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Article

Industry-university partnership governance base on new technologies emergence

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Abstract: Governance plays a critical role in advancing Industry 4.0 technologies by enhancing collaboration between industry and academia. This joint relationship significantly accelerates the development of artificial intelligence (AI) technologies, improves research quality, and strengthens scientific and technical capabilities. The primary objective of this research is to investigate the impact of advancements in AI technologies on strengthening the relationships between industry and universities. By conducting a qualitative analysis of governance practices in technology development across various countries, this study delves deeply into the dynamics of this relationship. The findings indicate that AI serves a pivotal role in enhancing research capabilities, introducing innovative technologies, promoting collaboration, facilitating technology transfer, and driving innovation, competitive advantage, and sustainable progress in industries. Furthermore, the study focuses on governance strategies related to AI within the context of industry-academia collaboration, including the formation of joint committees, initiation of collaborative research projects, facilitation of technology transfer, and establishment of shared platforms for education and research in AI and related fields. These aspects are meticulously examined within the framework of human capital development and knowledge-based economic growth, underscoring the importance of effective governance structures in leveraging AI advancements to strengthen industry-academia partnerships and stimulate technological innovation.

Keywords: AI technology; technology integration; industry-university cooperation

1. Introduction

Artificial intelligence (AI) significantly influences a wide range of industries by enhancing research capabilities and providing efficient solutions to complex challenges. The evolution of AI, shaped by effective governance, not only introduces innovative technologies but also bolsters market competitiveness. Moreover, AI promotes collaboration between industry and academia, creating an environment that nurtures innovation. The advancement of artificial intelligence under robust governance empowers both universities and industry stakeholders with the necessary tools to accelerate technology development and transfer, ultimately facilitating sustainable growth and development [1].

Artificial intelligence is a concept with varied interpretations [2], that often encompasses technologies like machine learning, neural networks, and various automated systems. It is occasionally presented as a versatile technology [3] due to its increasingly widespread use across different domains. This extensive application results in practical uncertainties, particularly in the realms of policymaking and regulation [4]. Nations such as the United States, China, and Russia aim to exploit artificial intelligence to shift the power dynamics in their favor [5], while other global

actors may employ artificial intelligence differently based on their own interests, objectives, and domains [6].

The swift expansion of artificial intelligence technologies and their transformative influence on a wide array of issues have presented fresh challenges for policymakers and other stakeholders on a global scale. Many endeavors associated with the advancement of artificial intelligence technologies are overseen by governments, yet international bodies have exhibited a notable capacity in addressing policies related to artificial intelligence. Despite artificial intelligence being an innovative technology that falls outside the scope of current legal or regulatory frameworks [7], there is a trend towards addressing new obstacles within existing structures [8].

Countries across the globe have implemented a variety of strategies to facilitate the advancement of artificial intelligence technologies. These strategies exhibit a range of objectives and methodologies. For instance, certain nations, particularly those in East Asia, place a strong emphasis on "development" by involving the government significantly in fostering artificial intelligence innovation [9]. Conversely, countries within the European Union concentrate on "control", emphasizing the implementation of regulations governing artificial intelligence [10]. In contrast, nations like the United Kingdom, the United States, and Ireland prioritize "promotion" policies with intricate governance structures and a predominant role assigned to the private sector [11]. The primary aim of these strategies is to modernize societies and integrate artificial intelligence technologies into various aspects of human life. Recognizing the significance of contemporary information and communication technologies, including artificial intelligence, these strategies necessitate comprehensive approaches that encompass experts, technological capabilities, financial resources, and legal frameworks. In essence, these strategies demonstrate an acknowledgment of the significance of artificial intelligence and the necessity for targeted integration of resources [12].

The governance strategies related to the advancement of artificial intelligence (AI) technologies within the context of industry-academia collaboration involve a diverse array of stakeholders, including private enterprises, industry associations, universities, professional organizations, government bodies, international organizations, and civil society. These stakeholders advocate for various norms and mechanisms to regulate AI, including ethical guidelines, national policies, and formal regulations [13]. While private companies are instrumental in guiding AI initiatives, their primary focus on profitability and market demands can sometimes conflict with the broader public interest. Therefore, there is a critical need for external government oversight to ensure that the wider implications of AI are adequately considered [14]. This scholarly investigation examines the experiences of different countries in implementing AI within the industry-academia dynamic and assesses the outcomes of these initiatives.

