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DIGITALIZATION AND ARTIFICIAL INTELLIGENCE IN THE ECONOMY: THEORETICAL FOUNDATIONS, LEGAL REGULATION, AND COMPETENCY DEVELOPMENT

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Abstract. In recent times, the growing influence of digital technology has had profound effects on the world economy. The current impact of digitalization on economic models, institutional arrangements, and human capital development differs from previous changes in the structure of production and employment brought about by automation. The new developments include the increasing incorporation of artificial intelligence (AI) into production systems, public governance, education, and labor markets. The objective of this study was to provide an overview of the theoretical basis of digitalization and AI; provide an overview of the various approaches to regulating digitalization and AI; and assess the importance of competence development in the digital economy. This study employed a comprehensive analytical approach to the topic. It included a review of academic literature, policy statements, regulatory frameworks, and national strategies regarding digitalization and AI governance. The results demonstrated that digitalization in the present day, while continuing the trend toward computerization and the emergence of platform-based economies, represents a paradigm shift in the increasing use of AI in systems and processes. Consequently,

there will be a need to adapt legal and institutional frameworks to protect data privacy, promote ethical uses of AI, ensure transparency and accountability of algorithms used in decision-making, etc. The study also revealed significant differences across countries in the regulatory approaches to digitalization and AI. Additionally, the results provided evidence of the substantial benefits of acquiring digital and AI-related competences as a necessary condition for achieving both sustainable and equitable economic development. As such, it is important to ensure that digital and AI-related competences are integrated into education systems and workforce training programs. Such actions would assist in reducing technological disparities and enable individuals to develop the skills required to effectively respond to digital transformations. The study provides practical recommendations for those responsible for policy formulation, educators, and researchers who wish to improve regulatory frameworks and facilitate the effective inclusion of AI in the economy and education systems.

Keywords: digitalization; human capital; artificial intelligence; global economy; digital economy; AI skills

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ЭКОНОМИКАДАҒЫ ЦИФРЛАНДЫРУ ЖӘНЕ ЖАСАНДЫ ИНТЕЛЛЕКТ: ТЕОРИЯЛЫҚ НЕГІЗДЕРІ, ҚҰҚЫҚТЫҚ РЕТТЕУ ЖӘНЕ ҚҰЗЫРЕТТІЛІКТЕРДІ ДАМУ

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Аннотация. Соңғы кездері цифрлық технологиялардың өсіп келе жатқан әсері әлемдік экономикаға терең әсер етті. Цифрландырудың экономикалық модельдерге, институционалдық құрылымдарға және

адами капиталдың дамуына қазіргі әсері автоматтандырудың салдарынан өндіріс және жұмыспен қамту құрылымдарындағы бұрынғы өзгерістерден ерекшеленеді. Жаңа үрдістерге өндіріс жүйелерінде, мемлекеттік басқаруда, білім беруде және еңбек нарықтарында жасанды интеллекттің (ЖИ) кеңінен қолданылуы жатады. Бұл зерттеудің мақсаты цифрландыру мен ЖИ теориялық негіздеріне шолу жасау; цифрландыру мен ЖИ-ді реттеудің әртүрлі тәсілдерін қарастыру; және цифрлық экономикадағы құзыреттіліктерді дамытудың маңыздылығын бағалау болды. Бұл зерттеу тақырыпқа кешенді аналитикалық тәсілді қолданды. Оған академиялық әдебиеттерге, саяси мәлімдемелерге, нормативтік базаларға және цифрландыру мен ЖИ-ді басқаруға қатысты ұлттық стратегияларға шолу кірді. Нәтижелер компьютерлендіруге және платформалық экономиканың пайда болуына бағытталған үрдісті жалғастыра отырып, қазіргі заманғы цифрландыру жүйелер мен процестерде ЖИ-ді пайдаланудың артуындағы парадигмалық өзгерісті білдіретінін көрсетті. Демек, деректердің құпиялылығын қорғау, ЖИ-ді этикалық пайдалануды ілгерілету, шешім қабылдауда қолданылатын алгоритмдердің ашықтығы мен есептілігін қамтамасыз ету және т.б. үшін құқықтық және институционалдық базаларды бейімдеу қажет болады. Зерттеу сонымен қатар елдердің цифрландыру мен жасанды интеллектті реттеуге көзқарастарындағы айтарлықтай айырмашылықтарды анықтады. Сонымен қатар, нәтижелер цифрлық және жасанды интеллектке қатысты құзыреттіліктерді алудың тұрақты және әділ экономикалық дамуға қол жеткізудің алғышарты ретіндегі маңызды артықшылықтарын растады. Сондықтан, білім беру жүйелері мен кәсіптік оқыту бағдарламаларына цифрлық және жасанды интеллектке қатысты құзыреттіліктерді интеграциялауды қамтамасыз ету маңызды. Мұндай әрекеттер технологиялық теңсіздікті азайтуға көмектеседі және адамдарға цифрлық трансформацияға тиімді жауап беру үшін қажетті дағдыларды дамытуға мүмкіндік береді. Зерттеу нормативтік базаны жетілдіруге және жасанды интеллекттің экономика мен білім беру жүйелеріне тиімді интеграциялануын ілгерілетуге ұмтылатын саясаткерлерге, оқытушыларға және зерттеушілерге практикалық ұсыныстар береді.

