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**«Саяси ғылымдағы цифрландыру мен жасанды интеллект:
жаңа тәсілдер мен зерттеу көкжиектері»**
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В рамках международной научно-практической конференции **«Цифровизация и искусственный интеллект в политической науке: новые подходы и исследовательские горизонты»** состоялся междисциплинарный научный диалог с участием ученых, экспертов, политологов, международников, социологов, молодых исследователей, докторантов и магистрантов из Казахстана, Китая, Узбекистана, Азербайджана, Кыргызстана и России. Проведенная дискуссия позволила выявить ключевые тенденции и закономерности трансформации политических процессов в условиях цифровизации, а также сформулировать ряд научно обоснованных выводов и практических рекомендаций.

В материалах конференции рассматриваются теоретико-методологические основы цифровизации и применения технологий искусственного интеллекта в политической науке, представлены современные научные подходы к исследованию цифровой трансформации политических институтов и процессов. Особое внимание уделено вопросам влияния искусственного интеллекта на политические технологии, информационную безопасность, цифровую этику и трансформацию механизмов государственного и общественного взаимодействия, анализируются современные методы исследования цифровой среды, медиа и новых форм политической коммуникации в странах Центральной Азии.

В настоящий сборник включены доклады участников международной научно-практической конференции, отражающие широкий спектр актуальных научных подходов и исследовательских направлений. Материалы сборника представляют интерес для ученых, преподавателей высших учебных заведений, государственных служащих, сотрудников научно-исследовательских институтов, докторантов, магистрантов и студентов.

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ON THE DEVELOPMENT OF THE ARTIFICIAL INTELLIGENCE CONCEPT FOR 2024–2029

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Abstract

The article examines the impact of artificial intelligence (AI) on society and public governance in Kazakhstan. It emphasizes that AI is becoming a strategic resource for economic modernization, enhancing the efficiency of political decision-making, and strengthening digital sovereignty. Kazakhstan's position in international AI readiness rankings is analyzed, including the Oxford Insights methodology, where the country ranks 72nd among 193 states. Particular attention is given to the development of digital infrastructure: the establishment of data centers, the national “West–East” backbone, the deployment of 5G technology, and the formation of regional IT hubs. The study highlights Kazakhstan's strengths – such as digital potential and an adaptive legal framework – as well as weaknesses, including insufficient technological maturity, low innovation capacity, and limited access to computing resources. Promising applications of AI are noted in forecasting public sentiment, optimizing strategies, and automating government services, while challenges remain regarding algorithmic transparency and accountability. The conclusion stresses the need to improve data quality, develop human capital, and integrate international best practices to build a sustainable digital ecosystem.

Keywords: artificial intelligence, digital infrastructure, public governance, Oxford Insights, data centers, IT hubs, digital sovereignty, public sentiment forecasting, innovation potential, digital transformation

Аңдатпа:

Мақалада жасанды интеллекттің (ЖИ) Қазақстан қоғамы мен мемлекеттік басқаруға ықпалы қарастырылады. ЖИ экономиканы жаңғыртуға, саяси шешімдердің тиімділігін арттыруға және цифрлық егемендікті нығайтуға арналған стратегиялық ресурсқа айналып келе жатқаны атап өтіледі. Қазақстанның ЖИ қолдануға дайындық бойынша халықаралық рейтингтердегі орны талданады, соның ішінде Oxford Insights әдістемесі бойынша ел 193 мемлекеттің ішінде 72-орынды иеленгені көрсетіледі. Цифрлық инфрақұрылымды дамытуға ерекше назар аударылады: деректерді өңдеу орталықтарының құрылуы, «Батыс–Шығыс» ұлттық гипермагистралының іске қосылуы, 5G технологиясының енгізілуі және аймақтық IT-хабтар желісінің қалыптасуы. Қазақстанның ЖИ саласындағы күшті және әлсіз жақтары қарастырылады: цифрлық

элеует пен бейімделгіш құқықтық база бар, бірақ технологиялық жетілу жеткіліксіз, инновациялық капитал әлсіз және есептеу ресурстарына қолжетімділік шектеулі. ЖИ-ді қоғамдық көңіл-күйді болжауда, стратегияларды оңтайландыруда және мемлекеттік қызметтерді автоматтандыруда қолдану перспективалары, сондай-ақ алгоритмдердің ашықтығы мен олардың шешімдері үшін жауапкершілікке қатысты сын-қатерлер атап өтіледі. Қорытындыда деректер сапасын арттырудың, адами капиталды дамытудың және халықаралық тәжірибені интеграциялаудың тұрақты цифрлық экожүйе қалыптастыру үшін қажеттілігі баса көрсетіледі.