2. Theoretical foundations of research

2.1. Industry-university government cooperation

Artificial intelligence (AI) has become a catalyst for significant transformations across various sectors of society, empowering mankind to approach management in a more methodical and strategic manner. The pivotal role of AI is evident in its ability to serve as a vital link between the realms of academia and industry, facilitating knowledge exchange and collaboration. The ascendancy of the industry in AI research is steadily increasing, primarily due to its command over computational capabilities, vast pools of data, and a talent pool rich in skilled researchers. This transition towards industry dominance is manifested in the generation of impactful research outcomes, including scholarly publications, cutting-edge models, and essential performance indicators that shape the landscape of artificial intelligence [15].

The domain of artificial intelligence (AI) is increasingly recognized within the field of international relations as a landscape marked by competition and potential conflicts, driven by uncertainties regarding the relinquishment of control over technology and oversight of human intervention. Russian President Vladimir Putin's statement in 2017 resonates with a commonly held perspective in global discussions, as he famously asserted, "Whoever becomes the leader in artificial intelligence will rule the world" [16]. In this context, numerous government and private entities have expressed their viewpoints on the societal implications of AI, particularly from a governance perspective, focusing on critical areas such as infrastructure development, military applications, and the effects on employment and human relations. While some of these viewpoints have proposed comprehensive strategies to address the challenges posed by AI, a majority have embraced principled stances aimed at mitigating the risks associated with disruptive AI technologies. By 2020, over 30 nations had initiated discussions on developing national strategies for AI, with 17 countries actively implementing these strategies [17].

The exploration and discussion of national strategies for artificial intelligence governance within the industry-university domain originated during a pivotal research session held at a Dartmouth workshop in 1956, marking the inception of a groundbreaking field of study. Since that momentous occasion, the realm of AI development has transitioned into the hands of the private sector, embarking on a transformative journey across diverse sectors such as industrial robotics, data mining, and the integration of AI-driven leadership roles. This evolution witnessed a pattern where these innovations first gained traction within the tech industry, gradually earning societal approval through early triumphs and practical applications. Over the course of subsequent years, a new wave of sophisticated AI technologies emerged, encompassing advanced AI systems, deep learning algorithms, cutting-edge voice and image recognition software, as well as state-of-the-art data analytics tools. These technological marvels have found widespread application in sectors such as banking, e-learning platforms, medical diagnostics, smart transportation systems, and beyond, revolutionizing the way we interact with and harness the power of AI in our daily lives [18].

In the contemporary landscape, nations at the forefront of technological innovation and home to the most prominent industrial players in the AI sector have assumed a leading role in shaping the trajectory of global AI development for the coming decade. Meanwhile, numerous other countries, particularly those in the developing world, are engaged in ongoing deliberations and knowledge-sharing

initiatives to define their respective national priorities and chart a course for future AI frameworks that align with their unique socio-economic landscapes and aspirations [19].

2.2. Industry-university governance based on artificial intelligence based on justice and ethics

The European Union, recognizing its internal disparities, holds the belief that artificial intelligence has the potential to support the green deal [3] and is committed to promoting "human-centric artificial intelligence". Consequently, artificial intelligence is seen as a means to advance social justice and reduce inequality, empowering even the most marginalized individuals. The European Union endorses the principles of "ethics by design" and "security by design" in research and technology development [3]. A specific category of "high-risk artificial intelligence" has been established by the European Union, subject to special regulatory and oversight measures [3].

The United Nations, the European Union, and the World Economic Forum concur that governance frameworks must be adaptable to keep pace with innovation and harmonize regulations across various stakeholders. Regulatory sandboxes are referred to by the European Union and the United Nations. A comprehensive governance framework is essential to mitigate the risks of artificial intelligence technologies and ensure their safe and ethical use, safeguarding privacy, fundamental rights, and benefiting the most vulnerable individuals.