Түйін сөздер: цифрландыру; адами капитал; жасанды интеллект; жаһандық экономика; цифрлық экономика; жасанды интеллект дағдылары

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ЦИФРОВИЗАЦИЯ И ИСКУССТВЕННЫЙ ИНТЕЛЛЕКТ В ЭКОНОМИКЕ: ТЕОРЕТИЧЕСКИЕ ОСНОВЫ, ПРАВОВОЕ РЕГУЛИРОВАНИЕ И РАЗВИТИЕ КОМПЕТЕНЦИЙ

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Аннотация. В последнее время растущее влияние цифровых технологий оказывает глубокое воздействие на мировую экономику. Нынешнее влияние цифровизации на экономические модели, институциональные механизмы и развитие человеческого капитала отличается от предыдущих изменений в структуре производства и занятости, вызванных автоматизацией. Новые тенденции включают в себя все более широкое внедрение искусственного интеллекта (ИИ) в производственные системы, государственное управление, образование и рынки труда. Целью данного исследования было представить обзор теоретических основ цифровизации и ИИ; представить обзор различных подходов к регулированию цифровизации и ИИ; и оценить важность развития компетенций в цифровой экономике. В данном исследовании использовался комплексный аналитический подход к теме. Он включал обзор академической литературы, политических заявлений, нормативно-правовых рамок и национальных стратегий в отношении управления цифровизацией и ИИ. Результаты показали, что современная цифровизация, продолжая тенденцию к компьютеризации и появлению платформенной экономики, представляет собой сдвиг парадигмы в растущем использовании ИИ в системах и процессах. Следовательно, возникнет необходимость адаптации правовых и институциональных рамок для защиты конфиденциальности данных, содействия этичному использованию ИИ, обеспечения прозрачности и подотчетности алгоритмов, используемых при принятии решений, и т. д. Исследование также выявило значительные различия между странами в подходах к регулированию цифровизации и ИИ. Кроме того, результаты подтвердили существенные преимущества приобретения цифровых компетенций и компетенций, связанных с ИИ,

как необходимого условия для достижения устойчивого и справедливого экономического развития. Таким образом, важно обеспечить интеграцию цифровых компетенций и компетенций, связанных с ИИ, в системы образования и программы профессиональной подготовки. Такие действия помогут сократить технологическое неравенство и позволят людям развить навыки, необходимые для эффективного реагирования на цифровые преобразования. Исследование содержит практические рекомендации для лиц, ответственных за разработку политики, педагогов и исследователей, желающих улучшить нормативно-правовые рамки и способствовать эффективному включению ИИ в экономику и системы образования.