Кілт сөздер: жасанды интеллект, цифрлық инфрақұрылым, мемлекеттік басқару, Oxford Insights, деректерді өңдеу орталықтары, IT-Hub, цифрлық егемендік, қоғамдық көңіл-күйді болжау, инновациялық элеует, цифрлық трансформация

Аннотация

В статье рассматривается влияние искусственного интеллекта (ИИ) на общество и государственное управление в Казахстане. Подчеркивается, что ИИ становится стратегическим ресурсом для модернизации экономики, повышения эффективности политических решений и укрепления цифрового суверенитета. Анализируется позиция Казахстана в международных рейтингах готовности к использованию ИИ, включая методику Oxford Insights, где страна занимает 72-е место среди 193 государств. Особое внимание уделено развитию цифровой инфраструктуры: созданию центров обработки данных, национальной гипермагистрали «Запад–Восток», внедрению технологии 5G и формированию сети региональных ИТ-хабов. Рассматриваются сильные и слабые стороны Казахстана в сфере ИИ: наличие цифрового потенциала и адаптивной правовой базы, но недостаточная технологическая зрелость, слабый инновационный капитал и ограниченный доступ к вычислительным ресурсам. Отмечаются перспективы применения ИИ в прогнозировании общественных настроений, оптимизации стратегий и автоматизации госуслуг, а также вызовы, связанные с прозрачностью алгоритмов и ответственностью за их решения. В заключение подчеркивается необходимость повышения качества данных, развития человеческого капитала и интеграции международного опыта для формирования устойчивой цифровой экосистемы.

Ключевые слова: искусственный интеллект, цифровая инфраструктура, государственное управление, Oxford Insights, центры обработки данных, IT-Hub, цифровой суверенитет, прогнозирование общественных настроений, инновационный потенциал, цифровая трансформация

In recent years, artificial intelligence has become one of the key drivers of global technological competition and the transformation of public governance. Leading positions in this field are occupied by the United States and China, largely due to the presence of major technology corporations such as Google, Facebook, Microsoft, Alibaba, Baidu, and Tencent, as well as substantial investments in artificial intelligence research and development. Kazakhstan entered this process relatively recently, when President Kassym-Jomart Tokayev, in his speech at the International Technological Forum “Digital Bridge 2023” in Astana, emphasized the importance of artificial intelligence for the country’s economic growth. The development of AI was identified as one of the priorities of state policy, which was reflected in the Concept for the Development of Artificial Intelligence for 2024–2029.

Government readiness to use artificial intelligence is assessed using the Oxford Insights methodology, which analyses key trends and initiatives. This methodology includes a set of sub-indices that form the basis of the overall score. These parameters are of interest not only as indicators of government readiness to deliver AI-based public services but also as broader indicators of a country’s overall capacity for artificial intelligence development. The sub-indices are grouped into three major categories: “government,” “technology sector,” and “data and infrastructure.”

The introduction of artificial intelligence into Kazakhstan's political processes represents not merely a technological upgrade but a fundamental transformation of the public administration model. In the context of rapid digital development, AI is becoming a key instrument for enhancing the efficiency, transparency, and adaptability of political decision-making.

One of the most promising areas is the forecasting of public sentiment. Using machine learning algorithms, data from social media, public opinion surveys, citizens' appeals, and other sources can be analysed to identify hidden trends and potential points of social tension. This enables public authorities to respond to emerging challenges before they escalate, contributing to more resilient and citizen-oriented policymaking.

In addition, AI can optimize the policy design process by modelling various development scenarios. For example, when making decisions on education or healthcare reforms, simulations based on historical data, demographic projections, and economic indicators can be applied. This reduces risks and increases the evidence-based nature of political initiatives.

