. (2018).	Artificial Intelligence and the Public Sector Applications and Challenges
Jankin, Slava, Marc Esteve, and Averill Campion (2018).	Artificial intelligence for the public sector: opportunities and challenges of cross-sector collaboration
Kalyanakrishnan, Shivaram, Rahul Alex Panicker, Sarayu Natarajan & Shreya Rao. (2018).	Opportunities and challenges for artificial intelligence in India
Sun, Tara Qian & Rony Medaglia. (2019).	Mapping the Challenges of Artificial Intelligence in the Public Sector: Evidence from Public Healthcare
Mikalef, Patrick, Siw Olsen Fjørtoft & Hans Yngvar Torvatn (2019).	Artificial Intelligence in the public sector: a study of challenges and opportunities for Norwegian municipalities." In Digital Transformation for a Sustainable Society in the 21st Century:
Surya, Lakshmisri. (2019).	Artificial Intelligence in Public Sector
Zheng, Yongqing, Han Yu, Lizhen Cui, Chunyan Miao, Cyril Leung, Yang Liu & Qiang Yang (2020).	"Addressing the challenges of government service provision with AI
Mutawa, M. A. & Hamad Rashid. (2020).	Comprehensive review on the challenges that impact artificial intelligence applications in the public sector
Chatterjee, Sheshadri. (2020).	AI strategy of India: policy framework, adoption challenges and actions for government
Pi, Yulu.(2021).	Machine learning in governments: Benefits, challenges and future directions
Criado, J. Ignacio, Rodrigo Sandoval-Almazan, David Valle-Cruz & Edgar A. Ruvalcaba-Gómez (2021).	Chief information officers' perceptions about artificial intelligence: A comparative study of implications and challenges for the public sector
Sobrino-García, Itziar. (2021).	Artificial intelligence risks and challenges in the Spanish public administration: An exploratory analysis through expert judgements
Seyadi, Abdulkarim Ebrahim, Fatema Jamal Al-Zayani, Sara Shehab, Allam Hamdan & Rafat Hussein Alhor. (2021).	The Implementation of Artificial Intelligence in the Public Sector: Opportunities and Challenges
McBride, Keegan, Colin van Noordt, Gianluca Misuraca & Gerhard Hammerschmid. (2021).	Towards a systematic understanding on the challenges of procuring artificial intelligence in the public sector
Weerasinghe, Thisara, Gapar Md Johar & Ali Khatibi. (2022).	Impact of AI Applications in Public Sector Services
Osborne, Stephen P., Maria Cucciniello, Greta Nasi & Edwina Zhu (2022).	Digital transformation, artificial intelligence and effective public services: challenges and opportunities
ULAŞAN, Fatih. (2023).	the dark side of artificial intelligence on the basis of public administration
Fernández, José Vida. (2023).	Artificial Intelligence in Government: Risks and Challenges of Algorithmic Governance in the Administrative State
Mulyana, Yaya(2023).	The Impact of Using Artificial Intelligence on Public Services in Indonesia
Nzobonimpa, Stany.(2023).	Artificial intelligence, task complexity and uncertainty: analyzing the advantages and disadvantages of using algorithms in public service delivery under public administration theories
Nazeer, Sara & Yousma Gil (2023).	Embracing artificial intelligence challenges for public sector organizations in pakistan
Maragno, Giulia, Luca Tangi, Luca Gastaldi & Michele Benedetti (2023).	Exploring the factors, affordances and constraints outlining the implementation of Artificial Intelligence in public sector organizations
Alhosani, Khalifa & Saadat M. Alhashmi (2024)	Opportunities, challenges, and benefits of AI innovation in government services

Results and Discussion

The role of artificial intelligence in creating and providing new job opportunities