Ключевые слова: цифровизация; человеческий капитал; искусственный интеллект; глобальная экономика; цифровая экономика; навыки в области ИИ

Introduction. Beginning with today's digitalization, there is an emphasis on using data as a primary source, building out digital infrastructure, and growing the number of platform-based entities, including marketplaces, social networks, and service-based ecosystems. As such, the ways organizations can compete and create value are evolving (UNCTAD, 2024). Digital transformation concerns how digital technologies and data are transforming existing and emerging forms of activity (Zakon, 2015). Therefore, it is critical to develop a digital future that is trusted and inclusive, and to establish institutions of trust and risk management (OECD, 2026). Artificial intelligence (AI) is playing a significant part in the digitalization process. AI can process data, simplify decision-making, and accelerate product development. As AI evolves, there will be a greater need for regulations. Regulations would include establishing guidelines and oversight mechanisms for transparency; setting boundaries and limitations on high-risk AI use; and protecting human rights (EP&CEU, 2024). The development of a regulatory system for AI will require a comprehensive governance framework encompassing principles, soft law, human rights treaties, industry standards, and risk management standards (OECD, 2019a).

Literature Review. Both digitalization and AI are core elements of the Fourth Industrial Revolution, thereby creating new production systems, reshaping labor markets, transforming innovation processes, and influencing sustainability models. Nonetheless, recent research has shown that there is considerable fragmentation in how digitalization and AI are conceptualized and analyzed in the current literature.

One of the largest bodies of research concerning the structural influence of digitalization and AI on employment and organizational economies has been conducted. In particular, Clauberg (2020) states that Industry 4.0 policy objectives aim to optimize the use of production systems through cyber-physical systems and intelligent automation. At the same time, they create significant challenges for labor markets, including job displacement and structural unemployment. Additionally, Sima et al. (2020) describe the changes in job profiles and the increasing demand

for employees possessing digital skills. Although both studies recognize the significance of re-skilling and education, they essentially adopt a technologically deterministic view of the relationship between technological change and labor market transformation.

Conversely, another area of literature views digitalization and AI from a human capital-centered perspective, focusing on the adaptability of individuals and organizations. Bryukhovetska et al. (2025) state that, in the context of the digital economy, human capital develops new strategic attributes including flexibility, digital literacy, and the capacity to function in decentralized work environments. This view is additionally supported by Staliarova (2022), who examines national competitiveness in terms of the development of AI based on indicators such as venture investments, scientific publications, and digital infrastructure. The primary difference between the studies presented here and those cited previously is that they move the focus away from the technological disruption caused by digitalization and AI and toward the institutional and capability-based explanation of why economic outcomes are influenced not just by technology, but also by the quality of human capital and the supporting ecosystem.

Finally, there is a third area of literature that explores the relationships among digitalization, AI, and sustainability and circular economy (CE) models. Specifically, Pathan et al. (2023) demonstrate that AI can improve resource efficiency and enable the implementation of CE, while Waqas et al. (2025) empirically validate the positive effects of digital technologies on CE performance via the means of supply chain integration using PLS-SEM modeling. However, as indicated above, the majority of the literature within this area tends to examine the impacts of digitalization on specific sectors or environmentally-related outcomes without examining the broader institutional and regulatory dimensions of digitalization.

The aforementioned areas of literature reveal several limitations. Most importantly, the vast majority of studies of digitalization either have been examined from a technological viewpoint (i.e., automation and AI adoption), a human capital viewpoint (i.e., skills and competences), or a sustainable viewpoint (e.g., waste reduction and energy consumption), and therefore do not provide a common analytical framework that incorporates all three viewpoints. Moreover, the institutional and regulatory aspects of AI governance typically are not addressed within the same context as the economic and behavioral transformations that occur as a result of the adoption of digital technologies. Thus, there exists a lack of coherence in the way the digitalization process is viewed. Finally, there is a relative absence of consideration of the behavioral mechanisms by which digital technologies affect decision-making, competences, and social interaction.

Therefore, the need for an integrated multilevel analysis framework that considers the technological system, the behavioral transformations that occur as a result of digitalization, the development of human capital, and the regulatory environment of institutions, clearly emerges as a research gap. This study aims to

address this gap by combining Digital Behavior Transformation Theory, human capital theory, and institutional economics in order to develop a comprehensive theoretical framework to evaluate digitalization and artificial intelligence in the economy.

Materials and Methods. This research draws upon Digital Behavior Transformation Theory (Rachmad, 2025), which shows that digitalization and Artificial Intelligence (AI) are systematically changing behavior across all aspects of society, including organizations and individuals alike. It has been noted that data-driven systems, algorithms, and AI technologies are doing more than simply optimizing economic activity. They have also fundamentally changed our thought structures, decision-making mechanisms, and social/economic interactions.