According to the Government AI Readiness Index 2023 published by Oxford Insights, Kazakhstan ranks 72nd out of 193 countries. The country's relatively strong performance is associated with its digital potential and data availability, reflecting the results of public sector digitalization and the active deployment of e-government services. At the same time, low scores in such areas as human capital, innovation capacity, and process maturity indicate systemic constraints that hinder the transition from digitalization to the full-scale use of artificial intelligence.

Despite its clear advantages, the use of artificial intelligence in politics is associated with a number of ethical and legal challenges. One of the key issues is the transparency of algorithmic decision-making. Citizens must understand how decisions are made and on the basis of which data, especially when such decisions affect resource allocation, social support, or legal outcomes.

Another critical issue concerns accountability: who bears responsibility for erroneous or discriminatory decisions made by AI systems? In the context of automation, it is essential to maintain human oversight and ensure mechanisms for appeal and review of decisions.

Kazakhstan is actively studying international experience and seeking to adapt best practices. In the European Union, the United States, South Korea, and Singapore, AI is already used for public opinion analysis, automation of public services, and political risk forecasting. Kazakhstan can adopt these approaches while adapting them to its cultural and institutional context.

Participation in international initiatives such as the Global Partnership on Artificial Intelligence (GPAI) provides access to expert knowledge and advanced technologies. This contributes to strengthening the country's position on the global stage and shaping its image as a technologically advanced state.

The creation of a network of IT hubs under the management of Astana Hub represents an important step toward the decentralization of digital development. Currently, 14 regional hubs are in operation, and five additional hubs are planned to open in 2024. These centres serve as growth points for local startups, educational initiatives, and technological experimentation.

Particular importance is attached to the construction of data centres, including the project in Ekibastuz and the launch of a major data centre in Astana. This will ensure the storage and processing of large volumes of data within the country, reduce dependence on foreign cloud services, and enhance digital sovereignty.

Work is also underway on the creation of the national "West-East" hyper highway, which will provide alternative traffic routes and increase the resilience of internet connectivity. This is especially important for rural areas, where access to high-quality internet remains limited. According to the plans of the Ministry of Digital Development, by 2027, 75% of cities of republican significance and 60% of regional centres will be covered by 5G technology.

Thus, Kazakhstan is forming a unique model of digital development in which artificial intelligence becomes not only a technological tool but also a strategic resource for modernizing public administration, improving quality of life, and strengthening national sovereignty in the digital era [1].

The organization demonstrates an uneven level of development across key areas of digital transformation. The strongest positions are associated with digital potential (75.67) and data availability (74.11), indicating the presence of a technological foundation and the ability to effectively use information for decision-making. A high level of adaptability (63.76) confirms the organization's capacity to respond to change and adopt new approaches. At the same time, governance and ethics (54.19) remain at a moderate level, suggesting the presence of basic management practices but the need for further strengthening. Human capital (38.55), innovation potential (33.63), and infrastructure (30.8) are underdeveloped, which limits opportunities for sustainable growth and the implementation of new solutions. The most critical areas are process maturity (15.48) and the absence of strategic vision (0), which significantly reduces the effectiveness of digital transformation.

Therefore, while maintaining its strengths, the organization should focus on developing a long-term strategy, increasing process maturity, enhancing human capital, and modernizing infrastructure in order to move toward a more sustainable and strategically aligned stage of digital development [2].

The country's strengths include data availability, digital potential, and the adaptability of the legal framework to digital business models. Weaknesses include the lack of strategic vision, insufficient technological maturity, underdeveloped infrastructure, low innovation capacity, and limited human capital. When examining individual indicators of the index, additional weaknesses include the absence of large private technology companies (unicorns), low levels of venture capital, and insufficient expenditures on research and development.

The foundations of artificial intelligence development are the quality of data and data governance tools. Kazakhstan has made significant progress in data generation and collection. In the public administration sector, intensive data collection is underway: 183 information systems of central government bodies are registered on the national architectural portal. Large volumes of data are also generated by the banking and financial sector, business customer services based on cloud technologies, the telecommunications sector, and other industries.

Among major data repositories, a key role is played by the data lake hosted on Smart Data Ukimet, where data from 93 information systems are consolidated into a single Data Lake for subsequent analytical processing and use in decision-making.