Furthermore, the United Nations, the European Union, and the World Economic Forum advocate for interdisciplinary research to guide the applications of artificial intelligence towards sustainable and socially just foundations [17]. Collaboration among diverse stakeholders, including universities, civil society, citizens, and the private sector, is deemed necessary to harness artificial intelligence effectively and ensure its sustainability. This collaboration is essential for enhancing understanding of artificial intelligence, reducing discrimination and biases [3], and ensuring that the impact of artificial intelligence is positive for the majority while facilitating data access. Private companies and universities contribute skills and expertise, while the public sector provides appropriate legislation, funding, and support. Citizens and users should engage in acquiring digital and technical skills. Transparency and explainability are crucial to ensure informed consent and trust.

The United Nations promotes the concept of data altruism for justice in industry-university governance, emphasizing data sharing by the private sector to complement public sector data for the benefit of disadvantaged individuals. Gender-disaggregated information and improved data accessibility in developing countries are also endorsed by the United Nations to be more beneficial for vulnerable populations. Computational capacities should be enhanced to facilitate artificial intelligence training [20].

Ethics and justice are crucial in the development of tripartite relationships among academia, industry, and government for several reasons [21]. Firstly, ethical considerations ensure the responsible and sustainable use of resources and technologies, promoting transparency and accountability in decision-making processes [13]. Secondly, a focus on justice helps to address power differentials and

ensure fair and equitable distribution of benefits and opportunities among stakeholders. Lastly, an ethical and just approach fosters trust and collaboration among academia, industry, and government, leading to more effective and impactful partnerships that contribute to societal well-being and progress.

3. Research background

3.1. Industry-university governance based on AI in China

China's approach to advancing artificial intelligence (AI) technologies is diverse. The nation is in the process of modernizing its military systems, increasingly integrating AI and associated technologies into areas such as information, command and control, logistics, and weapon systems. Efforts are underway to establish a regulatory framework for AI, including laws, ethical standards, and policy guidelines by 2025. China has emerged as a global frontrunner in AI research, innovation, and implementation, demonstrating significant progress in these areas. Moreover, the country has witnessed substantial growth in AI patent citations, particularly in key regions like the Yangtze River Delta, Pearl River Delta, and Bohai Rim. These developments underscore China's dedication to AI advancement and its commitment to fostering an environment conducive to innovation and technological progress.

3.2. Industry-university governance based on AI in Netherlands

Artificial intelligence (AI) is a rapidly growing technology field that can have a significant impact on Dutch society and all its economic elements. To strengthen the Netherlands' position and maximize opportunities, a long-term program called AiNed has been designed by the Dutch AI Coalition and a consortium of over 400 public and private organizations. The development and utilization of AI aim to enable the Netherlands to benefit from the economic and social advantages of AI and synchronize with other leading countries.

According to the Dutch government's governance forecast, this approach could potentially generate a 1.6% growth in the country's Gross Domestic Product (GDP) based on the development of AI technologies. This serves as a catalyst for strong growth in the number of companies investing in and utilizing AI. The Netherlands also promotes the beneficial social impacts of AI by employing responsible and human-centric AI programs that align fully with European objectives. The National Growth Fund has allocated 204.5 million euros for the initial phase of the AiNed program.

Examples of AI applications currently employed and supported under these approaches in the Netherlands include: Improving medical diagnoses and treatments, reducing pesticide use, energy savings, personalized education, more effective crime fighting, cost-effective repair and maintenance of roads, bridges, and railways, more efficient production and transportation of goods, long-term customer relationships in the service and retail sectors, as well as autonomous robots, vehicles, and unmanned aircraft.

Maximizing participation and seizing major opportunities for the Netherlands, the availability of extensive data, affordable computing power, and new generations of AI methods are rapidly advancing artificial intelligence. Despite a strong starting

position in terms of AI knowledge, digital infrastructure, and overall use of digital technology in the Netherlands, there is a need for stronger development and a risk of falling behind [22].

The Dutch experience in supporting the development of AI technologies includes aligning Dutch business goals and policies in AI development. The Dutch government has established a new research consortium called CVON-AI to facilitate the development and use of AI solutions in medical research. The goal of this consortium is to create a cloud-based platform accessible to researchers, demonstrate the clinical applications of AI, optimize analytical methods, and enhance AI awareness through education [23].