This theoretical base was strengthened through the use of Human Capital Theory, which illustrates the importance of knowledge, skills, and competencies as being the primary drivers of productivity and economic growth. In the digital economy, Human Capital has evolved to include digital and AI-related competencies, continuous learning capacity, and behavioral flexibility.

The integrated conceptual model links:

- (1) digital technological systems (AI, big data, platforms),
- (2) behavioral transformation processes (Rachmad, 2025),
- (3) human capital development and,
- (4) institutional governance structures.

To achieve an adequate level of analysis, quantitative data-based indicators have been complemented by a qualitative analysis of national digital strategies and their corresponding policy frameworks. The application of this mixed-methods approach enables a comprehensive assessment of economic systems at both the microeconomic and macroeconomic levels through the use of artificial intelligence and digitalization. According to the World Bank’s Digital Progress and Trends Report 2025 (World Bank, 2025), there are also notable cross-country differences in developmental paths of digital progress.

Table 1 — Digital Development Indicators

Country	Internet usage (% population)	Digital infrastructure development	Platform economy intensity	Digital skills gap	Overall digital development level
United States	92%	Very high	Very high	Low	Advanced
European Union	89%	High	High	Low–Moderate	Advanced
China	75%	High	Very high	Moderate	Rapidly developing
Kazakhstan	86%	Medium	Medium	Moderate–High	Emerging

Source: World Bank (2025)

The U.S. and EU are among the world’s most digitally transformed economies, supported by high internet use, well-developed digital infrastructure, and highly

interconnected platform-based business models (World Bank, 2025). These countries have achieved much higher levels of digitalization than the majority of the world's economies.

China represents a unique form of digitalization. It has the highest level of platform-economy intensity and the lowest internet penetration among the other three countries. Therefore, China is developing its digital economy under a government-driven model that prioritizes scale and technology over access and skills.

Kazakhstan has a high internet penetration rate (86%) compared to some developed economies; however, it is still considered to be in an emerging phase of digital development due to limited digital infrastructure and a large digital skills gap. Therefore, this finding supports the claim that having access to digital technologies alone does not guarantee full-scale digital transformation.

Quantitative interpretation of index-based indicators was used in conjunction with qualitative content analysis of policy documents and strategic programs. The combination of qualitative and quantitative methods enabled a more holistic view of how digitalization and AI impacts economic systems at both the micro and macro levels.

Results. It is necessary to differentiate among the concepts of digitization, digitalization, and digital transformation. Digitization is the conversion of analog information into machine-readable formats (OECD, 2026). Digitalization is the use of digital technologies, data, and connections to develop and innovate new products and services. Digital transformation describes the far-reaching implications of digitalization on economies and societies. Thus, knowing what type of technology an organization uses will help identify how technology is changing the way businesses operate and whether those changes extend beyond the adoption of technology itself.

As stated above, studies and research on digital transformation show that it is more than the use of Information and Communication Technologies (ICTs). Digital transformation is characterized by the creation of new markets, the emergence of new forms of doing business based on platforms, changes in employment, and new ways of generating and sharing value. At present, the digitalization process is occurring in phases. First, there were phases of computerization and office automation. Then came the phase of the Internet and platforms. Now we are entering a data-driven economy, where data is the core.

According to UNCTAD, rapid cross-border data flows and powerful digital platforms are unbalancing the global value chain. Therefore, the trend of digitalization is increasingly dependent on international relations and economics. Powerful digital platforms capture the majority of the value generated from data, build stronger networks, and make it harder for users to switch to other platforms. As a result, large digital platforms gain greater market power. The literature shows that digital markets grow in size, diversity and user experience. Nevertheless, many obstacles remain. Digital transformation occurs primarily within existing sectors.

For that reason, it is difficult to isolate the influence of data, platforms and artificial intelligence on productivity and welfare. Moreover, it is difficult to determine the dimensions of the digital economy, either as an independent industry or as a sector overlapping with others. The lack of clear measurements of the digital economy creates uncertainty for governments to understand the full economic consequences of the use of AI and data systems.