At the same time, gaps in the digitization of sectorial data persist within the public administration system. The top three sectors in terms of systematic data digitization are education (81%), finance (59%), and social protection (59%). Sectors with the lowest levels of digitized data include sports and tourism (25%), business (13%), energy (33%), and science (2%).

Thus, unresolved issues remain related to data quality, insufficient digitization, data duplication, and related challenges. At the same time, the full-scale use and development of artificial intelligence require high-quality and accessible data. Further efforts are needed in the areas of data collection, accumulation, and access provision, analysis of overlapping datasets across government bodies, and improvement of data quality, including the completion of missing values and regular data updates. These challenges are inherent to the formation of a data ecosystem and will be addressed progressively.

One of the key factors determining the development of artificial intelligence technologies and their effective integration into the economy is the level of digital infrastructure development. This includes the quality and availability of internet connectivity, access to modern high-performance computing equipment, including data centres, and related infrastructure. The Government of Kazakhstan is actively working to establish close

cooperation with major technology companies such as NVIDIA, Microsoft, and Amazon to locate data centres within the territory of Kazakhstan.

As of early 2024, out of 6,406 settlements in Kazakhstan, broadband mobile internet access is available in 116 cities and 4,866 rural settlements (including 3G broadband access in 1,652 villages and 4G access in 3,214 villages). Internet connectivity via Asymmetric Digital Subscriber Line (ADSL) technology is available in 1,950 rural settlements, while fiber-optic communication lines are deployed in 2,606 rural settlements.

The issue of achieving 100% coverage of rural settlements with high-quality internet access remains unresolved, affecting 1,294 rural settlements. Measures to address this objective are provided for in the current sectorial strategic document of the Ministry of Digital Development, Innovation and Aerospace Industry of the Republic of Kazakhstan, according to which by 2027, 75% of cities of republican significance and 60% of regional centres are expected to be covered by 5G technology.

Within the framework of the National Project “Accessible Internet,” measures are being implemented to ensure alternative traffic routes through the construction of the national “West–East” hyper highway and the establishment of a dedicated TIER III data centre for the transit and storage of international traffic.

Currently, 51 data centres operate in Kazakhstan, along with 15 data centres owned by JSC “National Information Technologies” (NIT), which serves as the operator of the information and communication infrastructure of Kazakhstan’s e-government system.

Construction is underway for a data centre in the city of Ekibastuz, with commissioning planned for 2025. In addition, as part of the deployment of the QazTech platform, JSC “NIT” is in the process of acquiring a data centre from JSC “Transtelecom.” At the same time, work has begun on launching the primary data centre in the city of Astana.

Computing infrastructure with sufficient processing capacity to conduct research and develop artificial intelligence technologies and models is established at the following institutions:

- L. N. Gumilyov Eurasian National University, which hosts the PARAM BILIM supercomputer with a performance of 10 teraflops (with planned modernization to scale performance up to 100 teraflops);
- Satbayev University Research Laboratory, which operates a supercomputer with a peak performance of 10.9 teraflops;
- Kazakh-British Technical University, which operates a supercomputer with a performance of 10 teraflops;
- Institute of Information and Computational Technologies, with a supercomputer providing 16 teraflops;
- Nazarbayev University, which operates a seven-node supercomputer with a total performance of 25 teraflops;
- Al-Farabi Kazakh National University, which has signed a contract for the delivery of a supercomputer with a performance of 1,938.41 teraflops.

Kazakhstan has an extensive network of 14 regional IT hubs located in the cities of Kyzylorda, Aktobe, Semey, Taldykorgan, Ust-Kamenogorsk, Aktau, Turkestan, Taraz, Oral, Kokshetau, Kostanay, Karaganda, Qonaev, and Pavlodar, all operating under the management of Astana Hub.

In 2024, the opening of five additional IT hubs is planned in the cities of Atyrau, Shymkent, Zhezkazgan, Petropavlovsk, and Zhanaozen.

Despite the presence of a basic infrastructure, the primary barrier to artificial intelligence development in Kazakhstan remains limited access to computational resources required for training and deploying AI models. The development and training of modern AI models require high-performance computing systems utilizing graphics processing units (GPUs), tensor processing units (TPUs), and language processing units (LPUs). In many cases, startups and small and medium-sized enterprises cannot afford to purchase such equipment and

are therefore forced to rent computational resources abroad or rely on foreign services and products.