3.3. Industry-university governance based on AI in Canada

Canada is actively promoting the advancement of artificial intelligence (AI) technologies. In 2017, the Canadian government introduced the "national strategy for artificial intelligence", aiming to position Canada as a global frontrunner in AI innovation. The government sponsors workshops on AI and its societal impacts, convening experts, influencers, and community representatives to explore the ethical and social dimensions of AI across various sectors like healthcare, education, and the workplace. However, there are concerns regarding the inclusiveness of these workshops, potentially excluding ordinary citizens and average consumers from engaging with the technology. Gender diversity in AI-related activities in Canada remains understudied, highlighting the need for legislative measures to support women in the AI industry and ensure equity and gender parity. In summary, Canada's efforts to advance AI technologies encompass strategic planning, educational initiatives, and a call for greater gender inclusivity and representation.

3.4. Industry-university governance based on AI in United Kingdom

The United Kingdom is actively promoting the advancement of artificial intelligence (AI) technologies. The National Health Service (NHS) is striving to establish itself as a global leader in AI applications in healthcare and is dedicated to training and involving medical professionals in AI initiatives. The integration of AI into healthcare presents regulatory challenges and necessitates a delicate balance between the advantages of ongoing enhancements and the assurance of safety protocols [24]. Within the field of dermatology, there is growing interest in utilizing AI for evaluating the risk associated with skin lesions; however, there is a notable absence of ethical guidelines and standardized regulations in this area. Recent legal competitions in the UK have underscored the imperative need for robust AI policies and the significance of incorporating legal considerations into AI governance and decision-making processes [25]. Aspiring physicians in the UK acknowledge the positive influence of AI technologies on their clinical training, yet they express apprehensions regarding the potential impact on clinical judgment and practical competencies.

3.5. Industry-university governance based on AI in Brazil

Brazil has a rich history of formulating digital advancement strategies,

encompassing endeavors in research and development, as well as the integration of AI-driven technologies across industry and governmental sectors. The government has prioritized enhancing criminal investigation techniques and public safety measures through the utilization of AI solutions. In light of the global health crisis caused by the COVID-19 pandemic, Brazil introduced a remote healthcare platform powered by artificial intelligence to enhance the accessibility of medical services [15]. Recent research underscores the necessity of establishing a public policy framework to foster the acceptance of AI technologies in Brazil, as delays in this regard could exacerbate disparities among nations. In summary, Brazil's approach entails a diverse array of policies and programs designed to bolster the advancement and implementation of AI technologies in key domains such as digital innovation, law enforcement practices, and healthcare services [26].

4. Research methodology

The current research methodology utilized in this study employs a meta-study approach known as Systematic Literature Review (SLR), focusing on analyzing the policies and developmental materials of chosen nations in the realm of artificial intelligence technology advancement. Systematic literature review involves the systematic exploration, assessment, synthesis, and interpretation of quantitative or qualitative research within a specific field [21]. Following the methodology proposed by Sandelowski and Barroso [27], the research process in this study unfolded through seven distinct stages, encompassing: Articulating the research objectives and formulating research inquiries, systematically scrutinizing texts and research backgrounds, identifying and selecting pertinent documents, extracting relevant data, analyzing and synthesizing study outcomes, ensuring quality control, and presenting the research findings. The tasks undertaken at each stage are detailed as follows:

4.1. Stage 1—Clarifying research objectives and inquiries

The primary aim of this study is to address the following queries through a comprehensive review of literature, documents, and policy frameworks concerning artificial intelligence technology development in selected countries: 1) To what degree is the advancement of artificial intelligence technologies prioritized in the governance strategies of chosen nations with regards to industry-academic partnerships? 2) What key initiatives and tactics are adopted by selected countries in fostering the growth of artificial intelligence technologies? 3) How do the primary strategies of selected countries in advancing artificial intelligence technologies align with industry-academic governance dimensions?

4.2. Stage 2—Thorough review of background information

This segment involves conducting library research and meticulously examining reputable documents and articles to identify the initiatives and policies of selected countries in the realm of artificial intelligence technology development.