Saudi Arabia, a nation rapidly transforming under its Vision 2030 program, is strategically embracing Artificial Intelligence (AI) as a key driver of economic diversification and growth. While concerns about AI replacing human labor are widespread, the reality in Saudi Arabia, as in many developing economies, is that AI is proving to be a significant catalyst for job creation, albeit in different and often more complex roles than previously existed. Contrary to the simple narrative of automation eliminating jobs, AI implementation is fostering a need for a diverse range of specialized skills.AI has driven the creation of specialized roles and contributed to a growing demand for skilled professionals. According to a report by the Saudi Data and Artificial Intelligence Authority (SDAIA), AI technologies are expected to create approximately 340,000 new jobs by 2030 across multiple industries (SDAIA, 2023). The integration of artificial intelligence (AI) in Saudi Arabia has significantly influenced job creation and workforce skill enhancement. The establishment of the Saudi Data and Artificial Intelligence Authority (SDAIA) underpins the Kingdom's Vision 2030, aiming to position Saudi Arabia as a leader in data-driven economies, which inherently fosters new job opportunities in AI-related fields (Memish et al., 2021). A report by PwC Middle East noted that "AI will create new roles which are focused on managing, creating, and supporting AI systems," (PwC Middle East, 2022). This demand encompasses a range of areas including:

1. **Artificial intelligence Engineering and Development:** This is arguably the most directly impacted sector. The Kingdom's ambitious AI strategy requires a skilled workforce capable of designing, building, testing, and deploying AI systems. This involves roles such as machine learning engineers, data scientists, AI architects, and software developers specializing in AI frameworks. The Saudi Data and AI Authority (SDAIA) is actively promoting training and education in these fields (SDAIA, 2023), signaling a growing need for these professions.

2. **Data Management and Analytics:** AI's effectiveness hinges on high-quality data. Therefore, jobs associated with data collection, cleaning, storage, and analysis are experiencing growth. Data analysts, data engineers, database administrators, and data governance specialists are crucial in ensuring AI systems function effectively and ethically. A McKinsey report highlighted the increasing importance of data-driven decision making in the Saudi economy, further reinforcing the need for data professionals (McKinsey, 2021).The rise of AI has led to increased demand for data scientists, AI engineers, and machine learning specialists.For example, organizations like SDAIA and NEOM employ AI experts to design smart systems for urban planning, transportation, and resource management. King Abdullah University of Science and Technology (KAUST) has launched programs to train thousands of AI and data professionals, ensuring a steady pipeline of skilled workers (KAUST, 2025)

3. **Artificial intelligence Integration and Implementation:** The deployment of AI solutions requires expertise in integrating these systems into existing infrastructure and workflows. This calls for project managers with AI knowledge, integration specialists, and consultants who can help organizations adopt and manage AI effectively. This is especially relevant in sectors like healthcare, finance, and manufacturing, which are undergoing significant AI-driven transformation.

4. **Artificial intelligence Ethics and Governance:** As AI becomes more prevalent, concerns about ethical considerations, bias, and transparency are also mounting. This has led to the emergence of jobs focused on AI ethics. Professionals involved in AI compliance, risk management, and policy development are becoming increasingly important, ensuring the responsible development and deployment of AI technologies in Saudi Arabia.

5. **Artificial intelligence Enabled Customer Service and Support:** While some customer service roles may be automated, AI is also creating new opportunities by enhancing existing roles. AI-powered chatbots and virtual assistants require human oversight and training to handle complex queries or

situations. This calls for a skilled workforce capable of managing and optimizing these AI tools to ensure positive customer experience.

6- **Artificial intelligence Enhanced Creative Professions:** Fields like marketing, content creation, and design are seeing AI-powered tools emerge, creating new jobs for those who can integrate these tools into their workflows. Professionals who can utilize AI to produce more compelling marketing copy, generate innovative designs, or craft personalized content will be in high demand.

