WEP Warwick Evans Publishing

International Journal of Social Sciences and Public Administration

ISSN: 3005-9836 (Print), ISSN: 3005-9585 (Online) | Volume 9, Number 3, Year 2025
DOI: https://doi.org/10.62051/ijsspa.v9n3.08
Journal homepage: https://ijsspa.org

Navigating AI in Central Asia: Legal Systems, Free Economic Zones, and Global Partnerships

Shumin Wang[1], Odenyazova Maysa[1,*], Saira Bashir Dar[2], Anwar Saeed[3],

Kseniia Novikova[1]

[1] School of Law, Dalian Maritime University, Dalian 116026, China
[2] School of Law, Bahria University, Islamabad 44000, Pakistan
[3] College of Artificial Intelligence, Dalian Maritime University, Dalian 116026, China
[*]Corresponding Author: Odenyazova Maysa

ABSTRACT

The study examines the integration of artificial intelligence (AI) and its regulatory frameworks in the context of Central Asian countries in Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan as these countries drive their economic and technological development. The main objectives of this study will be to analyze and compare normative acts, strategies of the inherent states and policy documents, to reveal how effective regulation and AI governance can facilitate the regional development, how governance systems of regulation can enable the AI to develop rapidly, and how regional zones of innovation will promote the economic growth and development of the infrastructure of countries of the region as well as the competitiveness of the technology. Another objective is to show that the sectors of innovations will promote AI startups, foster their development, and strengthen international connections to build innovation ecosystems. Drawing on China's expertise in AI governance system reveals opportunities where collaboration with the other parties could enliven the digital economy of the Central Asia region, create jobs and new opportunities in the health care and education sectors. This study illustrates how important adaptive regulatory frameworks are to facilitate AI and support economic development. It encourages the rapid adoption of targeted normative act for the AI systems and investment in AI education and training to address the lack of expertise so that the technological benefits are widely available. By analyzing the interplay between regulation, innovation zones, and international partnerships, this study provides valuable observations and policy recommendations to support decision-making on effective practices of regulatory strategies for the field of AI system to sustainable economic and technological growth.

KEYWORDS

Artificial Intelligence; Central Asia; Free Economic Zones; International Partnerships; China Legal Regulations; Sustainable Development.

1. INTRODUCTION

The exploration of artificial intelligence (AI) commenced in the mid-20th century. In the 30's of the 20th Century, Alan Turing predicted that it would not be long before machines would be capable of carrying out certain tasks. In 1950, he presented the "Turing Test." This test defined AI in terms of the ability of a machine to deceive a person into thinking that he was conversing with another human being. In 1956, it was John McCarthy who coined the phrase "artificial intelligence," which served as a stimulus for further research in the field [1]. Later he stated that a more appropriate term for the field would be "computational rationality" rather than "artificial intelligence" [2]. AI has been

subjected to ups and downs over the last decades due to the gap between expectations and reality. However, events like the victory of Deep Blue over the world chess champion in 1997 [3], and the superior performance of NLP models by M.S.W, which performed better than humans in text comprehension tests, show significant progress [4]. Since 2015, advancements in deep learning led by Yoshua Bengio, Yann LeCun, and Geoffrey Hinton have brought about a new "golden era" for AI. This development has propelled the advancement of anything from speech recognition to self-driving vehicles. In the last few years, the extraordinary growth and rapid advancement of artificial intelligence (AI) have changed the information technology (IT) space forever, providing vast new possibilities for innovation and efficiency [5]. AI is already widely used in a range of areas, including industrial manufacturing, network security, healthcare, transportation, robotics, energy and public services, due to extensive potential to dramatically enhance progress in society and human welfare. This widespread adoption of AI has greatly advanced social development delivering better health, better transport systems and better public services. However, the deep incorporation of AI's incorporation into IT systems has also raised major social, ethical and legal problems which must be tackled urgently through mitigation strategies [6]. Law and technology can be seen as two sides of the same coin, but law has set rules for the conduct of our lives for many years, while technologists has now set code as the means of governing the digital world. Hence it is Important to reflect upon the laws for the digital space and combine the two areas together which makes it very meaningful and important in the age of AI to make sure that citizens are protected, and businesses have opportunity to innovate [7]. Moreover, artificial intelligence is the key technology and important driver of economic performance in many areas of life, and in Central Asian countries it plays a very important role in the development of digital economy of these countries. In this context of growing digital transformations taking place in the region, particularly in the developing countries, the implementation of AI is very considerable importance to society for the attainment of sustainable economic development and improvement of competitiveness in different areas of life. Additionally, artificial intelligence is viewed as one of the major and transformative forces of the 21st century and this explains its incorporation into the national strategic objectives in the majority of countries of the world.

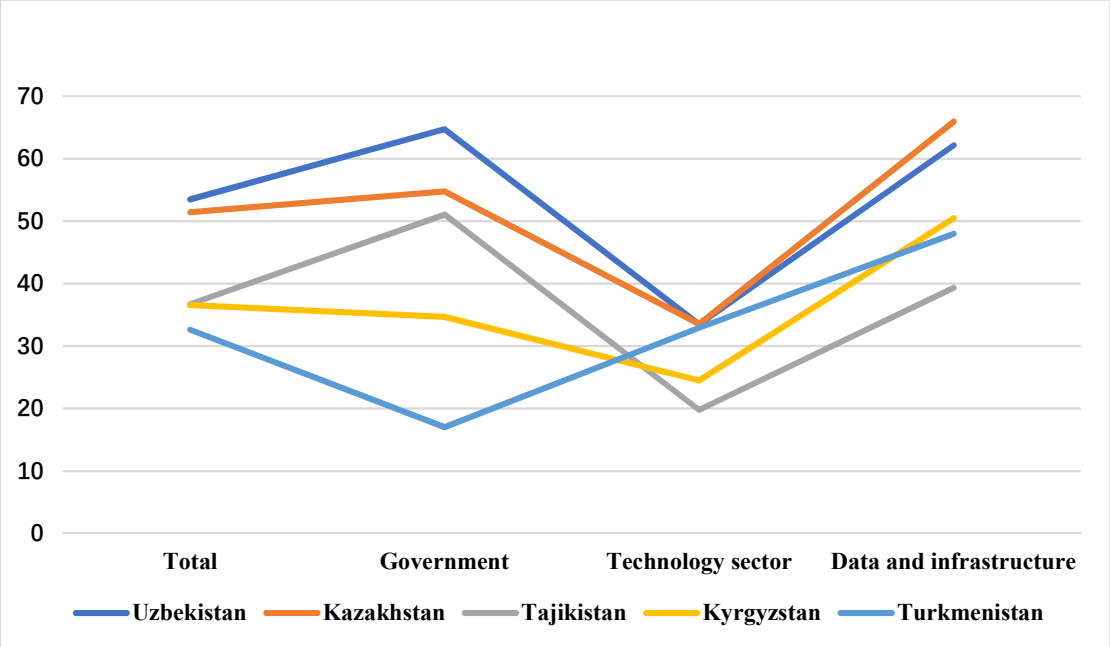

Figure 1. Government AI Readiness Index

Source: Sulamaan Rahim, 'Government AI Readiness Index' [2024] Oxford Insights [8]

As per Figure 1, the data indicates that there are significant differences AI readiness levels across the countries from Central Asia. In 2023 Kazakhstan held the first position in the region [9] but in the year 2024 Uzbekistan has emerged as the regional front-runner, Showing the greatest progress in AI strategic planning and implementation, while Kazakhstan continues to show rapid development in this field. Despite the great advantages AI has brought and still continues to bring to human lives and economies, the current legal systems in most of the Central Asia countries encounter a greater number of legal challenges compared to those in other regions. It is undeniable that the advancement of AI is significantly transforming human production and lifestyles, creating new opportunities for economic and social development, and new legal problems as well. These Security issues are a major concern for governments [10]. The Growth of AI has to do with large volumes of data. During the processes of data collection, application and analysis, there are risks of data security such as data leakages, personal privacy, etc. [11]. If the question of data security does not receive sufficient attention, then the growth of AI will be endangered. The above-mentioned questions relating to the application of the artificial intelligence technologies produce certain important questions.

(1) What are the existing legal compliances in Central Asia to regulate AI technologies and secure application or implementation?

(2) What initiatives are being taken for the application of AI and the development of the corresponding legal regimes in Central Asia?

(3) What are the existing legal regimes and what are the prominent legal and regulatory problems inhibiting the application and further growth of AI, and how are these difficulties being properly addressed?

The study presents a comprehensive evaluation of the effect of AI technologies on five of the developing countries in Central Asia, namely Turkmenistan, Uzbekistan, Kazakhstan, Tajikistan and Kyrgyzstan, which offers an overall evaluation of the difficulties and opportunities presented by such technologies. The research provides an in-depth examination of artificial intelligence (AI) technologies' impact on five developing nations in Central Asia: Turkmenistan, Uzbekistan, Kazakhstan, Tajikistan, and Kyrgyzstan- examining both the opportunities and challenges to the region. The examination begins by determining if the nations have implemented the reasonable legal frameworks to regulate AI use for the governance of specific actions, the identification of industries targeted by the AI framework, and the exploration of existing projects supporting industries where AI usage is regulated. The research also examines existing issues and risks related to issues raised around AI use, with prompt effective actions required to keep pace with technological advancement.

2. RESEARCH METHODOLOGY

This study provides a thorough examination of the legislative frameworks that govern the use of artificial intelligence (AI) and the implications for various dimensions of social and economic life through use of legal research methodology supported by an economic analysis of law framework. It specifically focuses on priority industries in diverse Central Asian countries, including industrial production, network security, healthcare, transport, robotics, energy, and public administration. This study selects five Central Asian countries-Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan-as they are the universally recognized core sovereign states of the Central Asian region in academic and geopolitical discourse.

Building off the legal instruments that public administrative organizations have implemented, regulated, and developed, the article includes relevant platforms in which AI technology is presently being implemented or is being considered for use in the near future. Various critical, analytical, and comparative approaches are employed to analyze the existing systems of legal and regulatory relations that are formative for existing and future uses of AI technology, resulting in an objective evaluation of the developing state of AI regulations and their uses in Central Asian countries and the

possibilities and future directions for AI regulation. This case-based methodology allows for a detailed analysis of how legislative frameworks are developing and adapting to the rapid advancements of AI technologies, as well as the challenges presented when utilizing these tools in social and economic sectors. Given the unique political, economic and social contexts of the Central Asian countries, it will be incumbent on leaders in these nations to develop coherent and deliberate strategies for the development and application of AI technology. The study is based on a critical analysis and evaluation of primary and secondary data. Primary data comprises national legislative Acts or other official state documents that govern the sphere of development and application of artificial intelligence.

This part will contain laws, regulations and strategic development policies that deal directly with processes involving AI applications in various forms in different fields. Kazakhstan has enacted various legislations and amendments relevant to the digital economy to foster the information technology sector. The country has established laws on copyright and related rights, personal data and its protection, artificial intelligence in business, and consumer rights protection, alongside many legislative amendments and additions to the domain of digital technologies. There are several legislative Acts regulating artificial intelligence in the Republic of Kazakhstan. In Kyrgyzstan, the "Digital Kyrgyzstan 2019–2023" concept supports the development of an open digital society. The "Digital Kyrgyzstan 2024–2028" concept further supports economic development and the use of AI for sustainable growth. The establishment of the National Council for the development of artificial intelligence in the country plays a vital role in shaping legal, ethical and technical standards in the field of artificial intelligence. The initiative to create a regional AI hub aimed at developing joint regulatory standards is a valuable step forward.

The Republic of Tajikistan has developed a strategy for the development of artificial intelligence, focused on improving legal, regulatory and ethical standards for the use of artificial intelligence across different fields of life; protecting personal identity information, developing an environment for effective scientific research and innovations in artificial intelligence and driving digital transformation of society and technology.

The Ministry of Development of the Digital Economy, the Ministry of Education and Science, and the Academy of Sciences of Turkmenistan propose to determine the format, organization and regulatory framework for the application of artificial intelligence (AI) technologies in the period 2019-2025. This aligns with the Resolution of the President of Turkmenistan "On the Concept of Development of the Digital Economy of Turkmenistan for 2019-2025", which mandates the creation of a legislative framework for the development and implementation of artificial intelligence technologies by bringing them into line with international standards and requirements for AI system security. The resolution specifies that this requires maximizing efforts to promote the widespread use of digital technologies to ensure sustainable economic growth, particularly in key economic sectors such as energy and education. The Republic of Uzbekistan has an undeniably robust legal and strategic foundation for the use of artificial intelligence (AI) technologies through the approval of the Strategy for the Development of Uzbekistan in the sphere of Digital Economy - "Digital Uzbekistan-2030" by the Cabinet of Ministers of the Republic of Uzbekistan, and with the approval of the President of the Republic of Uzbekistan on the introduction of a special regime for the use of artificial intelligence (AI) technologies.

