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GOVERNMENT DEVELOPMENT IN THE DIGITAL ECONOMY

E-government is crucial for modernizing public administration in the context of rapid digitalization. This paper examines e-government's evolution from basic process automation to advanced models incorporating AI, blockchain, and big data. Key e-government construction models are analyzed, emphasizing the need for comprehensive implementation to transform the public sector. Case studies illustrate technology's impact on service efficiency, while also addressing challenges like digital inequality, cyberattacks, and organizational barriers. International indices (UN EGDI and OECD DGI) are evaluated, noting their limitations. Ethical dilemmas, such as balancing managerial efficiency and data privacy, are also addressed. Future e-government prospects involve AI for predicting social risks and strengthening international dialogue on digital rights.

Keywords: *e-government, digital transformation, artificial intelligence, digital divide, cybersecurity, data protection, EGDI, ethical challenges*

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ЭВОЛЮЦИЯ ЭЛЕКТРОННОГО ПРАВИТЕЛЬСТВА В УСЛОВИЯХ ЦИФРОВОЙ ТРАНСФОРМАЦИИ

В условиях цифровой трансформации электронное правительство является ключевым фактором модернизации государственного управления. Статья анализирует эволюцию электронного правительства, включая интеграцию ИИ, блокчейна и больших данных. Автор исследует модели построения электронного правительства, подчеркивая необходимость их комплексного внедрения для трансформации госсектора. На примерах ряда стран демонстрируется повышение эффективности услуг. Однако прогресс сталкивается с вызовами, такими как цифровое неравенство и кибербезопасность. Статья оценивает международные индексы, отмечая их ограничения. Особое внимание уделяется этическим дилеммам, таким как баланс между эффективностью и приватностью данных. Перспективы развития электронного правительства связаны с внедрением ИИ для прогнозирования социальных рисков и укреплением международного диалога о цифровых правах.

Ключевые слова: *электронное правительство, цифровая трансформация государственного управления, искусственный интеллект, цифровой разрыв, кибербезопасность и защита данных, индекс развития электронного правительства (EGDI), этические вызовы цифровизации*

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Introduction

The rapid evolution of the digital economy necessitates a reevaluation of governance approaches, positioning the implementation of e-government as a critical strategy for enhancing the efficiency, transparency, and accountability of governmental institutions. The digital environment, underpinned by information and communication technologies (ICT), presents novel opportunities while simultaneously generating challenges related to technology integration, data security, and the digital divide. This article examines the progress of e-government within the context of the digital economy, focusing on its key trends, innovations, and implications for public administration and service delivery.

Research results

E-government is defined as the application of ICT in governmental functions and processes to improve efficiency, transparency, and citizen engagement. Historically, initial initiatives in this domain (1990s-2000s) concentrated on the digitalization of specific processes, particularly the automation of routine operations (e.g., tax payments), and online information dissemination, such as the establishment of government web portals for publishing laws and forms. However, with technological advancements (artificial intelligence, big data, blockchain) and evolving user expectations, the e-government model has evolved. It now encompasses online service delivery to citizens and businesses, citizen participation tools (e-petitions, crowdsourcing), data analytics for decision-making, and inter-agency integration.

Some key distinctions between traditional and contemporary e-government models are presented in Table 1.

Table 1

Traditional vs. New Paradigm of E-Government

Criterion	Traditional E-Government	New Paradigm of E-Government
Focus	Digitization of individual government processes, automating transactions, and providing information online	Deep integration of digital technologies across all government functions, enabling data-driven decision-making, citizen engagement, interagency collaboration, and personalized services
Approach	Mostly transactional, focused on efficiency and streamlining existing procedures	Transformative, with a focus on improving service delivery, promoting transparency, and empowering citizens
Technology	Primarily focused on basic web technologies, like websites and simple online forms	Leverages advanced technologies like artificial intelligence (AI), big data analytics, cloud computing, and mobile applications to create more innovative and user-friendly services
Citizen participation	Passive (access to information)	Active (co-management through digital platforms)

Source: author's developed.

Therefore, in accordance with the new paradigm, e-government can be defined as a transformational approach to the provision of public services, leveraging advanced digital technologies for big data-driven decision-making, citizen engagement, inter-agency collaboration, and personalized services. It aims to create a more efficient, transparent, and responsive public sector that empowers citizens and businesses in the digital world [2]. Key elements of the new model include a shift from "digitization" to process re-engineering, the use of big data analytics for forecasting and optimization, the protection of personal data and critical infrastructure, and inclusivity, i.e., bridging the digital divide through training and expanded access to technology.

Within the framework of e-government, five main interaction models are distinguished [3; 4]:

1) government-to-citizens (G2C) – digital services for the population;
2) government-to-business (G2B) – interaction with the commercial sector;
3) government-to-government (G2G) – interstate or interregional communications;
4) department-to-department (D2D) – data exchange within departments;
5) internal efficiency (IEE) – optimization of internal processes of government bodies [2; 3].

These models encompass the key aspects of digital interactions within the e-government system (Table 2).