7- **Healthcare:** AI is revolutionizing healthcare, with applications in diagnostics, drug discovery, and personalized medicine. This growth is creating jobs for AI specialists within medical institutions, researchers focused on AI in healthcare, and professionals who can implement and manage these systems. (Ministry of Health, Saudi Arabia, 2023 - though specific reports need to be consulted). AI creation of roles like healthcare AI specialists and medical data analysts. AI-driven diagnostic systems implemented in hospitals such as King Fahd Medical City require professionals to manage and optimize these systems (Ministry of Health, 2023). Implementation of AI systems at King Fahd Medical City has improved patient management and disease prediction, creating roles for data scientists and AI engineers (KFMC, 2023).

8- **Energy and Utilities:** The Saudi energy sector is utilizing AI for predictive maintenance, optimizing resource allocation, and improving operational efficiency, leading to job growth in AI-powered control systems, data analysis, and smart grid management. (Saudi Aramco, 2023 - again, refer to specific reports).

9- **Manufacturing:** AI adoption in manufacturing is leading to smarter factories, with roles emerging in robotics, automation, and data-driven production planning. (Ministry of Industry and Mineral Resources, Saudi Arabia, 2023 - see official documentation). AI-driven automation has enhanced production efficiency, creating jobs such as automation specialists and robotics engineers. Companies like SABIC have integrated AI into their operations, driving demand for workers to oversee AI-based supply chain systems (SABIC, 2023).

10- **Smart Cities:** Saudi Arabia's ambitious smart city projects like NEOM rely heavily on AI for various functions like traffic management, security, and energy optimization, creating job opportunities in related fields, from urban planning aided by AI to the real-time data management of city services (NEOM, 2024). Mega-projects such as NEOM and The Line require a significant workforce in AI-related roles, including infrastructure analysts, smart city planners, and automation specialists. These projects are expected to create over 380,000 new jobs by 2030, many of which are directly linked to the implementation of AI technologies (NEOM, 2024).

11- **Retail:** Retail platforms like Jarir use AI for personalized recommendations, driving demand for machine learning specialists to enhance user experience (Jarir, 2023).

12- **Smart Governance:** AI-driven platforms for e-governance and public services have emerged, requiring data scientists to analyze and optimize citizen interactions (Digital Government Authority, 2024).

13- **Education and Training:** The integration of AI in education has led to the creation of roles such as AI curriculum developers, e-learning specialists, and edtech platform managers. Initiatives like the National AI Capability Development Program have trained tens of thousands of Saudi nationals in AI-related skills, paving the way for employment in both private and public sectors (SDAIA, 2023).

a- **Educational and Training Programs:** The rising demand for AI professionals has prompted the expansion of educational initiatives:
  - **Academic Programs:** Universities such as King Saud University and King Abdullah University of Science and Technology (KAUST) have introduced specialized degrees in AI, data science, and machine learning, producing graduates equipped to meet market demands (KAUST, 2025).
  - **Government Initiatives:** SDAIA has launched training programs and workshops to upskill the workforce, including the National AI Capability Development Program, which trains thousands of Saudis annually in AI-related skills (SDAIA, 2023).

- **Industry Collaboration:**Partnerships with global tech companies like Google and IBM have facilitated the introduction of advanced AI training programs in Saudi Arabia, creating a pipeline of skilled professionals (IBM Saudi Arabia, 2025).

b- **Government and Private Sector Initiatives Supporting Job Creation**

- **SDAIA's Strategic Plans:** SDAIA's initiatives include providing training programs, certifications, and workshops to prepare a qualified workforce for AI-related roles. The AI Training and Internship Program, launched in collaboration with global tech companies like Google and Microsoft, has enabled many Saudis to gain practical experience in AI technologies (SDAIA, 2023).

- **Partnerships with Global Companies:**Collaborations with international firms such as IBM, Amazon Web Services (AWS), and Huawei have accelerated the growth of AI jobs. These partnerships include establishing innovation hubs and centers of excellence, which provide local employment opportunities (Ministry of Investment, 2023).

- **National Development Programs:** Programs like Future Work and Saudization have integrated AI into their strategies, ensuring that a significant portion of new jobs are occupied by Saudi nationals. These initiatives focus on training Saudis for high-demand roles in AI and technology (Human Resources Development Fund, 2023).