Background information includes as secondary sources academic research, monographs and articles published by Chinese and international experts on artificial intelligence technologies and their applications. This enables an analysis of global and regional trends, as well as the extent to which Central Asian states have incorporated best international practices into their AI regulatory frameworks. Thus, this work offers a deep, comprehensive understanding of the current state of legislation to regulate AI technologies in Central Asia, and the future prospects for AI development in these countries.

3. LITERATURE REVIEW

The rapid development of artificial intelligence (AI) will undoubtedly leave its impression on the economic and technological course of Central Asian states. Amidst the global digitalization and competition in technology, AI has developed as a fundamental driver of modernization and economic resilience-which is particularly important for a region wanting to find its competitive specialty in the global technical structure. It is no surprise that scholars have increasingly highlighted the importance of moral and legal boundaries of AI, especially concerning sensitive sectors: public health, energy, communications, and public administration [12]. To illustrate, the interaction of IT experts with legal professionals can be analyzed: while IT experts prepare algorithms for effect and effectiveness, legal professionals will be focused primarily on ensuring these AI tools conform to recognized laws, which intends to decrease tensions between innovative technological practices (like AI) and acceptance or ethics of legal policies [13].

In the past 10 years, AI has embedded itself in the everyday life and human system, first through consumer-based technologies: smart cleaning devices, smart home appliances, and chatbots. Its evolution to more complicated areas, internet-connected robots and autonomous vehicles, is an identifiable form of becoming entrenched in essential components of modern systems [14]. Generative AI has advanced this evolution, enabling the production of original forms of art, music, film, and speech, changing paradigms with respect to how digital content is generated and consumed [15]. Progress leads to many complicated questions about who owns the content, ethics of use, authenticity, proper use, and intellectual property rights that can be complicated to answer.

As AI becomes integrated into healthcare, finance, education, and manufacturing, there is a pressing need for legal frameworks that address new, unique legal, social, and economic issues that require careful scrutiny and an increased level of regulation [16]. The growth of AI requires careful management of innovation boundaries, while collaborating to protect the human rights of individuals. Greenhouse notes that the success of AI implementation is linked to the presence of purposeful governance-a necessity to manage risk and issues such as bias, discrimination, algorithmic opacity, privacy violations, and social inequality [17]. This is particularly pertinent in Central Asia, where digitalization is occurring rapidly amidst regulatory gaps that may unknowingly lead to negative consequences. These issues became even more apparent in the post-pandemic world, where AI became a central focus of economic recovery strategies, and the prevalence of AI became evident [18]. The demand for AI after the COVID-19 pandemic-to increase productivity, improve forecasting, and influence economic changes-has accelerated the digitalization of modern production. For economies in Central Asia, this is a major opportunity to modernize industries and become parts of a global information-driven economy. The emergence of national strategies identifies this as a priority with regional economies reflecting this effort to develop national strategies to become regional digital economies supported by e-governance efforts, public digital services, and the development of democratic political models [19].

Still, many structural barriers exist at multiple levels. The digital divide between artificial intelligence users and non-users is one important dividing line, generating economic and distributional gaps. These gaps exist for a multitude of reasons: underdeveloped governance and regulatory frameworks (especially data protection), inadequate financial and technical infrastructure, high costs for internet access and connectivity, the shortage of skilled digital economists, and a lack of public trust in digital technologies, to name a few [20]. Notably, while existing literature addresses global AI regulation and Central Asian digital transformation separately, there is a lack of comparative analysis on AI-specific legislative frameworks across the five Central Asian states-this study fills this gap.

3.1. Promotion of AI Regulation: Legislative and Regulatory Foundations in Central Asia

Addressing the regulatory and ethical issues identified in the literature, such as insufficient data protection governance, the countries of Central Asia are responding by evolving their legal regimes. They aim to increase innovation, and to do this they will strengthen IT infrastructure and progress digital transformation within a range of economic and social sectors that focus on big data, AI, and intelligent systems. Kazakhstan is at the front of the Central Asian territory in AI and digital communication infrastructure development. Noteworthy efforts include Kazakhstan's plans to develop a supercomputer by 2025 to help process data for more than ninety infrastructure projects and applications within the Ministry of Digital Development, and the integration of the Ministry of Digital Development, Innovations and Aerospace Industry 2024-2029 [21]. This larger vision positions Kazakhstan as a regional leader for digital transformation, and it combines super computer data center capabilities with AI innovations related to weather, health care, public safety and industry [22]. In early 2025, the government introduced a draft law "On Artificial Intelligence" in the National Assembly to create the first AI-specific law [23]. This draft law builds on legislative structures that are discussed in Figure 2, including the Law on Informatics, the Law on Personal Data, the Law on Copyright and Related Rights, amendments to consumer protection law, and digital technology laws. By aligning with these legal structures, the draft law summarizes and builds on overlapping provisions, creating a coherent and consistent foundation that embraces theoretical underpinnings and effectively governs AI in society. The draft law is comprised of 28 articles, and establishes the foundation for a national AI legal framework in Kazakhstan. A major problem that remains unresolved under copyright law is whether or not works produced by AI violates the traditional notion of human authorship; this is something that will require reforms across many domains of law, and likely at the international level, to be able to think about an enforceable regulatory framework. In addition, to situate the importance of the draft law, it is worth noting that Kazakhstan's digital technology reforms in 2020, tied to changing societal patterns, heavily factored into the development of this draft law and consequent legislation to build legal structures to adaptively allow individual and institutional responses to the transformation of AI. As such, it is important to stress the importance of building legal foundations for a variety of countries rapidly adopting AI and strengthening their "core" legal infrastructure. Figure 2 captures these legal infrastructures, and highlights milestones in Kazakhstan's development of AI law.

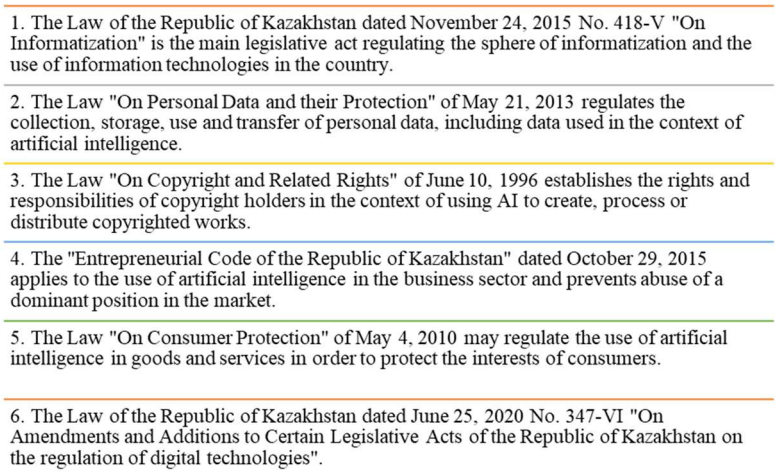

Figure 2. Key Legislative Acts Regulating Artificial Intelligence in the Republic of Kazakhstan

Source: D. Osmanova, S. Kapsalyamova, Y. Maratovna, Y. Baizhanov & D. Ryskaliev, 'Legal Challenges of Regulating Generative AI in Kazakhstan: A Comparative Assessment in Light of the EU Ai Act, [2025] Journal of Social Sciences and Humanities Open' [24].

Kyrgyzstan has similarly taken a strategic, phased approach to the adoption of AI and digital transformation, in order to establish itself a regional partner. The "Digital Kyrgyzstan 2019–2023" concept, an AI and Digital Transformation framework, was designed to improve governance and support an open digital society. The initiative used AI-based instruments to expand public service access and improve many administrative processes [25]. The next phase, "Digital Kyrgyzstan 2024-2028" [26], focused directly on the necessary integration of AI for public administration, emergency response, as well as in wider economic and political development. The objective was to increase efficiency and promote innovation in education [27] and healthcare [28] in particular. Moreover, the planned emergence of the National Council for the Development of Artificial Intelligence will co-ordinate approaches to bring Kyrgyzstan's AI environmen-legally, ethically, and technically- into conformity with international standards. By contrast, the Regional AI Hub [29] serves as a far-reaching initiative to build common knowledge, shared regulatory knowledge across Central Asia and develop cross-border innovation via a regional co-operative approach [30]. Kyrgyzstan's policy timeline from 2019-2025 epitomized in Figure 3 illustrates a regional partner's phased approach in responding to AI regulatory governance and cooperation process.

Figure 3. Policy Timeline for AI Development in Kyrgyzstan

Source: E. Xhixho, N. Pazylov, V. Savchenko, N. Patiev, & M. Pazylova, Digital transformation in the legal sector: challenges and opportunities for cybersecurity and data protection [2025] Journal of Law, State and Telecommunications Review [31]

Tajikistan is proving to be an important player in regional digital transformation efforts, particularly given Central Asia's growing focus on innovation generally, and more specifically on navigating regulatory challenges in artificial intelligence (AI) and information and communication technologies (ICT). The key element of this regional approach is the development of sustainable and secure ICT infrastructures to increase the efficiency of public administration, while fostering a new and supportive digital ecosystem for innovation. These overarching policy objectives appear significantly entrenched in one of the priorities set out in Tajikistan's “Development of Digital Economy” document that was adopted in December 2019, which highlights the significance of sustainable and

secure ICT systems for swift data transmission and processing [32]. It lays the groundwork for Tajikistan to "maximize the use of new technology and digital systems that can increase the efficacy of public administration and foster innovation and growth" [33]. A significant policy objective highlighted is the promotion of domestic software in institutions, which increases Tajikistan's digital sovereignty by lifting some of the country's reliance on foreign systems and software with dual-use implications [34]. Taken together, these outlined policy objectives laid out in the development of a digital economy will help create a necessary trajectory towards gradually implementing artificial intelligence systems throughout various public administrative and economic sectors, while first ensuring the safety and sustainability of its infrastructural systems.

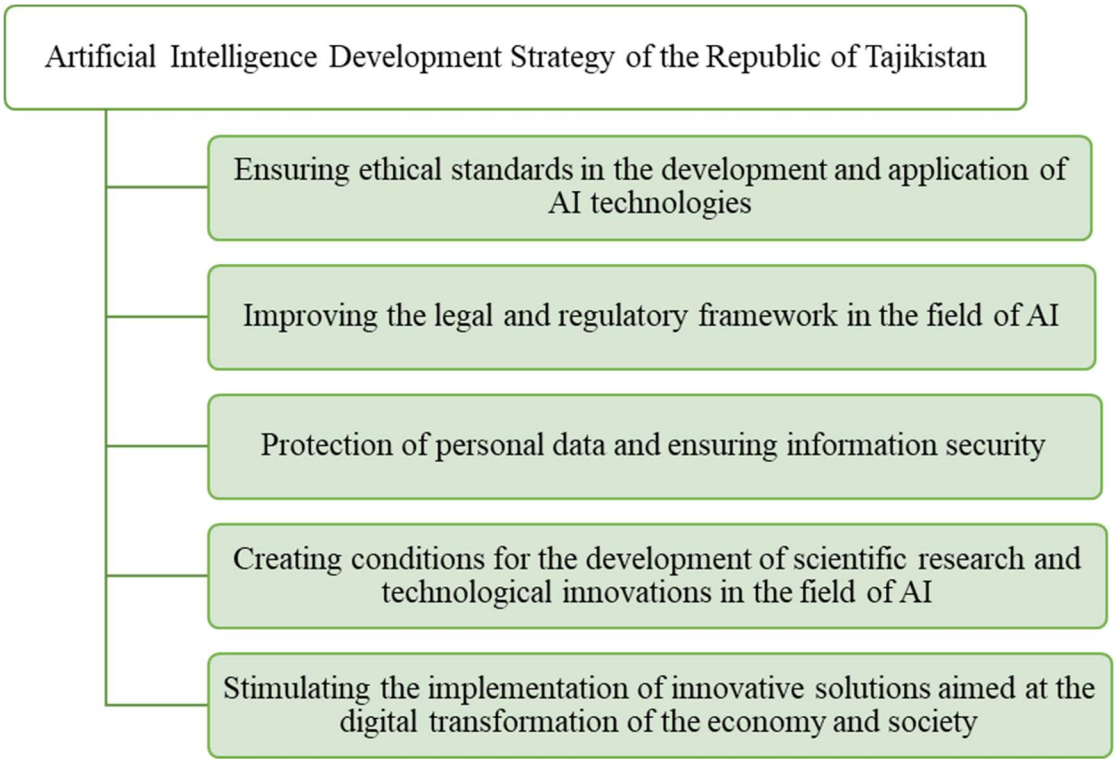

Figure 4. Key Components of Tajikistan's Artificial Intelligence Development Strategy

Source: Strategy for the development of artificial intelligence in the Republic of Tajikistan for the period up to 2040, [2022] Dig. Watch [35]

Tajikistan has incrementally built its governance of AI within this digital ecosystem through specific measures. On 30 September 2022, the Government of Tajikistan endorsed Resolution No. 483 - titled Artificial Intelligence Development Strategy until 2040 [36]. As shown in Figure 4, the strategy covers, among other objectives, the introduction of ethical principles concerning the development of AI, improvements in legal regulation, and the improvement of data protection in AI examples. It aims to create the right conditions for scientific research and innovation in technology while, more specifically, supporting the digitalization of Tajikistan economy and society (mostly in health care and public service delivery). As illustrated in Figure 4, these objectives demonstrate the commitment of the Tajikistan government to guaranteeing that AI is governed in an ethical and safe way. Tajikistan has pursued governance in AI at the international level. One of the more significant initiatives has been at the United Nations headquarters in New York, where Tajikistan presented a Resolution on Artificial Intelligence, which considered many aspects of developing and regulating AI [37]. The resolution advocates for horizontal self-regulation of AI in Central Asia to accelerate development of startups, calling for the establishment of a Regional Artificial Intelligence Center to combine

computing power for exchange of common data and data science projects, and to develop an all-in approach to self-regulation of AI. These are measures that attribute Tajikistan leadership in advancing regional interstate cooperation, aligning domestic regulations to international standards, and moving for innovating by navigating shared resources in the AI domain.