With the acceleration of technological transformation and digitalization, demand for IT specialists and talent continues to exceed supply. This demand is partially addressed through changing attitudes toward formal education in hiring and career advancement, where possession of an official diploma is increasingly losing importance to verified online learning outcomes and demonstrated practical IT skills. Technological progress is also reflected in the shortening lifecycle of hard skills and the rapid turnover of skill sets required remaining competitive in the labour market and performing professional tasks effectively.

Digital literacy is becoming a necessity for specialists across all fields, while organizations increasingly share responsibility for workforce training by allocating up to 1.5% of their revenue to professional development and reskilling.

In 2022, Kazakhstan ranked 15th in the E-Participation Index (EPI), with 94% of the population aged 6 to 74 identified as internet users. However, public awareness of artificial intelligence development remains low, which constrains demand for technological solutions and limits innovation activity.

According to the 2023 assessment by Oxford Insights, Kazakhstan demonstrates a low number of specialists with higher education in engineering and technology, a low level of digital skills, limited activity of IT professionals on GitHub, and a low number of graduates in STEM fields (science, technology, engineering, and mathematics).

Despite these challenges, Kazakhstan possesses significant potential. In 2021, Kazakhstani school students won medals at the Asian Physics Olympiad. In 2022, the national team ranked 17th at the International Mathematical Olympiad. Students from Shymkent represented Kazakhstan in Germany, where they won second place at a robotics olympiad, later achieved victory at the FIRST Global Challenge World Robotics Competition in Geneva in October 2022, and in 2023, Kazakhstani teams won prizes in Kaggle machine learning competitions.

In the field of non-formal education aimed at rapid acquisition of IT skills, several initiatives are being implemented in Kazakhstan. For example, the Tech Orda program provides state-funded grants of up to 600,000 tenge for individuals aged 18–45 to study at private IT schools. In 2023, the program involved 83 IT schools offering 219 courses with durations ranging from six months to two years, as well as one IT company operating its own academy with 11 courses.

Additionally, summer schools focused on programming and artificial intelligence skills development are conducted, including initiatives such as the nFactorial School program, implemented with the support of Chevron and Satbayev University.

Talent identification is carried out through the organization of hackathons, while talent development is supported through incubators and accelerators. The Ministry of Science and Higher Education of the Republic of Kazakhstan, in cooperation with companies such as NVIDIA, Coursera, Huawei, Amazon, Binance, Microsoft, and Google, is implementing training programs in artificial intelligence and machine learning that offer free certification.

In the field of formal education, Kazakhstan has been implementing the Atlas of New Professions and Competencies since 2021. Based on this framework, higher education institutions have been updating their curricula since 2023 by introducing modules in machine learning, data science, cybernetics, artificial intelligence, and robotics.

In 2023–2024, forums on the application of artificial intelligence across various sectors, including finance, business, and education, were held, increasing public awareness of AI capabilities. AI Centre, Satbayev University, ISSAI at Nazarbayev University, nFactorial, Alem, and other educational platforms are actively engaged in awareness-raising activities aimed at improving public understanding of the benefits of artificial intelligence and the safety of its use.

However, systemic challenges remain unresolved, including workforce shortages, insufficient knowledge, intense competition for AI talent, a limited number of educational programs, and a lack of practical training in artificial intelligence. These challenges underscore the need for continued training of educators, upskilling of sector-specific specialists, and more active integration of artificial intelligence into the educational programs of colleges and higher education institutions.

In Kazakhstan, 24 higher education institutions and research centers are engaged in research and development in the field of artificial intelligence. According to data from InCites (Clarivate Analytics) as of May 2023, Kazakhstani researchers published 191 articles in the Web of Science Core Collection in the subject area “Computer Science, Artificial Intelligence” during the period from 2018 to 2022.

The Concept for the Development of Higher Education and Science includes measures to stimulate interaction between science, industry, and business through grants for the commercialization of research results and retraining programs focused on commercialization competencies. Since 2023, artificial intelligence research has been included in the list of priority areas of scientific development.

The Technological Policy Council has been operating since 2022, with responsibilities that include defining technological development priorities and reviewing initiatives for the establishment of technology centres.