Specific Examples of AI-Driven Job Growth

- **Retail and E-Commerce:**AI-powered platforms like Noon and Jarir have created roles for customer experience analysts, recommendation system developers, and AI-enabled logistics managers (Noon, 2023).

- **Finance:** Banks such as the Saudi British Bank (SABB) and Riyad Bank use AI for fraud detection and personalized financial services, requiring AI specialists to manage these systems (SABB, 2023).

- **Transportation:**AI-driven initiatives like autonomous vehicle development and smart traffic systems have created jobs in AI algorithm design, sensor technology, and traffic management analytics (Ministry of Transport, 2025).

The impact of using artificial intelligence technologies on economic growth

Vision 2030, the Kingdom's strategic blueprint for economic diversification, explicitly recognizes the transformative potential of digital technologies, with AI at the forefront (Kingdom of Saudi Arabia, 2016). This has translated into substantial investments in AI infrastructure, education, and talent development. AI acts as a technology, enhancing productivity across industries by improving production processes, marketing, and customer acquisition (Ebin & Baig, 2024). Studies indicate a positive correlation between AI implementation and economic growth, with AI's influence becoming more pronounced in advanced economies (He, 2019). According to the Saudi Data and Artificial Intelligence Authority (SDAIA), AI is projected to contribute approximately $135 billion to Saudi Arabia's GDP by 2030, representing 12.4% of the total GDP (SDAIA, 2023). This growth is fueled by AI-driven innovations across multiple sectors.

1- **Energy Sector:** Saudi Arabia, a global oil giant, is leveraging AI to optimize exploration, production, and distribution processes. AI-powered predictive analytics are being used to enhance reservoir management, reduce downtime, and optimize drilling operations. As noted by a report from McKinsey, AI in the oil and gas sector can lead to a 10-20% increase in production efficiency (Manyika et al., 2017). Saudi Aramco, for instance, has implemented AI-driven solutions to monitor and optimize its vast network of pipelines, resulting in significant cost savings and improved operational performance (Saudi Aramco, 2023).

2- **Manufacturing Sector:** AI-powered robotics and automation are transforming Saudi Arabia's manufacturing sector. Intelligent systems are being deployed to enhance production line efficiency, improve

quality control, and reduce waste. A report by PwC (2022) highlights that AI-enabled manufacturing can boost productivity by up to 15% and reduce operational costs by 10-20%. These trends are visible in Saudi Arabia's diversification efforts towards manufacturing sectors like automotive components and consumer goods. AI applications in manufacturing and supply chain optimization have boosted productivity. SABIC, a global chemicals company, employs machine learning algorithms to analyze production processes, enabling it to reduce waste and maximize output. This has directly contributed to increased production efficiency (SABIC, 2023).

3- **Healthcare Sector:** AI is playing an increasingly crucial role in improving healthcare access and outcomes in Saudi Arabia. The use of AI in telemedicine, particularly in remote areas, is contributing to wider access to healthcare services. A study by the World Health Organization (2021) underscores the potential of AI to enhance healthcare delivery in resource-constrained settings like Saudi Arabia's less populated regions. AI tools used in hospitals such as King Fahd Medical City assist in early disease detection, diagnosis, and treatment planning. These innovations enhance patient outcomes and reduce healthcare costs (Ministry of Health, 2023).

  - **Enhanced Diagnostic Accuracy:** AI technologies are improving diagnostic processes, particularly in radiology, where 45.2% of professionals acknowledge AI's significant impact(Hamd et al., 2024).

  - **New Roles:** The demand for AI specialists in healthcare is rising, necessitating roles focused on AI implementation and management (Arafa & Farhat, 2024).

  - **Training Needs:** A significant gap exists in AI knowledge among healthcare professionals, with 58.6% reporting inadequate training (Hamd et al., 2024).