Building on regional trends, Turkmenistan is advancing a digital transformation agenda that will modernize its national economy and increase competitiveness. The Concept for the Development of the Digital Economy 2019-2025, ratified by a Presidential Decree dated 1 December 2018, primarily examines the current status of country information and communication systems while identifying objectives and implementation measures for digital transformations [38]. A key emphasis is on establishing legal foundations for the digital economy, modernizing management approaches, and optimizing economic processes [39]. In the framework of these documents, Turkmenistan is provided with a possibility of reaching economic growth by means of modern digital technologies according to the criteria of sustainable development by 2030, with particular emphasis on the energy sector and education. Additionally, Turkmenistan is formulating laws, rules, and provisions for the development and deployment of artificial intelligence (AI) technologies, tailored to its national context, global standards, and AI system safety requirements. It is considered that AI is viewed as a driver of socioeconomic progress, sustainable development, and improved quality of life for citizens. To engage in regional cooperation, Turkmenistan could also adopt Kyrgyzstan's proposal for a Regional AI Hub. This will permit to more thoroughly integrate AI policies in the framework of the digital economy, foster development and partnership. As illustrated in Figure 6, Turkmenistan's Concept for the Development of the Digital Economy 2019–2025 is implemented in three phases, thus giving fullness to the system of digitalization and integration of artificial intelligence.

2019	Developing a plan
	Infrastructure setup
2020–2023	Active promotion
	Bolstering the infrastructure
2024-2025	Finalization of implementation
	Evaluation and adjustment

Figure 5. Three Stages of Implementing Turkmenistan's Digital Economy Development Concept for 2019–2025

Source: S. Wang, et al., 'The Power of Digitalization, the Hainan Free Trade Port, and Regulations for Modern Economic Development in Turkmenistan Are Significant' [2024] Journal of Sustainability [40]

In a similar vein of advancing its regional leadership in AI, Uzbekistan has established a broad legal and strategic framework for the introduction and regulation of artificial intelligence (AI) technologies. As outlined in Figure 6, the first key step was the issuance of Presidential Decree No. UP-6079 on 5 October 2020, titled "On Measures to Introduce a Special Regime for the Use of Artificial Intelligence Technologies," which defined the fundamental regime in which these new technologies could be applied [41]. Moreover, the establishment of Presidential Resolution No. PP-4996 on 17 February 2021, entitled "On Measures to Create Conditions for the Accelerated Introduction of Artificial Intelligence Technologies" established a programme of AI development for 2021-2022, establishing core priorities around AI regulation, the establishment of supporting infrastructure and the integration of AI capacity into Uzbekistan's educational/academic system [42]. This was closely followed by

approval of Cabinet of Ministers Resolution No. 475 on 31 July 2021, the “Digital Uzbekistan - 2030 Strategy” [43] provided a more overarching framework for the overall economic digitalization of the country, including the expectations for AI to be implemented broadly. Finally, President Resolution No. PP-5234 on 26 August 2021, “On Measures to Introduce a Special Regime of Application of Artificial Intelligence Technologies" unified the previous resolutions and marked a commitment to building the required regulatory infrastructure to that will be necessary to enable and actualize a regulatory regime for AI and implemented [44]. These resolutions reflect a systematic attempt by Uzbekistan to consider AI development at the regulatory level, specifically to create regulatory certainty and enable innovation that utilizes a digital approach to its national development agenda [45]. Figure 6 sets out the multiple key strategic and regulatory acts demonstrate an overall response to formalize AI governmental governance in Uzbekistan.

Decree of the President of the Republic of Uzbekistan «On measures to introduce a special regime for the use of artificial intelligence technologies» No. UP-6079 dd. October 5, 2020;	Resolution of the President of the Republic of Uzbekistan «On measures to create conditions for the accelerated introduction of artificial intelligence technologies» No. PP-4996, dd. February 17, 2021;
	Resolution of the Cabinet of Ministers of the Republic of Uzbekistan «About approval of Strategy "Digital Uzbekistan-2030" and measures for its effective realization» No. 475 dd. July 31, 2021;
	Resolution of the President of the Republic of Uzbekistan «On measures to introduce a special regime of application of artificial intelligence technologies» No. PP-5234 dd. August 26, 2021;

Figure 6. Key Strategic and Regulatory Acts on the Development and Regulation of Artificial Intelligence Technologies in the Republic of Uzbekistan.

Source: U. Saitkamolov Mukhammadkhoja Sabirkhoja, K. Z., Markabaeva Jansaya Aybek, ‘ARTIFICIAL INTELLIGENCE AND ITS ROLE IN ACCELERATING DIGITAL TRANSFORMATION IN UZBEKISTAN’ [2024] *British Journal of Global Ecology and Sustainable Development* [46]

Central Asia’s countries adopt distinct approaches to artificial intelligence (AI) regulation, differing in institutional maturity and specific areas of legal focus-yet they share common strategic priorities [47]. Uzbekistan stands out for its most systematic and consistent framework, anchoring the development of AI in the level of presidential decrees, strategies, program documents also directed at creation of a special legal regime and digital infrastructure [48].

Kazakhstan strives to embed AI development within the broader context of a digital agenda, also developing a national concept of AI development, emphasizing international cooperation and development of human resources. In Kyrgyzstan, Tajikistan and Turkmenistan, the preliminary stage of forming a regulatory framework prevails, focused on digitalization through strategies and individual initiatives, without identifying AI as a distinct objective for legal regulation. Despite the active development of strategic documents and isolated elements of legal regulation, the Central Asia countries face several common legal gaps and difficulties in the field of AI. Firstly, most regional states lack a clear legal definition of artificial intelligence, which hinders its effective legal qualification and regulation. Secondly, data protection particularly in the context of AI technologies

processing large volumes of information remains a major challenge. Another key issue is the absence of unified regional AI regulatory standards, which prevents the harmonization of legal norms and the implementation of joint initiatives for data and technology. Additionally, copyright issues related to AI-generated artistic works remain unresolved, requiring the development of new legal mechanisms to protect intellectual property. Finally, strengthening technical standards for data security in AI use and adapting legal regulations to rapidly evolving technological conditions are becoming increasingly critical for the region [49].

3.2. Application of Artificial Intelligence in the Main Sectors

The rapid pace of applying artificial intelligence by countries in Central Asia, as highlighted in Chapter 3.1. regulatory framework shows that it is part of the region's efforts to implement advanced technologies in order to achieve socio-economic development. Building on their established legislative and strategic platforms, such as those in Uzbekistan [50] and Tajikistan, implementing artificial intelligence in certain sectors of the economy, such as healthcare, finance, law, public administration, which is aimed at increasing efficiency through innovations in these sectors. In this chapter an overview is provided of the various applications of artificial intelligence in Kyrgyzstan, Tajikistan, Uzbekistan, Kazakhstan, Turkmenistan, that align with the objectives of digital transformation in the region. The overview also addresses the scope for harmonized regulatory measures, as referenced in Figures 2–6 of Chapter 3.1. The application of technological developments in Kyrgyzstan is evident in the changes to the financial sector and in providing the security of citizens, through the use of artificial intelligence. This is reflected in the legislative development, overviewed be in Figure 3. As early as 2020, the National Bank of the Kyrgyz Republic allowed the use of remote technologies for the client's identification in banks, using artificial intelligence, machine learning and predictive algorithms to process users' biometric data [51]. Furthermore, an AI-based facial recognition system has been introduced in Bishkek, which allows the input of data on wanted people and automatic identification via a network of cameras, with subsequent delivery of these data to the law enforcement authorities [52]. These developments are evidence of the fact, that Kyrgyzstan focuses its efforts on the application of artificial intelligence in the provision of secure, rapid and efficient public services, in accordance with the concept of establishing a Regional AI Hub to achieve cross-border collaboration. Tajikistan is also seeking to apply artificial intelligence in the telecommunications field, which goes well with its strategic program of application of artificial intelligence until 2040 years, overviewed in Figure 4. While artificial intelligence is not widely applied in Tajikistan, the activities of the company MegaFon are notable. As early as 2019, MegaFon developed the Dono chatbot, a virtual assistant of daily contacts with approximately 14 thousand subscribers. This tool relieves employees from routine tasks, giving them time for dealing with more complicated issues [53]. The application of artificial intelligence contributes not only to the operational efficiency of the firm operations but supports and enhances the broader goal of digital sovereignty in Tajikistan, through the use of domestic technologies, strengthening the foundation for international engagement and self-governance in the field of artificial intelligence.

Uzbekistan, with an AI strategy developed and based on Figure 6, utilizes AI products across numerous economic sectors to advance the Digital Uzbekistan – 2030 Strategy [54]. The government takes steps to stimulate the production of AI products in the country [55], and a presidential decree has approved a program for the digitalization of economic and social sectors. The digitalization of government data in areas including justice, communications, finance, education and health care has been proclaimed an indispensable part of the country's development programs. The use of AI products, such as image recognition systems and navigation solutions, recently developed and widely used by large enterprises, and the government continues to create favorable conditions for the further application of this equipment [56]. Thus, efforts to implement AI-covered technologies are significant in Uzbekistan, as they shape the country's global leadership priorities in digitalization based on the

AI factors, defining the purpose of endowing everything with regulatory clarity with practical applications.

Similarly, in Kazakhstan, AI technologies are used to improve the judicial system and health care sector. Kazakhstan has an excellent legislative foundation, represented in Figure 2. It has been actively implemented in Kazakhstan judicial system. Over two years, AI technologies were used for analysis of both judicial affairs as well as predictions of their results. State authorities believe this approach will help reduce human error and enhance the quality of justice in society. In the health care sector, since 2022, the AI product Pneumo-Net has performed well thus providing detection of 17 dangerous lungs diseases, including pneumonia, tuberculosis, and cancer [57]. Namely these applications demonstrate the Kazakhstan's places as the regional leader in application of the AI technologies for the public good and welfare, finding with the development of the National AI Platform.

Turkmenistan also shows to great interest to the AI technologies. The use of digital technologies in the field of health care is considered as the priority, supported by the concept of Digital Economy Development presented in Figure 6. An example of AI-enabled technology adoption is the patient's digital twin technology developed by the firm named Hainu. This development was realized within 12 years of international research works, conducted in the USA, Canada, China and France. This development is already being used in 13 countries and was positively marked by the United Nations as one of the best innovations in the field of aging of healthy people [58]. The patient's digital twin analyzes the data from connected medical devices with the indicators, including genomic, metabolic, mental, environmental and sports data. The AI algorithm gives the possibility to make predictions of chronic diseases of such sorts as diabetes, hypertension, cardiovascular diseases and recommends patients' products for effecting measures of influence. In Turkmenistan, the implementation of this technology aligns with the country's emphasis on using digital tools to improve the quality of medical services and reduce errors. These problems align with Turkmenistan's broader goal of total digitalization of Turkmenistan and potential participations in the regional AI strategies.