In addition, recent UNCTAD reports show that the volume of e-commerce between 2016 and 2022 increased significantly and, at the same time, the volume of smartphones, IoT devices and digital infrastructure continue to increase. At the same time, the ecological footprint of digital technologies grows. Consequently, the debate around sustainable digitalization is increasing. In conclusion, our results show that digital transformation simultaneously stimulates economic dynamism and exerts additional pressure on the environment, thus demonstrating the necessity for holistic governance strategies.

Finally, our comparison of regulatory systems at the international level highlights four interrelated levels of governance: ethical principles and soft law; international human rights obligations; binding regulations; and managerial standards.

From the level of principles and soft law, the OECD (2019a) and UNESCO (2021) have played key roles. The OECD's Recommendation on Artificial Intelligence sets out seven value-based principles for trustworthy AI. These principles include transparency, accountability, robustness, inclusiveness and long-term sustainability. The OECD's Recommendation provides a common language for trustworthy AI across jurisdictions. UNESCO's Recommendation on the Ethics of AI emphasizes human dignity, fundamental rights, fairness and human oversight. This supports a human rights-centered approach in the global governance of AI.

From the perspective of international law, the Council of Europe's Framework Convention on Artificial Intelligence is a landmark. It is the first binding international treaty on AI and human rights, establishing standards that require states to guarantee that AI systems respect democracy, the rule of law and fundamental rights at all stages. From an economic policy perspective, this establishes a legal base that will shape national regulations.

The European Union has the most comprehensive binding regulatory system for AI, the AI Act (EP&CEU, 2024). The EU uses a risk-based approach to classify AI systems into banned, high-risk, low-risk and minimal-risk categories. The EU considers AI as a part of a broader digital regulatory system. These regulations form a coherent regulatory system. The U.S. focus on risk management and flexible policies: the NIST AI Risk Management Framework (AI RMF 1.0) (National Institute of Standards and Technology, 2023) is a non-binding voluntary guidance document. It offers guidance to organizations on managing AI-related risks throughout the lifecycle of an AI system. In 2025, federal policy turned towards deregulation. Executive Order 14110 was rescinded. Regulatory barriers

to maintaining AI competitiveness were reduced. Advisory documents, including the AI Bill of Rights, remain advisory and not binding.

The Chinese regulatory approach is based on a state-centric model. The Personal Information Protection Law (PIPL) (NPC, 2021) provides strong data protection for individuals. The PIPL also provides specific provisions governing generative AI services. The Interim Measures for Generative AI Services (CAC, 2023) establish the requirements for content control, national security and compliance. The Chinese model thus illustrates a focus on social stability and the control of digital infrastructure by the state. At the organizational level, international standards such as ISO/IEC 42001:2023 (ISO, 2023a) ensure that the governance principles are implemented practically by organizations. These standards provide a structured approach to implementing accountability, transparency and continuous improvement. They connect the macro-regulatory framework to micro-compliance practices.

Our study of Kazakhstan demonstrates a sequential institutionalization of digital transformation. Kazakhstan developed a step-by-step approach to digital transformation and AI governance. The “State Program ‘Digital Kazakhstan’” (2017) was initiated to promote economic modernization and raise the quality of life of citizens using digital technologies. The program was concluded in 2022 but established the necessary basic infrastructure and strategic orientation. A renewed strategic orientation was then given with the Security Strategy 2023-2029. In 2024, the Concept for AI Development (2024-2029) specified priority areas of development for Kazakhstan in AI. These priority areas included data ecosystems, infrastructure development, research capacities, and human capital formation.

A major milestone was the introduction of the Law “On Artificial Intelligence” (No. 230-VIII) (Zakon, 2025) in November 2025. The Law became effective in January 2026. This Law institutionalized the regulation of AI governance nationally and marked the transition from program-based regulation to legal regulation. The AI governance of Kazakhstan is embedded in a broader legal framework, namely the Law “On Informatization” (Zakon, 2015) and the Law “On Personal Data and Their Protection” (Zakon, 2013). The two Laws form the basis of data governance and cybersecurity standards.

The Decree of the President of the Republic of Kazakhstan declared 2026 as the Year of Digitalization and Artificial Intelligence. The decree emphasized the importance of AI policy at the national level and further stimulated the inclusion of AI in national economic and administrative systems. Evaluations are currently being conducted at technological, behavioral, institutional and macro-economic levels. The convergence of regulatory frameworks and competence frameworks demonstrates that governments and researchers increasingly recognize the close connection between the governance of AI and the formation of human capital and institutional design.