4- **Finance and Banking Sector:** The Kingdom's financial sector is rapidly adopting AI-powered solutions for fraud detection, risk assessment, and customer service. AI-driven chatbots are offering 24/7 support to customers, while machine learning algorithms are enhancing credit scoring and loan processing. A report from Ernst & Young (2022) indicates that AI can reduce operational costs in the financial sector by up to 25%, which could be a contributing factor to Saudi Arabia's ambitious expansion of digital financial services. The implementation of AI also leads to a more efficient and secure banking ecosystem.

5- **Smart Cities and Infrastructure:** Saudi Arabia's ambitious smart city projects, such as NEOM, are built on a foundation of AI and data analytics. AI is being used to manage traffic flow, optimize energy consumption, enhance public safety, and improve citizen services. These next-generation urban environments will be testbeds for future AI applications, further driving innovation and economic growth. A report by Deloitte (2021) suggests that smart city initiatives driven by AI can significantly boost urban economies through enhanced infrastructure efficiency and attracting new businesses.

6- **Agricultural Sector:** AI-driven solutions such as drone technology and smart irrigation systems are transforming agriculture. Projects like the Smart Agriculture Program in Al Jouf have utilized AI to monitor crop health and improve water usage efficiency, leading to higher yields and lower costs (Ministry of Environment, Water, and Agriculture, 2024).

7- **Retail and E-commerce:** Companies like Noon and Jarir have adopted AI to enhance inventory management and provide personalized shopping experiences. These implementations have not only increased customer satisfaction but also improved profitability by streamlining supply chains and reducing operational costs (Noon, 2023).

8- **AI in Technology**

  - **Business Model Innovation:** Companies are investing in AI to develop innovative business models, fostering new job roles in tech (Zafar, 2024).

  - **International Collaboration:** AI integration is enhancing business relationships between Saudi Arabia and other countries, creating roles in international business development (Zafar, 2024).

9- **Workforce Skill Enhancement:** The emphasis on reskilling programs in Saudi Arabia is crucial for preparing the workforce to adapt to the rapid advancements in AI technologies. As AI continues to transform various sectors, including business, education, and urban planning, equipping individuals with skills such as data analysis and critical thinking becomes essential for maximizing the benefits of these technologies (Hussain, 2024, Kumar et al., 2024)..

a- **Importance of Reskilling Programs**

- **Workforce Adaptation:** Reskilling initiatives are vital for enabling workers to transition into roles that require AI-related competencies, ensuring they remain relevant in a changing job market (Zafar, 2024).

- **Educational Integration:** Educational institutions are increasingly integrating AI technologies into their curricula, necessitating comprehensive training programs for both educators and students to effectively utilize these tools(Aldawsari & Almohish, 2024).

b- **Economic and Business Implications**

- **Business Performance:** Companies that invest in reskilling their workforce see improved business performance, as technological readiness and data quality enhance the effectiveness of AI applications(Alarefi, 2024).

- **Vision 2030 Goals:** Reskilling aligns with Saudi Arabia's Vision 2030, which aims to diversify the economy and reduce oil dependency by fostering a skilled workforce capable of leveraging AI and FinTech innovations(Abedalrhman et al., 2024).

10- **Collaboration with Academia:** Collaboration between academia and industry in Saudi Arabia is increasingly emphasized to ensure educational curricula align with the evolving demands of the job market, particularly in the context of AI technologies. The following sections outline key aspects of this collaboration (Hussain, 2024).

a- **Alignment of Curricula with Market Needs**

- Research indicates a significant gap between university programs and job market requirements, particularly in data and business analytics (Barefah, 2024).

- A framework utilizing machine learning has been proposed to identify and address these gaps, ensuring graduates possess the skills that employers seek (Yafooz et al., 2021).

b- **University-Industry Collaboration Models**

- New models for collaboration, such as the Technology Innovation Centers, aim to merge academic research with industry needs, fostering innovation and addressing real-world problems(Abdulaziz & Arabia, 2014, Khorsheed & Al-Fawzan, 2013).