3.2.1. AI as a Driver of Digital Development in Central Asia

Based on the legal and sectoral frameworks of artificial intelligence (AI) identified in Sections 3.1 and 3.2, Central Asian states are using AI to promote digital development and economic diversification. The collaboration between IT companies and the embedding of AI in these processes allows the relative shift from resource-based to technology-based economy in the region. This section describes technology parks, start-ups, IT education in the respective republics (Kyrgyzstan, Kazakhstan, Uzbekistan, Tajikistan and Turkmenistan). The early growth of the IT sector in Kyrgyzstan, stimulated by the existence of a democratic environment, creates additional possibilities for AI development. The High Technology Park (HTP), establish in 2011 unites about 200 companies (employing about 2,000 specialists) [59]. In 2022, IT services exports stood at USD 50 million, with a plan of doubling this amount in 2023 [60]. The tax incentives for HTP are disperse AI-based solutions and contribute to possible regional cooperative ventures like the Regional AI Hub. In Kazakhstan, the AI policy followed brings a social and positive focus towards digitally centred innovations. The Astana Hub has been creating since 2018, supporting start-ups with tax leeway and access to venture capital [61]. The creation of the National Innovation Fund (2003) and the legislation on the founding of venture funds (2004) have laid the foundation for this, between 2018 and 2022, these efforts generated 45% of investments from private sources [62]. As noted earlier (Section 3.2), these initiatives translate to AI applications in areas such as healthcare and justice. Rapid digitalization has allowed Uzbekistan to develop the local IT sector very quickly. The government-run IT Park launched in 2019, adopting more than 1200 companies (185 with foreign capital), through tax incentives and training, aligning with the so-called "Digital Uzbekistan–2030 Strategy" [63]. The latter engages in supporting AI in fields of justice and healthcare [64]. Tajikistan is attempting to develop its IT sector but still lags in this technological advancement. Since 2018, the State Business Incubator has operated in five towns (all over Tajikistan), supported by the UNDP. Additionally, a

state technology park in Dushanbe aims to attract global tech companies (UNDP, 2023) [65]. These efforts are related to AI applications, e.g. Dono chatbot or are to support with digital space sovereignty. Whereas in Turkmenistan, the state of technological advance is remained less significant, but is diligently improved [66]. Since 2020, the Startup Academy supported by the USAID has completed positive results by incubating 70 start-ups [67]. The educational aspect in IT is developing, but the state of support remains a discussion aspect, which will influence the adaptation of healthcare, including digital twins of patients.

3.2.2. AI in Educational Systems

In Central Asia, countries are introducing AI technologies to their education systems to solve problems with outdated curricula and teacher training, building on the AI and digital transformation criteria presented in Sections 3.1, 3.2, and 3.2. 1. AI can enhance the education system and increase the quality of education available, supporting the region's transition to technology-based economies. This section focuses on different ways AI affects personalized learning, language learning [68], sports education and student transitions, and problems relating to ethics and infrastructure. Education practices in Central Asia are improved through AI, especially through the expansion of personalized learning. Adaptive platforms enable customization of content for the context of each student and improve engagement and efficacy [69,70]. This coincides with the initiatives of Uzbekistan's IT Park educational programs, aimed primarily at enhancing the digital competence of the population. AI is also implicated in language learning and literacy, an important consideration in Central Asia's multilingual setting. Various AI tools can provide personalized feedback on different local and international languages, including English and Chinese [71]. This advances Tajikistan's stated objective of digital sovereignty as it pertains to expert use of technologies. AI is now also impacting sports education [72]. Hybrid machine learning approaches determine talent by investigating performance during training and competition and enhance the international competitiveness of Central Asia. This complements interest in generating innovation hubs in Kazakhstan as an added incentive for pursuing AI applications. Furthermore, AI can facilitate students' transitions from secondary schools to institutions of higher learning [73]. Through the development of digital literacy, it can better prepare students to meet university requirements, thus overcoming the shortage of technological exposure in institutions [74]. This dovetails with programs supporting IT sector growth in Kyrgyzstan. There are a several problems which arise with the introduction of AI into the educational sector. Teachers' lack of preparedness, students' varying technological literacy and access to required tools, and ethical issues (such as data protection and algorithmic bias) demand robust policies [75, 76]. The differences which exist in the digital infrastructure levels between urban and rural hinterland areas of Central Asia, also underline the necessity for reasonable access to facilities being made available.

3.2.3. AI in the Medical Sector

Central Asian nations are integrating AI to improve the healthcare delivery aligning with their educational and digital development goals. While the primary task of AI development is to increase the efficiency of carrying out the administrative tasks of health institutions, the use of AI to enhance medical diagnostic services and to increase access to healthcare services is already apparent, despite certain infrastructural and regulatory constraints. This section examines AI's contribution to healthcare provision in Central Asian countries, particularly innovations in Kazakhstan and regional initiatives. In Central Asia, AI development is most closely associated with the management of checking the flow of data and the patient journey through medical institutions. Regulatory restrictions (such as those governing local data storage) and inadequate infrastructure hinder more advanced AI development. Even so, regional governments support AI adoption through special governmental agencies, which include this focus within their broader digital transformation goals. Kazakhstan has already achieved good results from advanced applications of AI [77]. The Cerebra project to provide a system of AI based diagnosis of (cerebra) stroke resulting in an early diagnosis for patients developed in 2018 was subsequently (2022) recognized and rewarded as the best startup project of

Asia by Johnson & Johnson for its work in the most critical area of healthcare, having already raised $1.3m from local and Singaporean clients [78]. This corresponds to the trend revealed in Section 3.2 about the use of AI for healthcare purposes in Kazakhstan. Other countries are also showing signs of progress with an interest in that direction. In Tajikistan, the rollout of the Doc-Med system for online medical appointment scheduling reflects the initial stages of healthcare digitalization. Turkmenistan is collaborating with various companies to enable the improvement of medical infrastructures through the imposition of so-called digital twins of patients [79]. This indicates that the countries of the region are becoming increasingly more committed to improving healthcare delivery through AI.

3.2.4. AI in Banking and Financial Services

Central Asian nations systematically integrate AI in banking and other financial services to improve efficiency and accessibility [80]. AI helps with credit assessments, customer support and security of transactions, in support of the region's digital economy. This section studies the role of AI in Uzbekistan, Kazakhstan and Tajikistan, with reference to the state of fintech in the region. In Uzbekistan, AI is used to maximize the efficiency of financial services. AI is employed to automate evaluations concerning creditworthiness, with savings of time in respect of the processing of loans, and develop chatbot technology for customer applications, with complicated issues being referred to human specialists. Biometric identification is employed for the security of online transactions [81]. Uz Card Ventures finances AI-driven financial solutions, aiding growth in the digital infrastructure. In Kazakhstan, the fintech sector is developed with the use of AI [82] S1lkPay, which specializes in mobile banking and financial technology relating to payments, was credited with US$7.3 million during 2021-2022, with development to Dubai, and plans for entry to Sudan [83]. This aligns with Kazakhstan’s innovation centers (referenced in Section 3.2.1), which continue to position the country as a regional leader in fintech. The fintech sector of Tajikistan has considerable potential, epitomized in the case of Zypl.ai. This is an AI-driven start-up which augments access that disadvantaged segments of the population have to finance, and which has attracted $1.1 million in investment from local investors, and international investors including Aloqa Ventures from Uzbekistan and TumarVC representing Kazakhstan [84]. This fits within Tajikistan's digitalization initiatives, such as the Doc-Med platform.

3.3. Risks and Challenges of AI in Central Asia

As further explored in earlier discussions of the developments in AI (3.1 and 3.2 and their subsections), Central Asian states encounter serious legal, ethical, and infrastructural challenges in their implementation of AI necessitating adequate confluence of regulatory principles and coordinated advancement. These challenges jeopardize the sustainability of promise AI has generated and utility in health, banking, and education. This section provides examinations of these critical challenges and the need for regional answers. Prolonged ambiguities around legal accounts may compromise effective work of AI. Indeterminate liability for AI errors, unresolved legal functional status of AI systems, and unstructured certification entail barriers to effective implementation, as exemplified in finance and medical treatment, wherein safety and security of data are paramount. For instance, restrictions for banks in Uzbekistan on local data storage create friction against globalizing cloud models. Moreover, challenges are further complicated by infrastructural inadequacies in a technical sense. The shortage of computing is coupled with gaps in digital infrastructural capacity (with outright gaps in parts of Central Asia) render ability of allowing AI to integrate fully, contributing to early subsistence on foreign technology [85]. In Kazakhstan, intimations of skill shortages and job displacement as biological responses to financial technology require investing time for the workforce to upscale to responsibly operate AI systems. Ethical challenges exist as well [86]. Weak standards allow AI systems to become loose on exquisite details, or whimsically discriminatory in data, drown central to social inequality particularly in education and health [87]. In global view of these challenges, the need for a balanced AI-regulatory policy and significant investment is underscored. The collective cooperation of all republics within a regional establishment– as Tajikistan’s proposed establishment

of a Regional AI Center would facilitate to resolve collective challenges of legal, regulatory and ethical approaches to overcome barriers, thereby imploring sustainable transitions of AI systems in the Central Asian region.

4. DISCUSSION AND ANALYSIS

Building on the possibilities and difficulties of AI discussed above in Sections 3.1-3.3, the experience of adoption of AI in Central Asia reveals both commonalities on regional issues and country-specific progress. Although successes are apparent in certain sectors, there is also significant gaps persisting in readiness, infrastructure and regulation that, again, needs not only regional coordination but global engagement for long-term sustainability. This chapter synthesizes the adoption of AI, structural challenges and implications of the Chinese model for sustainable development. The adaptation of AI in Central Asia is nascent, with Uzbekistan and Kazakhstan somewhat advancing along institutional readiness, whilst Turkmenistan and Kyrgyzstan lagging, in terms of infrastructure and governance. As noted in Section 3.3 identified gaps underscores a greater need for coordinating polices to enhance AI application. AI in, and across, healthcare is largely viewed predominately as use as administrative because of data localization and infrastructure constraints as further highlighted in Section 3.2.3. Certain innovations, however, have emerged through public-private partnerships: Kazakhstan's Cerebra project (which integrates climate-conscious biotechnologies) and Tajikistan's telemedicine solution Doc-Med are key examples. The financial areas exhibit greater dynamism. Uzbekistan benefits from AI in its credit scoring and biometric solutions projects assisted by Uz-Card Ventures, whereas the development of S1lkPay in Kazakhstan indicates strong fintech infrastructures. The Tajik startup Zypl.ai, encourages diaspora driven innovation with the support of regional investors as described in Section 3.2.4. Structural constraints, however, such as weak governance of data, lack of infrastructure and regulatory voids persist. In Turkmenistan, digital development progresses gradually, where the state must accelerate growth in these areas to cope with innovation governance needs. As outlined in Section 3.3, these challenges need a set of policies interventions that will catalyze growth in the innovation sector. China's Centralized governmental model for AI strategy presents a natural model to encourage development in Central Asia. China's rapid AI growth fueled by robust state investment and academic collaboration, and its 2017-2030 AI development plan, serves as an inspiration to Central Asian nations. The countries in Central Asia especially need to employ this model to align with the unique demands of their cooperative economies and ensure alignment with global information standards. A key question emerges: should they cooperate with China to integrate AI into regional integration in free economic areas and centers for technology. Hints of this potential are visible in foreign interest in the models of integrated AI projects in Kyrgyzstan (High Technologies Park) and lessons from China's rapid technological development. The inconsistency of their application, however, reveals widely varying rates of regulatory and ethical progress, highlighting the need for more inclusive policies to ensure AI benefits are equitably distributed across all areas of society.

4.1. China's Influence on AI Policy and Development

China's leading position in AI technology, characterized by its state-driven, comprehensive approach to innovation, regulation, and capacity-building represents an opportunity for the sustainable development of AI in Central Asia. China has emerged as a world leader in AI technology, applying it across different sectors including the legal system, with extensive research and development investment [88]. In essence, China's leadership provides an opportunity for developing economies, which includes Central Asia, to increase the use of AI in terms of modernizing legal systems and improving administrative efficiency [89]. China's laws shape AI policy. The Next Generation Artificial Intelligence Development Plan (2017–2030) sets out priorities regarding legal standards in ethics, security and regulation, that may provide a beneficial target for developing countries such as

Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan [90]. Laws and regulations are the vehicle for change to effect the changes needed in modernizing regulations. China's practical application of AI in its legal system (e.g., automated document processing, delivery, and decision-support systems) can inspire Central Asian nations working to digitize their public administration systems and improve efficiency. These measures complement the regional objective to increase public administrative efficiency and improve governance.