Each region has its own distinct regulatory approach. The EU is rights-based. The US is market-based. China is state-based. Each recognizes the significance

of data and AI. Kazakhstan is developing a similar approach. It is combining strategic planning with the establishment of new laws. In summary, the findings support the view that digital transformation is more than just technological. Digital transformation is a transformation of the entire economy. The relationship among regulation, human capital, and technology will therefore determine whether digitalization leads to inclusive growth or exacerbates inequality on a global level.

Discussion. This research demonstrates that digitalization and artificial intelligence (AI) have fundamentally changed how economic systems function, and that this change has not been merely a technological advancement. The research will be analyzed through a conceptual model that combines Digital Behavior Transformation Theory (Rachmad, 2025), human capital theory, and institutional economics, with an emphasis on current global regulatory and geopolitical trends. Digitization, digitalization, and digital transformation (OECD) represent different levels of analysis. Digitization and digitalization represent purely technical processes, whereas digital transformation represents changes in institutions, labor markets, and the distribution of value. AI systems, according to Rachmad (2025), perform functions beyond automating tasks; they change the behavior, decision-making, and adaptation of individuals within the economy.

Therefore, digital environments currently function more like behavioral infrastructures. Algorithms select the information presented to consumers, direct what products and services are purchased, determine who is hired and fired, and increase productivity. Consequently, consumer and business decision-making is increasingly being influenced by AI. Thus, to fully comprehend the impact of digital transformation, we must analyze how technology influences human choice. However, institutional economics indicates that technological change is not free from regulatory oversight. Legal frameworks, governance standards, and public policy define the incentives, risk allocations, and market structures. As such, the extent of behavioral transformation is determined by the nature of the institutional design.

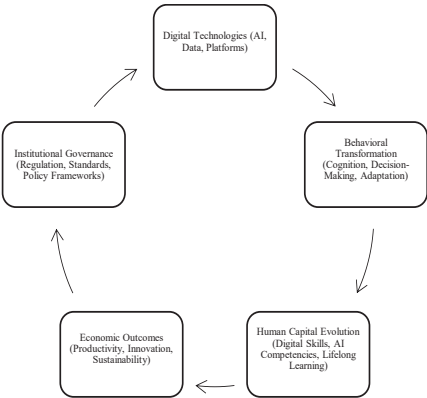


Figure 1 — Dynamics of Digital Transformation
Note: developed by authors

Figure 1 illustrates the feedback loop of technology, behavior, and institutions. Behavior creates pressure for new rules on technology. Thus, we will look at the divergent views of regulatory philosophy and the economic implications of the same. In comparison of the European Union, the USA, China, and Kazakhstan, there are divergent views of regulation. Each has different economic implications.

The European Union’s approach to regulating AI is based upon a risk assessment methodology that reflects a rights-focused model that includes regulation of AI within the broader data governance architecture. The integrated systems of regulation (AI Act, GDPR, Digital Services Act, Data Act) prioritize the concepts of transparency, accountability, and human oversight. Although this may cost more money in terms of compliance with the EU regulatory structure, it could ultimately increase confidence in the use of AI, provide greater stability over time, and protect rights. In contrast, the USA uses a more flexible, market-based approach to regulate AI. The voluntary guidelines of the National Institute of Standards and Technology (NIST) AI Risk Management Framework (2023) reduce regulatory burdens and may foster faster innovation; they also may contribute to increased risks and less equitable accountability.

China’s regulatory approach to AI is state-led and integrates regulation of AI into national security and content management. A strong central authority in overseeing AI development and implementation may promote rapid scale-up and coordination among industries; however, there may be limits to the ability to promote international standards or the protection of individual rights. Finally, Kazakhstan’s regulatory approach is illustrative of an adaptive approach to institutional alignment.

Kazakhstan’s trajectory demonstrates adaptive institutional alignment. The transition from strategic programs to a formal AI law suggests movement toward regulatory consolidation. However, its regulatory ecosystem is still in an early stage of institutionalization compared to the EU. Comparative models of AI control are presented in Table 2.