- Partnerships between universities and private sector entities have been shown to enhance knowledge transfer and technology commercialization, contributing to economic growth (Awadai, 2023).

c- **Economic Development and Vision 2030**

- The alignment of educational programs with industry demands is a critical component of Saudi Arabia's Vision 2030, which aims to diversify the economy and reduce unemployment (Yafooz et al., 2021, Awadai, 2023).

- Successful partnerships have been reported to promote environmental sustainability and agricultural productivity, further supporting national goals (Awadai, 2023).

While the collaboration between academia and industry presents numerous benefits, challenges remain in ensuring that all stakeholders are adequately engaged and that curricula are continuously updated to reflect the dynamic nature of the job market. AI presents opportunities for job creation and skill development, it also poses challenges, such as potential job displacement in routine tasks. This duality necessitates a balanced approach to workforce management and policy-making to mitigate adverse effects while maximizing benefits (Tripathi, 2024).

Challenges and Risks of Artificial Intelligence

Previous research includes a wide range of geographical and cultural contexts worldwide, according to an assessment of their distribution and spatial context in Table 1. Numerous of these studies concentrated on the difficulties posed by AI in industrialized nations like the US, Norway, Spain, Estonia, the Netherlands, the UK, and other European nations. Other research, on the other hand, focused on AI issues in developing nations like China, India, Indonesia, and Pakistan. Some research concentrated on nations like Serbia and Mexico that were making the shift from developing to developed status. Other experiments did not define a specific spatial environment; instead, they addressed AI difficulties generally. From the perspective of the researcher, this variety and thoroughness of studies should enhance the research topic and evaluate it holistically, assisting in illuminating the most significant issues surrounding the use of artificial intelligence.

The researcher used a sequential methodological approach based on a thorough and structured study in order to create a model that depicts the risks and difficulties that governments face as a result of artificial intelligence, as well as to thoroughly examine and comprehend these difficulties. By taking these actions, the researcher hopes to create an extensive. From basic definitions and classifications to temporal and spatial dimensions as follows:

1- **Initial Analysis:** The researcher's goal in this step is to perform a thorough initial analysis in which all of the dangers and difficulties listed in the 23 studies cited in table No. 1 are gathered and categorized. As indicated in table 2, this stage led to the identification of 45 distinct obstacles pertaining to the use of AI in the public sector.

2- **Analysis of the most recurrent challenges:** The goal of this stage is to determine which studies have the most reoccurring challenges in order to determine the primary problems and most urgent difficulties in the field of artificial intelligence.

Privacy appeared as the most prevalent challenge in the investigations, with 14 studies mentioning it, making it the most discussed topic. Protecting people's data and personal information from unauthorized use or disclosure, as well as preventing unauthorized access, modification, destruction, or negative exploitation that could harm people and societies, are some of the issues and challenges associated with this challenge. The second challenge, cited 12 times, is **the scarcity of qualified talent**. This challenge is the difficulty of finding qualified individuals with the skills and experience to efficiently develop, manage, and implement AI applications. The third challenge is **transparency**, which revolves around the ability of users and stakeholders to understand how AI systems work and how they work. This challenge is also accompanied by the **lack of awareness and resistance to change among public sector** bureaucrats towards the use of AI applications. These two challenges were mentioned 11 times, making them prominent challenges. Challenges related to the **readiness of the infrastructure for AI applications**, along with the challenge of **accountability and responsibility,** came in fourth place with 10 occurrences. These challenges include difficulties related to providing the appropriate infrastructure for the application of AI technologies, in addition to issues of determining responsibility for the results of decisions made by these technologies that may affect individuals and societies. Next, with 9 recurrences, are the challenge of the **capacity and financial solvency needed to implement AI applications**, the challenge of **trust and societal acceptance of these applications**, their uses and outcomes, **issues of bias and unfairness, and concerns related to the impact of AI applications** on individuals or specific groups in society. Then came the **job loss** challenge and the **data quality** challenge with 8 occurrences each. This was followed by the **safety and security** challenge with 7 occurrences. While the **ethical issues** challenge was mentioned in the studies 6 times. This was followed by the **cybersecurity challenge** and the **legal regulatory framework** challenge with 5 occurrences. The legal regulation challenge, the bureaucratic structures challenge, and the governance challenge were each mentioned 4 times. While the human-machine interaction challenge, the human-machine interaction challenge, the R&D and innovation challenge, the availability of big data challenge, the explainability of decisions challenge, the oversight challenge, the dependence on service providers challenge, and the social inequality challenge were mentioned 3 times.