Globally, the AI industry was valued at $707.8 Billion U.S.D in the year 2023, with an annual increase of 19.3% in the year of 2024 [91]. This growth clearly highlights the transformational potential of AI, which is important for economic and social development in Central Asia. The development of AI in China is divided into four stages, namely embryonic exploration, expert systems, machine learning and large language models. The development in machine learning through neural network technology allows for processes such as image recognition, speech processing and natural language recognition, which are critical for the planned use of AI in public administration in Central Asia.

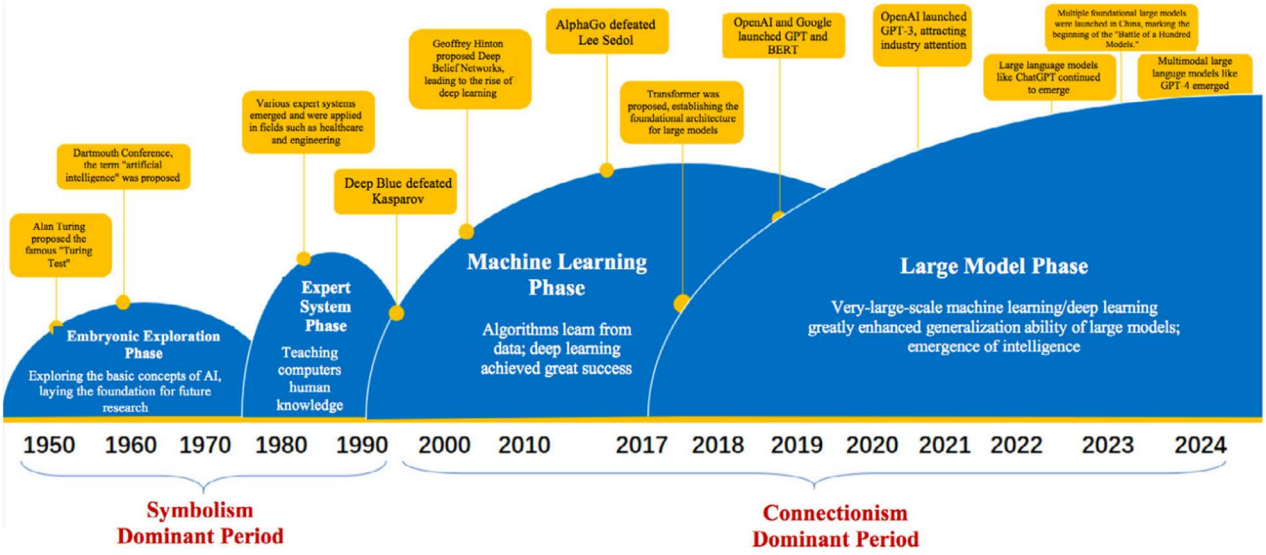

Figure 7. Phases of AI Development in China: From Embryonic Exploration to Large-Scale Models

Source: CIIS Report, 'China-ASEAN cooperation on AI development and governance: Observations on progress and suggestions for advancement'[2024] [92]

China's integrated model for developing AI, balancing technological innovation, legal modernization and institutional capacity building, is a model for Central Asia to emerge with deep capacity of its own to support its AI ecosystem. Partnerships may assist Central Asia to leverage the expertise from China to facilitate its plans for its ecosystem to grow sustainably [93].

4.2. International Partnerships and AI in Free Economic Zones

Following the previous discussions about advancements, challenges in AI and partnerships, Central Asia free economic zones (FEZ) have turned into platforms for attracting investments, technology development and facilitating AI innovations arising from international cooperation, especially technical cooperation with China. These zones also reflect Central Asia's striving to strengthen its position in the world economy. In the Republic of Kazakhstan, there are fourteen special economic zones (SEZ) each one of which is aimed at developing certain branches of the economy and attracting foreign investments, including in the field of artificial intelligence (AI) [94]. The most remarkable of

them is the Astana Hub - the international techno park of the IT startups, and the Astana International Financial Centre (AIFC) which serves as the center for finance and technology. Other significant zones are: “Astana - New City”, “Park of Innovative Technologies” and “Seaport Aktau” that reflect the diversified economic strategy of Kazakhstan [95], which encompasses digital technologies, innovations, petrochemistry, and maritime logistics (see Figure 8). All the SEZs have similar features: tax privileges, customs concessions, and infrastructure assistance. The key difference among them is sectoral specialization on a sectoral basis [96]. An important aspect of international cooperation in these zones is developing partnership of Kazakhstan with China, with the goal of technology transfer in AI, synergies in the IT-sphere, and joint generation of digital ecosystems, that reflect strategy of Kazakhstan for securing its economic position within the Eurasian integration scheme.

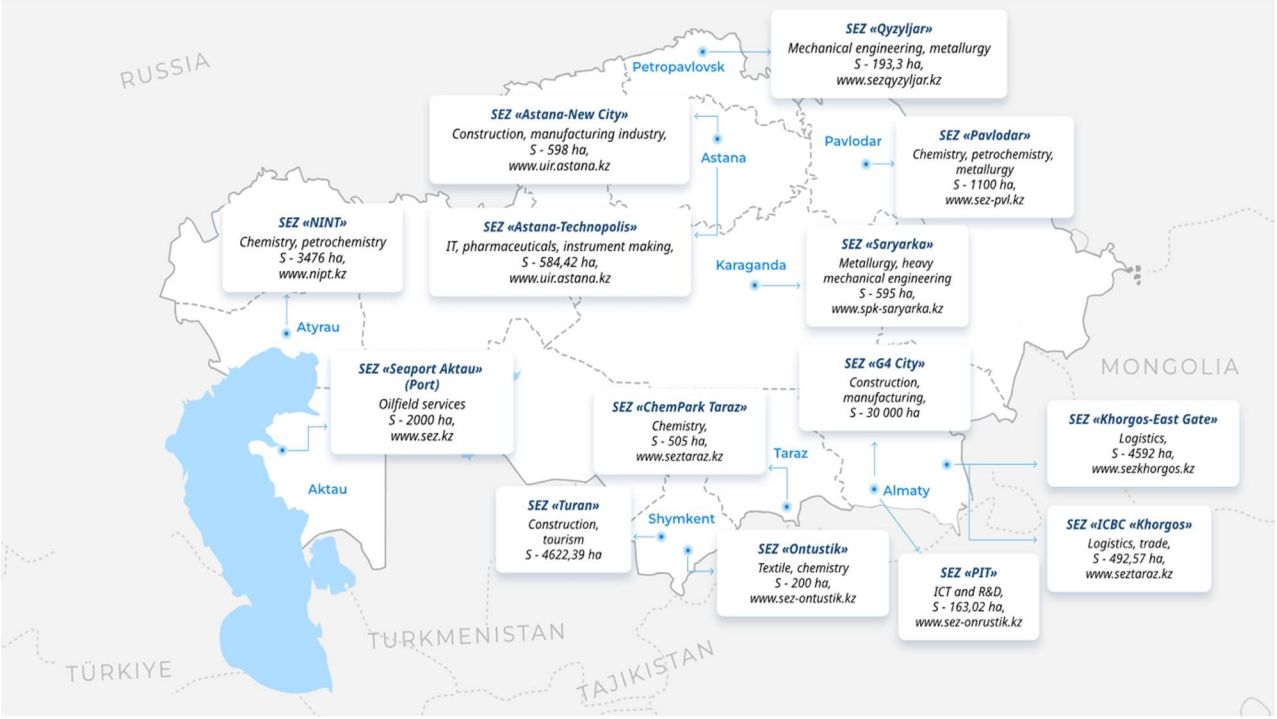

Figure 8. The Special Economic Zones functioning in the territory of the Republic of Kazakhstan represent a state-driven mechanism aimed at fostering investment, technological development, and international cooperation.

Source: H. U. Sherzodjonovich, ‘ANALYSIS OF FREE ECONOMIC ZONES IN UZBEKISTAN’ Economics and Innovative Technologies [2024] [97]

Uzbekistan boasts extensive zone infrastructure [98]: 20 SEZs, 116 Small Industrial Zones (SIZs), 12 tech parks, and 440 industrial clusters-all designed to attract investment, drive technological innovation, and enable international collaboration (see Figure 9). Among the SIZs, Cyber Park and IT Park are priority platforms around AI and high-tech. Tech parks focus on digital transformation, research and innovation, particularly related to AI [99]. While SEZs in Uzbekistan pay attention to industrial production and infrastructure development, the techno parks like Cyber Park and IT Park offer tax reliefs for investors, simplified administrative rules and support measures for domestic and foreign companies [100]. Uzbekistan’s strategy for globally integrating technology relies on international collaborations, including developing and partnering with Chinese technology firms to contribute to digital innovation development [101].

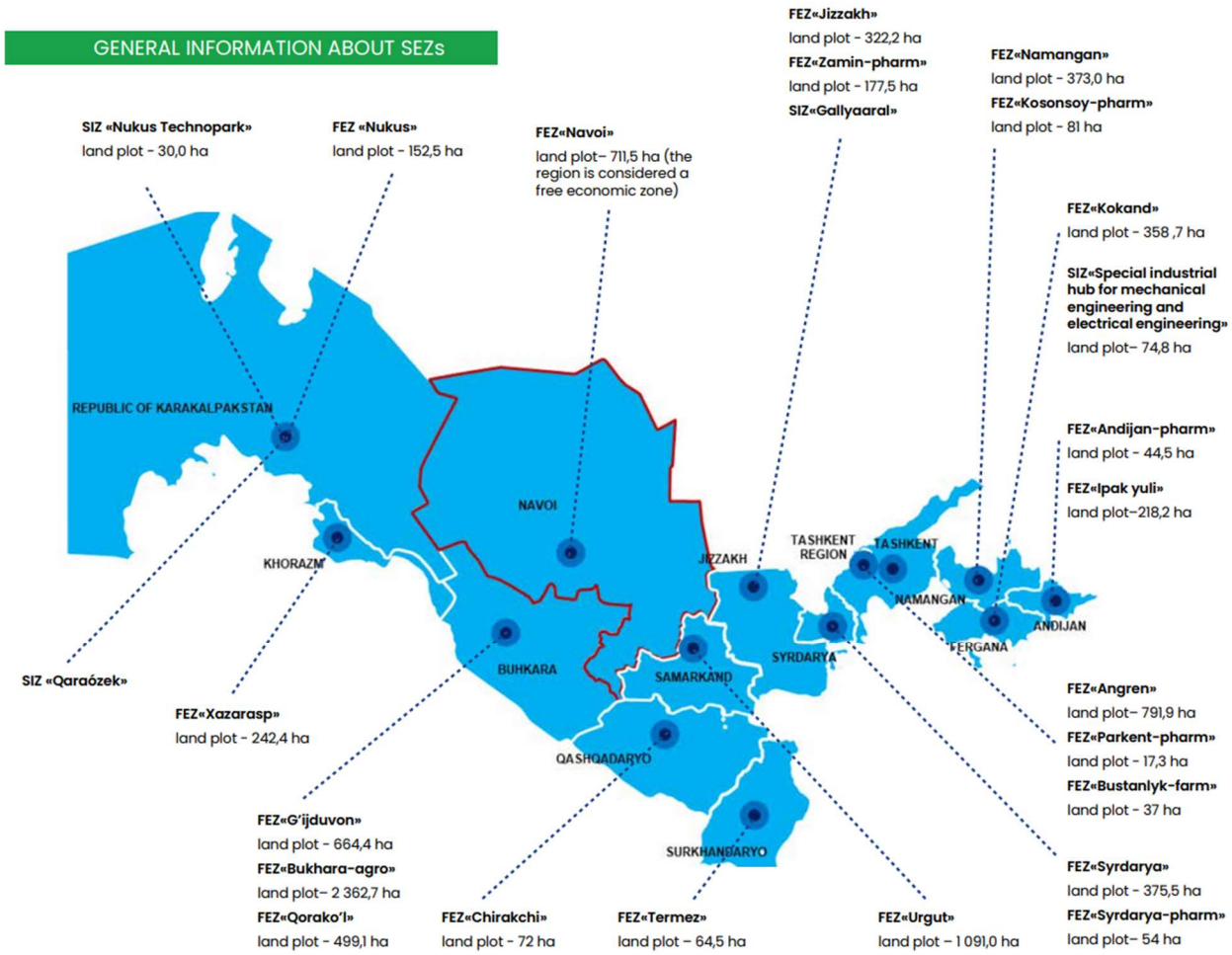

Figure 9. Special Economic Zones (SEZs) in Uzbekistan.