Funding for research and development remains low compared to other countries. Despite nominal growth in R&D funding, the planned target of allocating 1% of GDP to research and development has not been achieved. At the same time, one of the challenges related to data concerns the underutilization of the full potential of the Kazakh language. In this context, the development of KazLLM using artificial intelligence technologies represents a key factor in stimulating and advancing the Kazakh language through AI. AI-based products built on KazLLM are applicable across nearly all sectors and business processes that involve text-based data. Investments in the development of KazLLM are strategically important for sustaining and strengthening the national economy and technological independence, while opening new opportunities for growth and innovation in the global digital environment. Overall, the advancement of scientific research in artificial intelligence requires increased financial support and stronger collaboration between science, industry, and business [3].

The integration of artificial intelligence technologies into social processes represents an important stage of digital transformation aimed at improving citizens’ quality of life, optimizing governance, and ensuring sustainable development. Within the framework of the Concept for the Development of Artificial Intelligence for 2024–2029, particular attention is given to the following areas:

- E-government. Artificial intelligence is being actively integrated into public administration, contributing to process automation and improved service accessibility. The use of intelligent assistants, chatbots, and automated systems for processing citizens’ requests enables rapid responses, reduces administrative burdens, and increases public satisfaction. In addition, AI is applied to public opinion analysis, supporting the development of more accurate and adaptive public policies.

- Urban infrastructure (Smart City). Within the “smart city” concept, AI is used to manage traffic flows, optimize energy consumption, and ensure public safety. Intelligent systems enable the forecasting of road congestion, regulation of street lighting, and real-time monitoring of environmental indicators. This contributes to the creation of a more comfortable, safe, and sustainable urban environment.

- Environmental monitoring. AI plays a key role in environmental protection. It is used to analyse levels of air, water, and soil pollution, forecast climate change impacts, and optimize natural resource management. These technologies allow for the timely identification of environmental threats and the implementation of preventive measures.

- Social policy. AI enables governments to more accurately identify the needs of different population groups, forecast demographic and social trends, and provide targeted assistance. Algorithms make it possible to assess the effectiveness of social programs, identify vulnerable groups, and optimize resource allocation, thereby contributing to a more equitable and effective social protection system.

Thus, the integration of artificial intelligence into public processes creates new opportunities to enhance governance efficiency, improve quality of life, and strengthen trust between the state and society. However, the successful implementation of these initiatives requires adherence to the principles of transparency, ethics, and inclusiveness, as well as active citizen participation in the digital transformation process. In this context, the development of AI requires not only technological solutions but also institutional ones.

Kazakhstan possesses significant potential in the field of artificial intelligence, actively developing educational initiatives, scientific research, and digital infrastructure. Despite high internet penetration and strong performance of school students in international competitions, the country faces systemic challenges, including a shortage of qualified specialists, low levels of digital skills, limited practical training, and insufficient funding for research and development. In response to these challenges, large-scale programs such as Tech Orda, nFactorial, Alem, and the AI Centre have been launched, aimed at education, capacity building, and talent development. The creation of the national language model KazLLM and the inclusion of artificial intelligence among the priority areas of scientific development reflect a strategic commitment to technological independence and the strengthening of national identity. Sustainable progress will require further investment, modernization of educational curricula, professional development of teaching staff, and stronger cooperation between academia, business, and government [4].

The integration of artificial intelligence technologies into social processes in Kazakhstan opens up significant opportunities for improving the efficiency of public administration, developing urban infrastructure, strengthening environmental monitoring, and enhancing social policy. These initiatives have the potential to improve citizens' quality of life, increase trust in public institutions, and ensure sustainable development. However, the successful implementation of this strategic course requires overcoming systemic challenges, including workforce shortages, insufficient levels of digital skills, and limited funding for research and development. Programs such as Tech Orda, nFactorial, Alem, the AI Centre, and the development of the national language model KazLLM demonstrate the country's commitment to technological sovereignty and the strengthening of national identity.

Thus, the future development of artificial intelligence in Kazakhstan depends on a comprehensive approach that includes investment in education and science, continuous professional development of specialists, and close cooperation between the state, business, and society. Only by adhering to the principles of transparency, ethical governance, and inclusiveness can digital transformation become a sustainable driver of progress.

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