This was followed by the intellectual property challenge, the salary inequality challenge, the market and regulatory environment challenge, the lack of strategy challenge, the salary increase challenge, and the training and investment in human resources challenge, which were mentioned only twice. Finally, the following challenges were mentioned only once: the challenge of social discrimination, the challenge of operating costs, the challenge of international competition, the challenge of private sector dominance of investments, the challenge of research funding, the challenge of joint investment between the public and private sectors, the challenge of integration of operations, the challenge of employment obstacles, the challenge of cooperation with experts and employees, the challenge of scalability, the challenge of data ownership, the challenge of weak skills and training, and the challenge of income inequality.

The researcher attributes the emergence of these challenges in particular to the rapid growth and continuous expansion of artificial intelligence applications.

Table 2: All challenges identified through the Initial analysis phase

Challenges	Mikhaylov et al.(2018)	Wirtz et al.(2018)	Kalyanakrishnan et al.(2018)	Mikalef et al.(2019)	Sun & Medaglia.(2019)	Surya.(2019)	Murawa & Rashid.(2020)	Criado et al.(2020)	Chatterjee.(2020)	Zheng et al.(2020)	Pi.(2021)	Sobrino-García.(2021)	McBride et al.(2021)	Seyadi et al.(2021)	Osborne et al.(2022)	Weerasinghe et al.(2022)	VidaFernández.(2023)	ULAŞAN.(2023)	Nzobonimpa.(2023)	Mulyana.(2023)	Maragno et al.(2023)	Nazir & Gul.(2023)	Alhosani & Alhashmi.(2024)
Privacy	1	1	0	0	1	1	1	0	1	1	0	1	1	0	1	1	1	0	1	0	0	0	1
the scarcity of qualified talent	1	1	0	1	1	1	0	0	1	0	0	0	0	1	0	1	1	1	0	0	1	0	1
Transparency	1	0	0	0	1	0	0	0	0	1	1	1	1	0	0	1	1	1	1	0	0	0	1
lack of awareness and resistance to change among public sector	0	0	1	1	1	1	0	1	1	0	1	0	0	0	0	0	1	0	0	0	1	1	1
Accounting/Accountability	0	1	0	0	1	0	0	0	0	1	1	1	1	0	1	0	1	0	1	0	0	0	1
the readiness of the infrastructure for AI applications,	1	0	1	0	0	1	1	1	1	0	0	0	0	0	0	0	1	1	0	1	1	0	0
the capacity and financial solvency needed to implement AI applications	0	1	0	1	1	0	1	1	1	0	1	0	0	0	0	0	0	0	1	0	0	1	0
trust and societal acceptance of these applications	0	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	1	0	1	1	1	1	0
issues of bias and unfairness, and concerns related to the impact of AI applications	0	0	1	1	0	0	0	0	0	0	1	1	1	0	1	0	1	1	0	0	0	0	1
job loss	1	0	1	0	1	0	1	1	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0
Data Quality	0	1	0	1	1	0	1	1	0	0	1	0	0	0	0	1	0	0	0	0	1	0	0
Safety and security	1	1	0	1	1	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	0	0
Ethical issues	0	1	0	1	1	0	0	0	0	0	0	0	1	0	1	0	1	0	0	1	0	0	0
Cyber Security	1	0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0
Legal regulatory frameworks	0	0	0	0	1	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0
Regulatory legal	0	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
Challenges and bureaucratic structures	0	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	1	1	0
Governance	0	0	0	1	1		1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Human0machine interaction and machine0machine interaction	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0	0
Research, development and innovation	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
Big data availability	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
interpretability of decisions	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	1	0	0
Censorship	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Relying on service providers	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0
social inequality	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0
Intellectual Property	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
salary inequality	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0