4.3. Stage 3—Criteria for selecting study subjects

The choice of countries for analyzing developmental documents was based on three key factors: 1) Availability of information; 2) global rankings and achievements in artificial intelligence; and 3) alignment with the unique context of Iran's ecosystem. Following rigorous evaluation and assessment by researchers, the countries selected for examination were China, England, Canada, Brazil, and the Netherlands. Subsequently, the primary industry-academic governance policies and developmental materials from these nations were reviewed and assessed.

4.4. Stage 4—Data extraction

During this phase, comprehensive examination and supplementary research were conducted, leading to the initial (open) and axial coding of the documents.

4.5. Stage 5—Information analysis and synthesis

This stage involved breaking down and analyzing the coded data to identify key concepts and themes using the content analysis technique. Systematic Literature Review (SLR) offers a range of methodologies for synthesizing data, including content analysis, theory-driven analysis, thematic synthesis, qualitative comparative analysis, and framework analysis [28]. The deductive content analysis approach was utilized to develop a central theory, model, or conceptual framework. Thus, the research employed open coding, axial coding, and selective coding techniques to achieve its objectives.

5. Findings

The integration of artificial intelligence (AI) technology into partnerships between universities and industries significantly enhances educational innovation by aligning specialized environments, educational content, teaching methodologies, and learning platforms with real-world industry practices and demands. As academia transitions into a digitally immersive era propelled by AI, it is crucial for researchers and professors to adapt to effectively engage with AI technologies to shape the future of education. AI is fundamentally transforming the interaction dynamics between academia and industry, with the latter increasingly contributing to AI research and its myriad applications across various sectors.

This study investigates the governance aspects of industry-university collaboration in advancing AI technologies and examines the experiences of selected countries. Notably, the research highlights three governance models: Control, Develop, and Promote, which provide a framework that resonates with both theoretical insights and practical experiences. The absence of these models in subsequent discussions is noted and could be beneficial for the literature review protocol and selection of case studies.

The innovations and strategies outlined in four key AI applications are as follows: (1) Enhanced data collection and analysis to facilitate knowledge acquisition, drive scientific breakthroughs, spur industrial advancements, and support informed decision-making; (2) Increased automation across sectors such as transportation and manufacturing; (3) Improved productivity regarding individual consumption, energy

utilization, and resource management; (4) Promotion of equality and poverty alleviation through AI interventions.

These points, while reasonable, could be perceived as stemming from a deductive approach, with limited reference to how they were synthesized. Enhanced data gathering and analytic capabilities enabled by AI are evident in various studies indicating its effectiveness in uncovering insights and trends within extensive datasets, which can lead to scientific discoveries and enhanced understanding of complex global issues. AI tools empower quicker and more informed decision-making processes, employing technologies such as machine learning, smart sensors, remote sensing, the Internet of Things, computer vision, and drones for comprehensive data analysis. These applications span monitoring diverse phenomena, including weather patterns, species migration, forest health, public transport efficiency, and energy consumption.

Moreover, research showcases the proficiency of AI in predictive analytics, such as forecasting future energy demands, carbon emissions, and climate change consequences. The United Nations Digital Cooperation Roadmap emphasizes the necessity of utilizing big data and AI to derive actionable insights that can effectively address public health challenges, including disease outbreaks and their implications for vulnerable communities [16].

The World Economic Forum, along with the United Nations and the European Union, advocates for the utilization of artificial intelligence technologies to tackle challenges posed by climate change and environmental shifts. These technologies leverage big data to identify patterns that enhance decision-making processes and improve forecasting accuracy [16]. Within the realm of industry-university governance centered on artificial intelligence, it is anticipated that advancements in democratic systems and responsible economic models will be fostered. This will be achieved through improved information accessibility, enhanced communication channels, and more efficient monitoring of inefficiencies [1]. Artificial intelligence plays a crucial role in bolstering cybersecurity measures, enabling the tracking and analysis of intricate criminal networks, and streamlining migration and asylum procedures. The growing adoption of automation [4] is another key aspect highlighted in studies on industry-university governance driven by artificial intelligence. Automation, facilitated by technologies like robotics and autonomous vehicles [5], liberates individuals from mundane tasks, allowing them to focus on more creative endeavors. This shift not only enhances human well-being by freeing up time for innovation but also contributes to more effective industry-university governance by redirecting attention towards creative and impactful tasks. In work environments, automation enhances operational efficiency and organizational performance by minimizing errors and production fluctuations on assembly lines. The implementation of autonomous vehicles and intelligent systems through automation aids in reducing accidents and improving overall road safety. By integrating automation and artificial intelligence technologies, individuals can allocate more time to strategic and creative pursuits, alleviating them from repetitive and exhausting tasks. This transition ultimately leads to the enhancement of industry-university governance and the promotion of human welfare.