Table 2 — Comparative AI Governance Models

European Union	Rights-based, risk-oriented	AI Act, GDPR, DSA, Data Act	High compliance, increased trust, harmonized standards
United States	Market-driven, voluntary risk management	NIST AI RMF, executive policies	Innovation flexibility, potential regulatory fragmentation
China	State-centric, sovereignty-focused	PIPL, Generative AI Measures	Coordinated scaling, centralized oversight
Kazakhstan	Hybrid, institutional transition	AI Law, Digital Concepts	Emerging governance framework, institutional capacity building

Note: developed by authors

A comparison of the models shown in Table 2 illustrates how different regulatory strategies can affect country-to-country competition within the global AI economy. Regulatory fragmentation caused by a lack of coordination on rules can negatively affect cross-border data flow and digital trade.

Regardless of the regulatory environment, human capital is the primary driver of all factors. The increased reliance on advanced digital skills, knowledge of artificial intelligence (AI), and ongoing learning and adaptation needs are created through the process of digital transformation. The behavioral transformation theory provides additional insight into the human capital theory through its explanation of how digital systems shift the incentives for acquiring the needed skills for the job. In addition to needing to learn the new technical skills, workers must be able to adapt their cognitive abilities to the algorithmic nature of these digital environments.

Lifelong learning has transitioned from being a political talking point to an unavoidable structural necessity. However, as yet, there are no clear indications of how AI adoption will impact individuals or groups. While automation may displace routine jobs, it is likely to create many high-skill jobs. If no policies exist that enable every individual to acquire the new skills required for the digital age, then it is possible that the digital transformation could exacerbate income inequality.

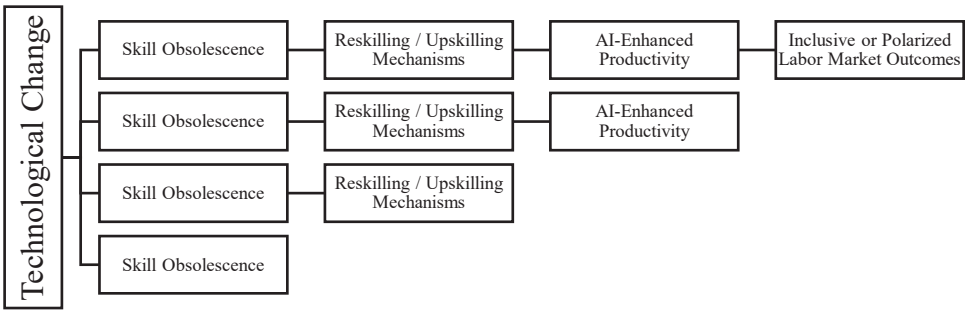


Figure 2 — Human Capital Adaptation Pathway
Note: developed by authors

The data generated in Figure 2 illustrates four potential trajectories of labor-market adjustment; policy choices can decide if skill upgrading (reskilling) will generate inclusive growth or labor market polarization.

The economics of large-scale networks, where data is collected and analyzed by large platforms, increases the power of scale and network relationships. These larger platforms have an advantage due to their ability to collect and analyze the behavioral data they are able to collect. Additionally, high barriers to entry, as well as the use of algorithms to optimize their operations, create a barrier to entry for competitors.

Therefore, this supports the view of UNCTAD that digital value chains contribute to an unequal distribution of profit. Developing and middle-income countries will be challenged to capture economic benefit from the growing number of data-intensive activities.

Understanding the causal relationship of the effect-and-cause diagram shown in Figure 3 to Kazakhstan’s strategy to develop artificial intelligence is necessary to fully understand how a national strategy to build data systems, research capabilities, and collaborate with regional actors will affect its ability to capitalize on the benefits of developing AI.

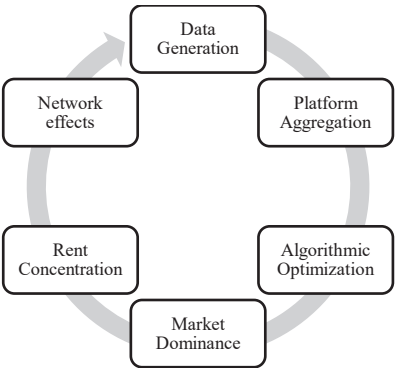


Figure 3 — Data-Driven Value Concentration Model
Note: developed by authors

Figure 3 shows how feedback loops between data generation and platform aggregation can make inequalities /asymmetries worse.