Challenges	Mikhaylov et al. (2018)	Wirtz et al.(2018)	Kalyanakrishnan et al (2018)	Mikalef et al.(2019)	Sun & Medaglia.(2019)	Surya.(2019)	Mutawa & Rashid.(2020)	Criado et al.(2020)	Chatterjee.(2020)	Zheng et al.(2020)	Pi.(2021)	Sobrino-García.(2021)	McBride et al.(2021)	Seyadi et al.(2021)	Osborne et al.(2022)	Weerasinghe et al.(2022)	VidaFernández.(2023)	ULAŞAN.(2023)	Nzobonimpa.(2023)	Mulyana.(2023)	Maragno et al.(2023)	Nazir & Gul.(2023)	Alhosani & Alhashmi.(2024)
Market Challenges and Regulatory Environment	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lack of strategy	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Salary increase	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Training and investment in human resources	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
social discrimination	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Operating costs	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
International competition	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Private sector dominance of investments	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Research funding	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Public0private joint investment	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Process integration	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Employment Obstacles	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Collaborate with experts and staff	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Scalability	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Data Ownership	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
Poor skills and training	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Income inequality	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Number 1 indicates the presence of a challenge. Number 0 indicates the absence of a challenge.

The researcher attributes the emergence of these challenges in particular to the rapid growth and continuous expansion of artificial intelligence applications. This progress requires sufficient financial resources and advanced infrastructure, in addition to the presence of qualified and specialized human cadres to manage and operate these technologies. Achieving optimal benefit from artificial intelligence also requires a high level of awareness of its benefits and potential negative effects. In addition, the uncertainty about the potential negative effects of using artificial intelligence contributes to the emergence of issues of transparency, accountability and responsibility, with the need to ensure fairness and impartiality in the use of these applications

Recommendations

Through the previous review and study of the vital role played by artificial intelligence in achieving sustainable economic development and enhancing economic growth in the Kingdom of Saudi Arabia, and its role in providing and creating new job opportunities and understanding the challenges and risks facing the application of artificial intelligence technologies in order to achieve the goals of the Kingdom's Vision 2030, the researcher recommends the following points that would achieve this

Developing Human Skills and Competencies:

1- Launching specialized training and qualification programs in the fields of artificial intelligence and big data, targeting Saudi youth and graduates.

2- Enhancing cooperation between universities, technical institutions and major companies to develop advanced educational curricula in artificial intelligence.

Enhancing Technical Infrastructure:

1- Investing in improving digital infrastructure, including large data centers, high-speed Internet connectivity, and cloud computing.

2- Establishing research and development centers specialized in artificial intelligence to be innovative platforms that enhance the achievement of the goals of Vision 2030.

Addressing Security and Ethical Risks:

1- Developing strong cybersecurity policies to protect sensitive data associated with artificial intelligence applications.

2- Formulating clear regulatory frameworks that take into account the ethical and privacy aspects of using artificial intelligence technologies.

Strengthening Public-private Partnerships:

1- Encouraging cooperation between the government and leading technology companies to accelerate the adoption of AI technologies in various economic sectors.

2- Supporting AI startups and innovators by providing funding and incentives.

Community Awareness:

1- Implementing awareness campaigns that highlight the benefits of AI in improving the quality of life and its role in achieving sustainable development.

2- Addressing community concerns related to new technologies, such as job loss due to automation, by raising awareness of the importance of adapting to technological developments.

Monitoring Progress and Evaluating Performance:

1- Establishing a monitoring system to periodically measure the impact of AI application on achieving the goals of Vision 2030, with a focus on challenges and obstacles.

2- Updating policies and plans based on practical results and observations to enhance the effectiveness of AI application.

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