6. Enhanced efficiency and environmental sustainability

Automation plays a pivotal role in reducing redundancy, energy wastage, and unnecessary emissions. Research indicates that artificial intelligence contributes significantly to advancing sustainable production practices, particularly in the realm of agricultural progress. Within agriculture, the integration of artificial intelligence technologies aids in minimizing pesticide and fertilizer usage, optimizing water resources, controlling weed proliferation, promoting animal well-being, and swiftly identifying crop diseases. Furthermore, applications extend to streamlining transportation systems, managing energy distribution effectively, optimizing waste disposal methods, and implementing energy-efficient solutions like smart homes that align with residents' daily routines. Smart grids further enhance energy management by integrating various renewable energy sources. The European Union highlights the potential of "smart thermostats, which analyze user behavior and adjust temperatures accordingly, leading to potential energy savings of up to 25%" [3].

Advancement in social equity and poverty alleviation. In the discourse surrounding sustainable development, artificial intelligence is anticipated to play a crucial role in fostering gender equality. Emphasis is placed on creating new employment opportunities, particularly for women, through artificial intelligence interventions. Given the competitive edge in artificial intelligence development held by major economies like China, the United States, and the European Union, the United Nations has devised an "internal strategy to bolster AI-driven empowerment, with a specific focus on supporting developing nations and millions of vulnerable individuals" [20]. Reports from the Global Pulse initiative underscore the positive impact of artificial intelligence technologies in aiding populations in developing countries, particularly in areas such as women's workforce participation, monitoring gender-based violence, mapping unsafe regions, and more.

7. Conclusion and insights

The collaboration among academia, industry, and society forms the foundation of artificial intelligence (AI) governance. Active involvement from AI developers, professional bodies, and educational institutions shapes the norms governing AI development and deployment. Despite technology companies espousing ethical standards for AI utilization, the pursuit of financial gains and market pressures can sometimes impede their alignment Enhanced efficiency and environmental with public interests. Reflecting on the broader spectrum of intelligence encompassing both artificial and natural information flows is essential to understanding the societal and environmental impacts of AI. The deployment of AI systems presents unique legal complexities, necessitating global harmonization of laws and regulations. While AI has revolutionized the public relations domain and offers avenues for enhancement, it also raises pertinent concerns that demand attention from researchers and experts.

The formulation of policies governing the collaboration between academia and industry in the domain of artificial intelligence holds significant importance due to the myriad benefits it offers to nations. Given the swift evolution of AI technologies, countries must adapt their policies promptly to keep pace with advancements and leverage the opportunities presented by these technologies. The provided **Table 1**

delineates key strategies for managing industry-academia relationships in the development of AI technology in five specific countries. These strategies, derived from a comprehensive document review, are segmented into four categories: Data-driven decision-making, automation-centric industry-academia governance, productivity-oriented industry-academia governance, and proactive industry-academia governance aimed at fostering greater equality and reducing poverty.

The utilization of AI in policymaking presents governments with valuable prospects. For instance, AI enables governments to prioritize issues according to public preferences and formulate evidence-based policies. Moreover, it facilitates real-time policy assessment and feedback on their efficacy. Additionally, the integration of AI technologies in industry-academia governance promotes collaboration between stakeholders and policymakers, enhancing legitimacy. As indicated in the literature, AI can streamline policy decisions, resulting in greater efficiency, enhanced service delivery, and the generation of public value. Nevertheless, the implementation of AI policies in policymaking encounters a range of challenges that necessitate scrutiny. Key challenges encompass data management, ethical considerations, organizational structure, accountability, and ethical responsibilities. Addressing ethical concerns such as data privacy and equitable AI usage is crucial in industry-academia governance and policy development.

Table 1. Key strategies for industry-university cooperation in the development of AI technology in selected countries (alphabet base).