Source: Y. J. Ahn, Z. Juraev & J. Y. Gu, 'Analyzing Free Economic Zones in Uzbekistan for Sustainable Growth' The Indonesian Journal of Geography' [2024] The Indonesian Journal of Geography [102]

Kyrgyzstan's free economic zones (FEZ) infrastructure consists of five officially established zones. Presently, FEZ Bishkek is the only operational industrial-oriented zone that is aimed to prepare a productive platform with market access to the Eurasian Economic Union (EUE) [103]. For example, the High Technology Park (HTP), a part of FEZ framework, provides a special tax-privileged environment for IT companies and high-tech exporters, where commercial organizations receive considerable tax breaks if they obtain at least 80% of the revenue from export activities. While FEZ Bishkek is mainly focused on traditional industries, HTP supports the development of digital technologies, including artificial intelligence. Both platforms facilitate the development of international cooperation, especially with foreign investors and technological partner organizations, with Chinese companies accounting for a growing share. This cooperation is essential for the formation of growing innovation ecosystem of Kyrgyzstan in the region [104].

In Turkmenistan and Tajikistan, existing economic zones focus on traditional sectors such as agro-industrial processing, petrochemical industries, tourism and construction, while offering opportunities to introduce AI technologies in areas like management or energy efficiency improvement [105]. This does not rule out the possibility of incorporating ICT or AI as auxiliary tools involving the improvement of the processes. Although the emphasis in these zones is still on more

traditional sectors of the economy, the inclusion of digital technologies and AI could be an important area of their future development.

Overall, the countries of Central Asia, including Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan and Turkmenistan, are increasingly involved in the introduction of digital technologies and in the formation of cooperation with partners from abroad, in particular from China. China is being active both as an investor and a technological partner, which allows these countries to tap into cross-border investments in high-tech industries. Cooperation with Hainan Free Trade Port, and China's larger role in the economic development of Central Asia, enables collaborative economic advancement and technical development[106]. This will enhance the technological and economic development of the Central Asian countries but on the flip, side will also strengthen the entire technological web of the wider region, which will lead to a stronger regional integration and better cross-border investment in high technology industries.

4.3. Study Outcome

The results from the research indicate that China's approach towards AI development can be considered a timely reference point for Central Asian countries seeking to build their own technology-driven economic ecosystems. Countries such as Kazakhstan, Uzbekistan, Kyrgyzstan, Tajikistan and Turkmenistan can learn from China as a holistic model of AI policy, innovation and capacity building, adapting it to support sustainable development of free economic zones (FEZs) and special economic zones (SEZs). Examples of the approach include Kazakhstan’s Astana Hub, Uzbekistan’s Cyber Park and IT Park, and accompanying tax incentives and partnerships with Chinese companies, which demonstrate that China’s expertise in digital transformation may stimulate activities around innovative solutions in AI [107]. Kyrgyzstan’s High Technology Park, which is export-oriented in goods from IT, looks to China in respect of technological collaboration, while Turkmenistan and Tajikistan, whose economic zones are oriented to traditional sectors such as agro-industrial processing, might consider China’s applications in AI addressed to questions of management and energy efficiency. The Next Generation Artificial Intelligence Development Plan of China (2017–2030) may benefit Central Asian countries as a suitable model of what they could adapt to when looking at questions of ethical standards, data security and legal frameworks related to AI. The extent to which Central Asian business organizations, such as Kazakhstan’s Cerebra, Tajikistan’s Zypl.ai and the proposed Regional AI Center, look to make active partnerships with the Hainan Free Trade Port may help not only in relation to a capital and innovative products inflow but also in respect of the long-term development of the digital economy in the region, making use of China’s so extensive experience. The growth of the global AI industry to USD 707.8 billion in 2023 evidence that adoption-amplified by the experience and growth in China-could imply real economic and social gain for Central Asia [108]. Key challenges remain, however, most notably unequal adoption of AI across the region. Central Asian countries would benefit from targeted inclusive policies inspired by the examples of Chinese national ones to a large extent. In the future, research should focus on how Central Asia can learn from China in AI and adapt it to local conditions always with an eye toward providing ethical and inclusionary development.

5. CONCLUSION AND FUTURE DIRECTIONS OF RESEARCH

Drawing on analyses of AI governance, implementations, and other international partnerships, the deployment of AI technologies in critical sectors of Central Asia is currently limited but likely to bring about transformative economic benefits in key sectors, including healthcare, banking, education, and infrastructure. While countries such as Uzbekistan and Kazakhstan have made significant progress, barriers-including insufficient hard and soft infrastructure, gaps in the regulatory environment, and a slow pace of technology adoption-inhibit the realization of AI solutions. For instance, in healthcare, AI technologies have a primary application in administrative matters, with

hardly any application in more complex settings of diagnostics or clinical advice due to outdated laws that have failed to keep pace with the evolution of technology. Similar barriers in education and banking hamper their operational efficiency while illustrating the need to reform regulatory policies and invest in hard infrastructure. The success of China in rolling out AI technologies in the healthcare and financial sectors may provide an important point of reference for Central Asian countries as they overcome these barriers. China's success is rooted in strong government support for the regulatory framework and infrastructure development to allow for innovation. Therefore, it could be politically prudent for Central Asia to consider launching a major reform of regulatory policies and infrastructure investments in the area of AI, while drawing lessons from other regional nations attempting to grow AI-enabled ecosystems in similar ways. International cooperation with countries such as China on this front may help solidify these systems of support and, in principle, these frameworks would be premised on the adoption of an approach that unfolds support for technological and economic growth . These barriers are multi-dimensional, challenging, and sometimes intractable. In conclusion, there is a path forward for Central Asia. By investing in education, infrastructure, and regulatory reforms, Central Asian countries will be able to benefit from the expansionist wave of AI technologies, leading to economic development and improvements to public services and standards of living. Despite hurdles still to overcoming learning barriers to final adoption of AI technology, the potential for transformational effects in Central Asia remains great. Thus, through coordinated reforms both at the political and economic levels inspired by global models and best practices, (as well as regionally inspired trademarks and advances) it is argued that the region can overcome its technological gaps and induce a strong measure of sustained progress.

5.1. Recommendations

The following recommendations for overcoming barriers and promoting integration of AI technologies are suggested in light of conclusions about the leadership of China in the AI sector and the study of Central Asian free economic zones (FEZs). First, it is necessary first to fill in the legal vacuum in Central Asia. Countries of the region should create adaptive frameworks aligned with international standards, using China’s AI governance strategies as a foundational model while tailoring provisions to the region’s specific needs, particularly in data protection and ethical control. Second, measures should be taken to attract and develop highly skilled personnel in Central Asian countries. A critical step is to commit a portion of the budget of the state of AI education and training initiatives. The establishment of interdisciplinary training initiatives in these fields would have a direct impact of building a region's AI technical capacity. Governments should also place a priority on building innovative ecosystems through the expansion of free economic zones and public-private partnerships - these actions will enhance the level of entrepreneurship involved in the development of AI technology, and they will attract foreign investment in technology. To promote mutual progress in this innovative avenue and the reduction of technological and knowledge gaps, the countries in Central Asia need to build regional cooperation in knowledge exchange with global leaders in AI and establish relationships for mutual benefit for building a basis for a digital economy. All these activities aim to render Central Asia a competitive player in the global AI development landscape with the aim towards sustainable economic and technological progress in Central Asian countries.

5.2. Future Directions of Study

Based on research on AI policy, applications, and fostering international cooperation, the uptake of AI technology by the Central Asian states presents opportunities as well as challenges and requires further research. The question of how to close the gap between technological innovation and territorial disadvantage is an area that future research should orient around the effective inclusion of AI into high-impact sectors such as health, transport, education, and social services. The saliency of this potential can be seen in the region's prior work on AI. With persistent hurdles around outdated legislation and inadequate infrastructures, future research should focus on the development of

sustainable legislative policy and technical standards fit for all parts of Central Asia, for example, data security and ethical governance. Comparing research work with countries like China that have extensive AI integration into key resource producing sectors may yield findings that help provide the necessary direction for potential restrictive policy and innovation policy. Effective research should investigate existing AI policies to understand data collection and privacy - as well as technical requirements in Central Asia. Important areas of inquiry would be how developing economies like those in Central Asia might balancing technically robust data sovereignty through locally managed systems with the global digital environment. Furthermore, a scoping of the socio-economic impact of AI use, particularly as it pertains to changes in the labor market and need to understand job displacement and creation in developing economies will need to be conducted. Research within these frameworks will help formulate a research agenda that will provide the structure to be more effectively positioned toward understanding AI integration in Central Asia that will also help the region remain competitive in the fast-changing global context.

5.3. Limitation of This Investigation

In terms of the overall scope of this study, I would like to acknowledge several limits when considering the recommendations of the study concerning AI integration in Central Asia. Whereas software technologies make rapid advances in Central Asian countries, it is also true that legislative development has lagged behind. This means that the study's analysis was limited to the normative acts, government strategy, and policies that were available and we do not yet know which future normative developments or informal practices of implementation might relate to the accuracy of the meanings of some norms. Moreover, limited, practical access to English language comprehensive legal databases in some Central Asian countries makes it particularly challenging to engage in direct analysis of the primary material or documents. Consequently, the derived study relies, to some degree, on available translations and secondary research, including language translations from regulatory authorities, which affect the assessment of the accuracy of legal interpretations.

In addition, and given the early but developing state of regulation or governance of AI technologies in the region, this study sourced information from a variety of sources, including government reports, strategic documents, and publications provided by institutions such as semi-government organizations. Although peer reviewed academic research into the governance of AI and depth of literature related to AI governance in the form of academic literature is less prevalent than other disciplines, these sources will still provide a timely and contextually relevant bedrock to engage in developing a study of limited empirical complexity and acknowledge that much more research is required that could drive a wider cohort of research as well. The study is limited by monitoring the development of AI at the regional level and offers initial insights into the regulatory landscape of AI in Central Asia and guiding future research to address these methodological limitations.

CONFLICTS OF INTEREST

The authors declare that this research was conducted in the absence of any financial or personal conflicts of interest that could have influenced the results or interpretation of the data.

ACKNOWLEDGEMENTS

Funded by the Ministry of Education of the People’s Republic of China on Major Research Projects in Philosophy and Social Science, Research on Accelerating the Construction of a Free Trade Port (23JZD027). Funded by The Major Humanities and Social Sciences Cultivation Project of the Basic Scientific Research Services fund in Central Universities, (3132024719).

REFERENCES

[1] J. McCarthy, what is Artificial Intelligence? Stanford University Press, (2007) 3-15, https://www-formal.stanford.edu/jmc/whatisai.pdf.

[2] P. Norvig, & S. Russell, Artificial Intelligence: A modern approach, fourth ed., Pearson, United Kingdom, 2022, https://api.pageplace.de/preview/DT0400.9781292401171_A41586057/preview-9781292401171_A41586057.pdf

[3] M. Campbell, A. J. Hoane Jr., & F. H. Hsu, Deep blue, Artificial Intelligence. 134 (2002) 57-83, https://doi.org/10.1016/S0004-3702(01)00129-1.

[4] T. R., Shultz, J.M., Wise, & A. S. Nobandegani, 2025. Text understanding in GPT-4 versus humans. Royal Society Open Science. 12, 241313.

[5] H. Allioui, & Y. Mourdi, Unleashing the potential of AI: Investigating cutting-edge technologies that are transforming businesses, International Journal of Computer Engineering and Data Science. 3 (2023) 1-12, https://ijceds.com/ijceds/article/view/59/25

[6] S. Du, & C. Xie, Paradoxes of artificial intelligence in consumer markets: Ethical challenges and opportunities, Journal of Business Research. 129 (2021) 961-974, http:// https://doi.org/10.1016/j.jbusres.2020.08.024.

[7] P. De Filippi, & S. Hassan, Blockchain technology as a regulatory technology: From Code is Law to Law is Code, University of Illinois at Chicago Library. (2018). https://doi.org/10.48550/arXiv.1801.02507.

[8] S.Rahim, Government AI Readiness Index, (2024). (https://oxfordinsights.com/wp-content/uploads/2024/12/2024-Government-AI-Readiness-Index-2.pdf) (accessed December 27, 2024).

[9] Rahim S, Government AI Readiness Index. Oxford Insights, (2023). https://oxfordinsights.com/ai-readiness/ai-readiness-index/10. (accessed December 6, 2023).

[10] J. Andraško, et al., The regulatory intersections between artificial intelligence, data protection and cyber security: challenges and opportunities for the EU legal framework, AI & SOCIETY. 36 (2021) 1-14, http://DOI:10.1007/s00146-020-01125-5.