Digitalization makes processes more efficient but also uses more energy. AI training, data centers, and more IoT devices add to environmental pressure. Because of this, the idea of “sustainable digitalization” is now very important.

Regulations now more often include environmental risk assessments. However, the economic reasons to use green AI are still not the same everywhere.

	Environmental Pressure	Sustainability
Digitalization	↑ Energy Demand & E-Waste	↑ Productivity & Connectivity
Sustainable Digitalization	→ Policy Intervention	→ Green AI & Sustainable Infrastructure

Figure 4 — Digitalization–Sustainability Trade-Off
Note: developed by authors

The trade-off illustrated by Figure 4 highlights the need for effective governance in order to integrate sustainability metrics throughout the regulation of the AI life cycle.

Our results demonstrate that successful digital transformation relies heavily upon the existence of stable institutions. In cases where a country has fragmented regulations, this fragmentation can lead to reduced levels of trust and cooperation. Conversely, overly restrictive regulations can impede innovation.

Although the most recent policy changes in Kazakhstan indicate an increasing

alignment with international standards regarding AI development, naming 2026 the Year of Digitalization and AI will assist in achieving the desired level of coordination among institutions. Ultimately, however, the success of such efforts will be determined by the presence of clear regulations and strong enforcement, and the ability of the public and private sectors to cooperate effectively.

An integration of the Digital Behavior Transformation Theory with both human capital and institutional economics provides a valuable analytical tool. The theory illustrates that digital transformation simultaneously involves:

1. Technological (the AI systems themselves),
2. Behavioral (the cognitive adaptations necessary to utilize the technology),
3. Institutional (the regulatory design which facilitates the use of the technology) and,
4. Structural (market power).

By using a multi-level approach to analyzing digital transformation, researchers can begin to link micro-behavioral changes with broader macro-governance trends.

Conclusion. Digitalization and AI are changing the economy across both technology and institutions. Changes in these areas influence labor market structures, redefine the state's regulatory and technological roles, and create new governance needs and requirements for human capital development. The OECD (2019a) has previously established the need for effective interaction among technological systems, regulatory frameworks, and competencies to develop a sustainable digital economy.

Based on previous research (OECD, 2019a), this study demonstrates that successful digital transformation is based on three interconnected foundations: Data and Platform Governance; Development of Trustworthy and Legally Regulated AI Systems; and Formation of Digital and AI-Related Competencies. Specifically, AI Regulation should take a risk-based approach throughout the lifecycle of AI systems, with clear differentiation between prohibited practices and high-risk applications. Additionally, national regulatory frameworks should align with international human rights standards and the principles of trustworthy AI, including transparency, accountability, and non-discrimination. The use of internationally recognized governance and risk management frameworks, such as the NIST AI Risk Management Framework and ISO/IEC Standards, could support the operationalization of regulatory requirements at the organizational level.

The study's results indicate that the development of digital and AI competencies is a necessary foundation for the long-term resilience of the economy and inclusive growth. Education and training systems that integrate international competency frameworks, such as DigComp 2.2 and UNESCO ICT standards, provide a systematic response to the rapid spread of AI technologies. As well, Labor Market Policies should account for the increasing demand for digital and data-related skills, thereby making large-scale upskilling and reskilling efforts a strategic priority during periods of accelerating technological change.

Today, Kazakhstan is experiencing a turning point in its digital transformation.

2026 has been declared the Year of Digitalization and AI. The Law “On Artificial Intelligence” has opened a unique opportunity to modernize the regulatory framework and industrial strategy. However, the success of this transition will be dependent on the consistency of institutional reforms, the quality of governance mechanisms, and the extent of integration into Global Digital Ecosystems.

Finally, the overall contribution of this study is to propose an Integrated Analytical Framework that incorporates technological, behavioral, institutional, and human capital aspects of digital transformation. As well, this study is limited by its conceptual and comparative design. Therefore, future studies should focus on incorporating empirical and longitudinal data to assess the causal relationship of AI and Digitalization on Productivity, Labor Markets, and Economic Inequality across various countries and developmental environments.

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