	Enhanced decision-making through data analytics	**Automation-driven industry-university cooperation**	**Productivity-focused industry-university partnership**	**Promoting equity and poverty alleviation through industry-university cooperation**
Brazil	• Focus on research and development of artificial intelligence technologies in industry and government • Promoting economic improvement and developing innovation based on artificial intelligence • Focus on criminal investigation and population security based on artificial intelligence • Development of AI-based telehealth platform in the covid-19 pandemic.	• Improving and empowering the workforce • Supporting the workforce to develop artificial intelligence technologies and automate production processes. • Using artificial intelligence to automate processes	• Defining a public policy to promote the adoption of artificial intelligence that can reduce inequalities in the field of technology in the country.	• Smartening of public services • Resource management optimization • Real-time evaluation of policies
Canada	• Development of training programs and workforce preparation in the field of artificial intelligence • Encourage research and development in the field of artificial intelligence and big data	• Development of capabilities of intelligent and automatic devices in different economic and social sectors	• Improving the level of education and training in the field of artificial intelligence and related technologies • Promoting research and development in the field of artificial intelligence and creating connections between universities, industry and government	• Creating legal and ethical frameworks for the use of artificial intelligence and protection of privacy and data security • Creating organizational and policy frameworks to facilitate and accelerate the process of developing and deploying artificial intelligence in Canada.

Table 1. (*Continued*).

	Enhanced decision-making through data analytics	Automation-driven industry-university cooperation	Productivity-focused industry-university partnership	Promoting equity and poverty alleviation through industry-university cooperation
United Kingdom	• Development of intelligent data centers that provide the possibility of collecting and analyzing various data and information. • Encouraging research and development in the field of artificial intelligence and big data • The use of artificial intelligence in public services in various fields	• Developing research and development strategies in the field of artificial intelligence • Improving the position of artificial intelligence in terms of strategy and institutional, • Artificial intelligence support for learning and sustainable development. • Developing legal and ethical standards and frameworks • Using solutions based on artificial intelligence and data, • Creating a facilitating political environment • Establishing and developing reliable artificial intelligence systems that include competition	• Increasing awareness and transformation in the vision of senior managers towards artificial intelligence and its applications • Creating specialized and targeted networks among different actors • International networking in the field of research and development • Providing artificial intelligence knowledge and skills at all levels of education and training skilled human resources • Education and skill enhancement of the working forces in the public and private sector for labor market developments • Financing and investment	• Development and strengthening of artificial intelligence financing ecosystem in priority areas. • Encouraging private and public sectors to invest in research and development of artificial intelligence. • Facilitating sharing and access to national data
Netherlands	• Promoting research and development in the field of artificial intelligence and big data • Policymaking in the area of privacy protection in the use of data and information	• Developing research and development strategies in the field of artificial intelligence in order to strengthen the position of the Netherlands in this field. • Improving the position of artificial intelligence strategically and institutionally with the aim of maximum use of artificial intelligence technology. • Artificial intelligence support for learning and sustainable development at different economic and social levels.	• Developing legal and ethical standards and frameworks for using solutions based on artificial intelligence and data. • Creating a facilitating policy environment for the establishment and development of reliable and competitive artificial intelligence systems.	• To use responsible and human-centered AI programs that are in line with European goals, in order to create beneficial social impacts of AI. • Development and use of artificial intelligence so that it is possible to exploit its economic and social benefits and keep pace with other leading countries.

Hence, nations must incorporate AI development policies into their overarching strategies to capitalize on the benefits AI offers in policymaking. These policies should address pertinent challenges and factors to maximize the advantages of AI in enhancing governmental performance and public services. Governments should have confidence in AI's ability to optimize operations and services. Many countries have already harnessed AI, some employing it in policy formulation. Iran should similarly

embrace AI across all facets of industry-academia governance, particularly within government institutions, to unlock unprecedented opportunities and narrow the technological gap with other nations. This objective is also articulated in Iran's strategic vision for AI development, aiming to position the country among the top 10 global leaders in AI by 2031, fostering economic prosperity and societal well-being. Therefore, comparative analyses of successful nations' experiences and developing countries sharing similarities with Iran can offer valuable insights for policymakers to leverage.

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