[11] D. Saharnaz, et al., Privacy and security of big data in AI systems: A research and standards perspective, Institute of Electrical and Electronics Engineers, IEEE. (2019). https://doi10.1109/BigData47090.2019.9006283.

[12] E.O. Benefo, et al., Ethical, legal, social, and economic (ELSE) implications of artificial intelligence at a global level: a scient metrics approach, Journal of AI and Ethics. 2 (2022) 667-682. https://DOI:10.1007/s43681-021-00124-6.

[13] J. Babikian, navigating legal frontiers: exploring emerging issues in cyber law, Revista Espanola de Documentacion Cientifica. 17 (2023) 95-109, https://DOI:10.13140/RG.2.2.20264.55048.

[14] G. Mercan & Z. Varol Selçuk, Artificial intelligence (AI) activities in legal practices. International Journal of Eurasian Education and Culture. 9 (2024) 131-144, http://DOI: https://dx.doi.org/10.35826/ijoecc.1824.

[15] W. Raymond, Role of generative artificial intelligence in publishing. What is acceptable, what is not, The Journal of extra corporeal technology. 55 (2023) 103-104, https://doi.org/10.1051/ject/2023033.

[16] T.O. Abrahams, et al., Cyber security awareness and education programs: a review of employee engagement and accountability, Computer Science & IT Research Journal. 5 (2024), 100-119, http://DOI:10.51594/csitrj.v5i1.708.

[17] S. Greenhouse, US Experts Warn AI Likely to Kill off Jobs –and widen wealth inequality, The Guardian. (2023). https://www.theguardian.com/technology/2023/feb/08/ai-chatgpt-jobseconomy-inequality.

[18] Q. Yong et al., Artificial intelligence and economic development: An evolutionary investigation and systematic review, Journal of the Knowledge Economy, 15 (2024) 1736-1770, https://doi.org/10.1007/s13132-023-01183-2.

[19] T. Aksar, Towards a Central Asia-as-a Platform Strategy and a Digital Solutions Centre for Sustainable Development. Asia-Pacific Information Superhighway Working Paper Series, No. 08/ (2021). United Nations ESCAP, ICT and Disaster Risk Reduction Division, Bangkok. http://www.unescap.org.kp.

[20] F. Khakimov, National Digitalization Strategies of Central Asian States: Challenges and Opportunities. Central Asian Bureau for Analytical Reporting.asia. (2022). https://cabar.asia/en/national-digitalization-strategies-of-central-asian-states-challenges-and-opportunities.

[21] Kazakhstan Creates Concept for AI Development for Next Five Years, The Astana Times, (2024). https://astanatimes.com/2024/02/kazakhstan-creates-concept-for-ai-development-for-next-five-years/ (accessed February 25, 2024).

[22] B. Bokayev, A. Amirova, A. Galy, A. Yessengeldina & K. Sadykova, Innovative Approaches to Public Services Delivery through the Prism of the Industry 5.0 Paradigm, The Innovation Journal. 29 (2024) 1-26. https://www.researchgate.net/publication/380660453_INDUSTRY_50_AS_A_NEW_PARADIGM_OF_MODERN_MANAGEMENT

[23] Overview of Kazakhstani draft laws on Artificial Intelligence and its provisions on protecting personal data, GRATA International, https://gratanet.com/publications/overview-of-kazakhstani-draft-laws-on-artificialintelligence-and-its-provisions-on-protecting-personal-data (accessed May 15, 2025).

[24] D. Osmanova, S. Kapsalyamova, Y. Maratovna, Y. Baizhanov & D. Ryskaliev, Legal Challenges of Regulating Generative AI in Kazakhstan: A Comparative Assessment in Light of the EU Ai Act, Social Sciences and Humanities Open, (2025). https://dx.doi.org./10.2139/ssrn.5274268.

[25] Digital Kyrgyzstan 2019-2023, Digital Watch. https://dig.watch/resource/digital-kyrgyzstan-2019-2023). (accessed August 1, 2020).

[26] The Concept of Digital Transformation of the Kyrgyz Republic for 2024-2028, Annex to the Decree of the President of the Kyrgyz Republic Concept of Digital Transformation of the Kyrgyz Republic for 2024-2028, No 90, Dig. Watch. https://digital.gov.kg/wp-content/uploads/2024/06/concept-digital-transformation-of-the-kyrgyz-republic-for-2024-2028.pdf (accessed December 20, 2024).

[27] A. Alekseev & T. Turatali, Kyrgyz NLP: challenges, progress, and future, Cham, Springer Nature Switzerland, (2024). https://doi.org/10.48550/arXiv.2411.05503.

[28] L. Bojić, K. Ryom, M. Agatonović, A. Popova, M. Ćurčić, G. Zhanzhigitova, & M. Čabarkapa, Human Doctors Versus AI Models: Advice Perceptions in Serbia, Kazakhstan, and Kyrgyzstan, in: Human-Computer Creativity: Generative AI in Education, Art, and Healthcare, Cham: Springer Nature, Switzerland, 2025, pp. 277-299.

[29] Artificial intelligence in Central Asia: Strategies, initiatives, prospects, News Central Asia, https://www.newscentralasia.net/2025/02/03/artificial-intelligence-in-central-asia-strategies-initiatives-prospects/ (accessed February 3, 2025).

[30] About National council concerning development of artificial intelligence, Resolution of the Cabinet of Ministers of the Kyrgyz Republic. No. 29, EA Legislation, https://cis-legislation.com/document.fwx?rgn=164899 (accessed January 22, 2025).

[31] E. Xhixho, N. Pazylov, V. Savchenko, N. Patiev, & M. Pazylova, Digital transformation in the legal sector: challenges and opportunities for cybersecurity and data protection. Law, State and Telecommunications Review, 17 (2025) 250–271.

[32] ESCAP, Tracking E-Resilience in North and Central Asia, https://repository-uat.unescap.org/items/7730c736-176d-4ab2-9b99-721b6cf2b4d9/full , 2023.

[33] N. Jamshed & G. Gayatri, Are Digital and Social Media Marketing Matters for Tajikistan's Youth Travelers? ASEAN Marketing Journal, 17 (2025) 6.

[34] S. Temurbekova & A. Sulaymonov, Role of Information Technologies in the Digital Economy of the Republic of Tajikistan, Easy Chair, (2022) 7527, https://easychair.org/publications/preprint/w71d.

[35] Strategy for the development of artificial intelligence in the Republic of Tajikistan for the period up to 2040, Dig. Watch. https://dig.watch/resource/strategy-for-the-development-of-artificial-intelligence-in-the-republic-of-tajikistan-for-the-period-up-to-2040 (accessed September 30, 2022).

[36] Strategy for the development of artificial intelligence in the Republic of Tajikistan for the period up to 2040, Appendix 1 to the Government Resolution Republic of Tajikistan, No. 483, Dig. Watch. https://dig.watch/resource/strategy-for-the-development-of-artificial-intelligence-in-the-republic-of-tajikistan-for-the-period-up-to-2040 (accessed September 30, 2022).

[37] Tajikistan Introduces UN Resolution on Artificial Intelligence, The Caspian Post. https://caspianpost.com/tajikistan/tajikistan-introduces-un-resolution-on-artificial-intelligence (accessed March 10, 2025).

[38] H. Merdan, ADVANTAGES OF THE DIGITAL SYSTEM, Central commission for holding elections and referendums in Turkmenistan, (2020), https://saylav.gov.tm/en/articles/353

[39] Bayramova, T., and J. Kasymova. "Digital Reform and Economic Development" (in Russian). Symbol of Science 4-1-2 (2024): 31–32.

[40] S. Wang, et al., The Power of Digitalization, the Hainan Free Trade Port, and Regulations for Modern Economic Development in Turkmenistan Are Significant, Journal of Sustainability, 16 (2024) 5947, https://doi.org/10.3390/su16145947

[41] E. Dr. Oğuzhan, Uzbekistan's national artificial intelligence strategy (2025), https://www.researchgate.net/publication/388146491

[42] CIS. Legislation. (2012, February 21). On measures to create conditions for the accelerated introduction of artificial intelligence technologies. Resolution of the President of the Republic of Uzbekistan No. PP-4996, CIS. Legislation. https://lex.uz/docs/5297046

[43] Approval of Strategy, Digital Uzbekistan-2030 and measures for its effective realization, Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 475. CIS. Legislation, (2012), https://lex.uz/docs/5544451 (accessed on July 31, 2022)

[44] S. S. Gulyamov, (2022). Development of artificial intelligence in Uzbekistan, International journal of theoretical and practical research, 2 (2022) 7-17.

[45] A. Kobilov, et al., Artificial intelligence as a technological innovation for economic development of the republic of Uzbekistan, ICFNDS '22: Proceedings of the 6th International Conference on Future Networks & Distributed Systems, (2023) 292-297, https://doi.org/10.1145/3584202.3584245

[46] U. Saitkamolov Mukhammadkhoja Sabirkhoja, K. Z., Markabaeva Jansaya Aybek, ARTIFICIAL INTELLIGENCE AND ITS ROLE IN ACCELERATING DIGITAL TRANSFORMATION IN UZBEKISTAN, British Journal of Global Ecology and Sustainable Development, 29 (2024) 38 -41, https://journalzone.org/index.php/bjgesd/article/view/580

[47] K. Alisher, R. Odiljon, A. Muzaffarjon & S. Rajabov, ARTIFICIAL INTELLIGENCE AS A TECHNOLOGICAL INNOVATION FOR ECONOMIC DEVELOPMENT OF THE REPUBLIC OF UZBEKISTAN in Proceedings of the 6th International Conference on Future Networks & Distributed Systems, (2023) 292–297, https://DOI:10.1145/3584202.3584245

[48] Kobilov, A., Rikhsimboev, O., Abdulakhatov, M., & Rajabov, S. (2022, December). Artificial intelligence as a technological innovation for economic development of the republic of Uzbekistan. In Proceedings of the 6th International Conference on Future Networks & Distributed Systems (pp. 292-297).

[49] M. Kurmangali, Y. Yeraliyeva, & A. Beimisheva, Digitalization and Artificial Intelligence in Central Asia: Governmental Responses and Further Implications, Public Policy and Administration, 23(2024)146-15, https://DOI:10.13165/VPA-24-23-2-03

[50] D. Muhammadiyeva & S. Kadirova, ENSURING THE IMPLEMENTATION OF THE'NEW UZBEKISTAN-THIRD RENAISSANCE CONCEPT, International Journal of Artificial Intelligence, 1(2025) 223-226.

[51] S. Report, National Bank of the Kyrgyz Republic, Strategic Directions in Activity Conducted by the National Bank of the Kyrgyz Republic for 2025-2030, (2025). https://www.nbkr.kg/index1.jsp?item=3326&lang=ENG (accessed March 10, 2025).

[52] US, Kyrgyzstan, India hunt criminals with facial recognition watchlists, Biometric Update, (2023). https://www.biometricupdate.com/202306/us-kyrgyzstan-india-hunt-criminalswith-facial-recognition-watchlists (accessed on June 14, 2023).

[53] Yakhyaeva, The New Trends of Artificial Intelligence in Central Asia, Journal of Society and Innovations, Special Issue No. 9 (2024) 215-218. https://inscience.uz/index.php/socinov/article/download/4748/4596/13201

[54] R. Pulatov, DIGITAL TRANSFORMATION IN SOCIAL MANAGEMENT: INTERNATIONAL EXPERIENCE AND PROSPECTS FOR IMPLEMENTATION IN UZBEKISTAN, Journal of Multidisciplinary Sciences and Innovations, 1 (2025) 150-157.

[55] B. G., Navruzbekovna & K. Feruzjon, DIGITAL TRANSFORMATION OF UZBEKISTAN'S LAND CADASTRE SYSTEM: LEGAL FRAMEWORK, TECHNOLOGICAL ADVANCEMENTS, AND THE ROLE OF ENGLISH LANGUAGE: SHOKH LIBRARY, (2025) 641-649. https://doi.org/10.5281/zenodo.15666911.

[56] A. Omar, THE FUTURE OF ARTIFICIAL INTELLIGENCE IN UZBEKISTAN: TRENDS AND INSIGHTS, Web of Teachers: Inder science Research, 2 (2024) 65-68. https://webofjournals.com/index.php/1/article/view/2104

[57] Health Care in Kazakhstan Adopts AI, The Borgen Project. https://borgenproject.org/health-care-in-kazakhstan/ (accessed November 11, 2022)

[58] Turkmenistan Interested in Innovative AI Technology for Health. Asman news. https://asmannews.ru/news/6929/turkmenistan-zainteresovan-vo-vnedrenii-innovacionnoi-tehnologii-ii-dlya-zdorovya (accessed March 29, 2025)

[59] Kyrgyzstan's High Technology Park Confirms Indefinite Preferential Tax Regime, The Times of Central Asia. https://timesca.com/kyrgyzstans-high-technology-park-confirms-indefinite-preferential-tax-regime/ (accessed April 2, 2025)

[60] Central Asia: A New Frontier on the Global Tech Map, Crunchbase News. Crunchbase Partnerships. https://about.crunchbase.com/blog/central-asia-global-tech-map/ (June 14, 2023).

[61] Central Asia: Technology innovation hub in Kazakhstan, HKTDC https://research.hktdc.com/en/article/MTc0ODk3MzQyNA (accessed on July 25, 2024).

[62] Venture Capital Market Overview in Kazakhstan, White Hill Capital. https://tech.aifc.kz/files/pages/2024/docs/19/venture-capital-market-overview-in-kazakhstan-2023.pdf (accessed December 27, 2023).

[63] Global CIO Digital transformation of Uzbekistan, International community of IT leaders: striving for the best practices & professional growth together. (November 2, 2023). https://globalcio.com/articles/main/digital-transformation-of-uzbekistan/?sphrase_id=513

[64] Uzbekistan's IT sector on fire and targeting the vast US market, Bne Intelli news. https://www.intellinews.com/uzbekistan-s-it-sector-on-fire-and-targeting-the-vast-us-market-247916/ (June 18, 2022)

[65] Business Incubation Project in Tajikistan, Project Completion Report, State Committee on Investments and State Property Management of the Republic of Tajikistan. Japan International Cooperation Agency, IMG Inc. https://openjicareport.jica.go.jp/pdf/12343497.pdf (February 26, 2023)

[66] Artificial Intelligence in Central Asia: strategies, initiatives, prospects, News Central Asia Report. https://www.newscentralasia.net/2025/02/03/artificial-intelligence-in-central-asia-strategies-initiatives-prospects/ (accessed 04-02-2025)

[67] Golden age electronic newspaper, Science is the backbone of Turkmenistan's rapid development. Altynasyr Newspaper. https://turkmenistan.gov.tm/en/post/84839/science-backbone-turkmenistans-rapid-development (accessed June 12, 2024)

[68] U. Arpidinov & R. Isaev, Mobile Application for Learning the Kyrgyz Language Using Artificial Intelligence and Augmented Reality Technologies, preprint, (2025). https://DOI:10.20944/preprints202504.2465.v1

[69] K. Roy and K. Swargiary, Exploring the Impact of AI Integration in Education: A Mixed-Methods Study, SSRN, (2024) 1-21. http://dx.doi.org/10.2139/ssrn.4857648

[70] A. Gocen and F. Aydemir, Artificial intelligence in education and schools, Research on Education and Media Sciendo, 12 (2020) 13-21.

[71] L. Kohnke, et al. ChatGPT for language teaching and learning, Relc Journal, 254 (2023), 537-550. https://DOI:10.1177/00336882231162868

[72] L. Lianju & Z. Haiying, Research on badminton take-off recognition method based on improved deep learning, Journal of Ambient Intelligence and Humanized Computing, 15 (2024) 3317-3330.

[73] M. Irfan, Enhancing critical thinking and journalism skills through artificial intelligence literacy: A case study of journalism students in Tajik National University, Tajikistan, (2025). https://doi.org/10.46328/IJONSE.014

[74] Y. A. Muhie and B. W. Abeselom, Integration of artificial intelligence technologies in teaching and learning in higher education. Journal of Science and Technology, 10 (2020) 1-7.

[75] M. R. Suleman & A. Abbas, Navigating the integration of AI in education: Challenges and opportunities for learning and teaching, (2024). https://www.researchgate.net/publication/380362320_Navigating_the_Integration_of_AI_in_Education_Challenges_and_Opportunities_for_Learning_and_Teaching

[76] A. Harry, Role of AI in Education, Interdisciplinary Journal & Humanity, 2 (2023) 260-268. https://DOI:10.58631/injurity.v2i3.52

[77] R. M. Potluri, Y. B. Mukashev & I. Baktygulova, Problems and Prospects of AI in the Global Healthcare Sector: A Case of Kazakhstan. In Artificial Intelligence in Healthcare Information Systems-Security and Privacy Challenges, Cham: Springer Nature Switzerland, 2025, pp. 185-202

[78] S. Reporter, Kazakhstan Startup Cerebra AI Relocates Headquarters to Silicon Valley to Address Severe Emergency Care Diagnostics Gap through Novel Generative AI Medical Imaging Approach, Business wire. (accessed April 2, 2024). https://www.businesswire.com/news/home/20240402257293/en/Kazakhstan-Startup-CerebraAI-Relocates-Headquarters-to-Silicon-Valley-to-Address-Severe-Emergency-Care-Diagnostics-Gap-through-Novel-Generative-AI-Medical-Imaging-Approach

[79] D. Specht, Future trends in geospatial information management (3rd ed.), United Nations Committee of Experts on Global Geospatial Information Management, 2023, https://ggim.un.org/meetings/GGIM-committee/10th-Session/documents/Future_Trends_Report_THIRD_EDITION_digital_accessible.pdf80.

[80] Kurmangali, M., Yeraliyeva, Y., & Beimisheva, A. (2024). Digitalization and Artificial Intelligence in Central Asia: Governmental Responses and Further Implications. Public Policy and Administration, 23(2), 146-159.

[81] M. S. Abdurashidova & M. E. Balbaa, Artificial Intelligence in the Banking Sector in Uzbekistan: Exploring the Impacts and Opportunities. In Proceedings of the 7th International Conference on Future Networks and Distributed Systems, 2023, pp 51-57. https://DOI:10.1145/3644713.3644721

[82] T. Narbaev, B. Aitkhozha, A. Samoilov & G. Castelblanco, An Assessment of Financial Stability of Artificial Intelligence-based Monitoring Project in Kazakhstan, Eurasian Journal of Economic and Business Studies, 69 (2025) 95-108.

[83] A New Frontier on the Global Tech Map. Crunchbase News. Central Asia. (accessed June 14, 2023). https://about.crunchbase.com/blog/central-asia-global-tech-map/

[84] Zypl.ai: Spearheading AI-driven financial innovation and regional integration in Central Asia. The Diplomat. (accessed on January 25, 2024). https://thediplomat.com/2024/01/zypl-ai-spearheading-ai-driven-financial-innovation-and-regional-integration-in-central-asia/

[85] Ö. K. Küçüksolak & T. Fırat, The Geopolitics of Artificial Intelligence in Central Asia: Russian and Chinese Cases, Journal of Security Services, 12 (2023) 25-44. https://doi.org/10.28956/gbd.1249381

[86] A. Mona, M. Rohit, J. Anton, S. Uthayasankar, Ethical framework for Artificial Intelligence and Digital technologies, International Journal of Information Management, 62 (2022) 2. https://doi.org/10.1016/j.ijinfomgt.2021.102433

[87] A. Kauanova, S. Amanzholov & A. Sagikyzy, AI In Inclusive Education: Ethical Challenges and Opportunities in Central Asia. Irfan, Oriental Journal of Mystical Insights and Cultural Heritage, 1 (2025) 5–10. https://maulanapress.com/index.php/irfan/article/view/19

[88] P. E. Strukova, Artificial Intelligence in China: The Current State of Industry and Development Trends, Vestnik of Saint Petersburg University, Asian and African Studies, 12 (2021) 588–606. https://doi.org/10.21638/spbu13.2020.409

[89] M. A. Lipchanskaya, T. N. Balashova, & E. V. Maslennikova, Constitutional Right to Health Protection in the Context of Artificial Intelligence Development in book Proceedings of the International Scientific Conference "Smart Nations: Global Trends In The Digital Economy" Springer International Publishing, (2022) pp. 204-212. https://DOI:10.1007/978-3-030-94873-3_25

[90] A. Banerjee, Next Generation Artificial Intelligence Development Plan, Centre for Joint Warfare Studies, (2023) 1-6.

[91] Central Asian experts appreciate China's contribution to AI development, CGTN, Russian CGTN, (accessed on April, 30 2024) https://russian.cgtn.com/news/2024-04-30/1785160440962256898/index.html

[92] CIIS Report, China-ASEAN cooperation on AI development and governance: Observations on progress and suggestions for advancement, (December 2024) https://www.ciis.org.cn/english/NEWS_183/202412/t20241216_9452.html

[93] D. Rezapoor, China's Cooperation with Central Asia with an emphasis on Artificial Intelligence, Central Eurasia Studies, 17 (2025) 157-187. https://DOI10.22059/JCEP.2024.378369.450229

[94] Venture Capital Market Overview in Kazakhstan, White Hill Capital. (2023), https://tech.aifc.kz/files/pages/2024/docs/19/venture-capital-market-overview-in-kazakhstan-2023.pdf (accessed on August 28, 2024)

[95] N. Saulius & A. Konysbek, EXPLORING SPECIAL ECONOMIC ZONE GOVERNANCE: A COMPARATIVE STUDY OF KAZAKHSTAN, THE RUSSIAN FEDERATION AND KYRGYZSTAN, Journal of Economic Research & Business Administration, 150 (2024) 106-119. https://doi.org/10.26577/be.2024.150.i4.a8

[96] Y. Kalyuzhnova & H. Holzhacker, ADBI Working Paper Series No. 1271, Enhancing connectivity and trade between Central Asia regional economic cooperation countries and the world: Benefits, risks and policy implication, Asian Development Bank Institute, 2021, https://www.adb.org/sites/default/files/publication/713731/adbi-wp1271.pdf

[97] Gout, V. (2025, March 27). Unlocking the potential of Kazakhstan's special economic zones: Enhancing governance, transparency, and investment attraction for sustainable growth [Policy brief]. Charter Cities Institute. https://chartercitiesinstitute.org/wp-content/uploads/2025/03/Unlocking_The_Potential_KZ_Policy.pdf

[98] H. U. Sherzodjonovich, ANALYSIS OF FREE ECONOMIC ZONES IN UZBEKISTAN, Economics and Innovative Technologies, 12 (2024) 88-95. https://iqtisodiyot.tsue.uz/journal/index.php/iit/article/view/594

[99] I. A. Sayfiddinov, THE IMPACT OF ARTIFICIAL INTELLIGENCE ON THE UZBEKISTAN ECONOMY. Scholar-Journal.Org, 2 (2024) 64-68. https://scholar-journal.org/index.php/s/article/view/149

[100] D. M. Akhmetov, Comparative legal analysis of the experience of creation and functioning of special economic and industrial zones of the Republic of Kazakhstan and the Republic of Uzbekistan, Bulletin of the Karaganda University Law Series, 107 (2022) 118-127. https://doi.org/10.31489/2022l3/118-127

[101] F. Ibragimov, Application of logistics in the innovative development of cluster activities in Uzbekistan. Business Expert Magazine, 5 (2019) 58-61. https://DOI:10.47191/ijmra/v3-i9-05

[102] Y. J. Ahn, Z. Juraev & J. Y. Gu, Analyzing Free Economic Zones in Uzbekistan for Sustainable Growth, The Indonesian Journal of Geography, 56 (2024) 44-51. https://DOI:10.22146/ijg.84351

[103] Free Economic Zone Experiment in Kyrgyzstan Fails, Central Asian Bureau for Analytical Reporting. (January 30, 2020), https://cabar.asia/en/free-economic-zone-experiment-in-kyrgyzstan-fails

[104] A DIAGNOSTIC STUDY OF KYRGYZ REPUBLIC'S FREE ECONOMIC ZONES AND INDUSTRIAL PARKS, CAREC, Asian Development Bank. (accessed April, 2018), https://www.carecprogram.org/?publication=diagnostic-study-kyrgyz-republic-free-economic-zones-industrial-parks

[105] S. Reporter, Free economic Zones in the Republic of Tajikistan, https://mfa.tj/en/berlin/relations/free-economic-zones (accessed on March 10, 2020)

[106] M. B. Khaskheli & Y. Zhao, The sustainability of economic and business practices through legal cooperation in the era of the Hainan free trade port and southeast Asian nations, Sustainability, 17 (2025) 2050, https://doi.org/10.3390/su17052050

[107] K. M. Ochildiyevna, Special Economic Zones AS Drivers of Regional Economic Development: Best Practices and Implications for Uzbekistan, American Journal of Business Management, Economics, and Banking, 30 (2024) 29-32. https://americanjournal.org/index.php/ajbmeb/article/view/2451/2297.

[108] Technology and innovation report UNCTAD, (2025). https://unctad.org/system/files/official-document/tir2025_en.pdf (accessed December 30, 2025)