Table 2

Five models of e-government

Model	Description	Examples	Advantages
G2C	Digital interaction between the state and citizens	Public services portal, mobile applications for paying fines, online voting	Simplification of procedures, availability of services, reduction of bureaucracy, transparency
G2B	Digital interaction between government and business	Electronic platforms for public procurement, online registration of enterprises	Acceleration of processes, transparency of procurement, simplification of interaction with government agencies
G2G	Data exchange between government agencies of different levels state apparatus	Interdepartmental electronic platforms, document management systems	Reducing duplication of functions, increasing the efficiency of the state apparatus
D2D	Intra-departmental information exchange between departments	Corporate document management systems, databases for departments	Optimization of internal processes, cost reduction
IEE (G2E)	Digitalization of internal processes of public bodies and interaction with employees Improving management efficiency, reducing costs, improving the quality of services	HR-systems, electronic document management, online training of civil servants	Improving management efficiency, reducing costs, improving the quality of services

Source: [3; 4].

A comprehensive approach integrating all five models is essential for the successful implementation of e-governance. This integration facilitates a holistic transformation of the public sector, ultimately leading to improved governance and enhanced quality of public service delivery.

The new e-governance paradigm leverages a range of advanced technologies to improve efficiency and deliver superior services to citizens. Key technologies include:

– Artificial intelligence (AI) for task automation, data analysis, personalized service delivery, and improved customer service quality.

– Big data analytics, enabling government agencies to derive valuable insights from diverse sources for more informed decision-making and service enhancement.

– Cloud computing for secure and accessible data storage and processing, streamlining inter-agency collaboration and increasing service accessibility.

– Mobile applications, making government services more accessible and convenient for citizens. These applications enable citizens to access information, pay bills, schedule appointments, and more, via their mobile devices.

– The Internet of Things (IoT) allows government agencies to collect data from various devices and systems, aiding in efficiency improvements and service quality enhancements. For example, sensors in a water supply system can detect pipe issues and prevent failures.

– Blockchain technology for secure and transparent transactions and data management. This includes managing government registries, providing e-services, and streamlining public procurement processes.

These technologies collectively contribute to a more integrated and efficient e-government system. The implementation of e-government is transforming the interaction between the state, citizens, and businesses, thereby enhancing service accessibility. Online platforms facilitate remote task completion, including tax payments, permit acquisition, and document requests. For instance, certificates can be obtained via the "E-Pasluga" mobile application without the need to leave one's residence, streamlining both personal and professional activities. Estonia has achieved 99 % online availability of government services, reducing document processing times to mere minutes. Several countries publish open data on budgets, government procurement, and projects on specialized portals, such as data.gov in the United States. In Singapore, the Gov.sg platform reaches 82 % of the population through messaging applications like Telegram and WhatsApp.

Process automation reduces paper-based workflows and associated costs. According to the Korea Institute of Public Administration, the implementation of the Open Fiscal Data system in South Korea has increased public trust in the government. Big data analytics aids in forecasting needs. For example, in Finland, analyzing social media inquiries allows for real-time adjustments to healthcare center operations.

Despite its advantages, the implementation of e-government faces systemic challenges. A primary issue is the digital divide. According to the "ICT Development Index 2024" report by the International Telecommunication Union, approximately one-third of the global population (around 33 %) lacks internet access. Even within the OECD, 14 % of students do not have home internet access. Countries are addressing this through programs like the "Homework Gap" in the United States,

In Table 3, we have summarized the benefits of e-government, and the challenges associated with its implementation.

Table 3

Benefits and challenges of e-government

Category	Advantages	Challenges of Implementation
Citizens	Increased accessibility and convenience. Reduced bureaucracy and paperwork. Enhanced transparency and accountability. Personalized services. Enhanced participation in governance	Unequal access to technology and digital skills among certain demographic groups. Limited accessibility for those without internet access. Concerns about data privacy and security
Businesses	Simplified business registration and licensing. Improved access to government information and services. Efficient procurement processes. Reduced corruption	Resistance to change from traditional methods. Complex integration with existing systems. Lack of trust in online security and data protection
Government	Enhanced efficiency and effectiveness. Reduced costs. Improved data analysis and insights. Increased transparency and accountability	Resistance to change from government officials. Bureaucratic inertia and lack of coordination between agencies. Security threats and data breaches. High costs associated with development and implementation

Source: author's developed.

A comprehensive strategy integrating technological, educational, and managerial aspects is essential for the successful implementation of the e-government concept. The following are key areas for optimization, supported by international experience.

The primary condition for the accessibility of electronic services is to increase the level of digital competence of the population. It is necessary to introduce digital literacy courses for all age groups, including training in working with online platforms. Cybersecurity and data protection are critical factors for trust in e-government. To this end, it is necessary to implement end-to-end encryption protocols to

protect transactions. Conduct regular penetration tests and vulnerability assessments of systems. For example, Estonia uses X-Road, a decentralized data exchange system with multi-level authentication.

Feedback and adaptation of services to the changing needs of users are also necessary. For example, the UK uses Google Analytics and Heatmaps tools to study citizens' interaction with the GOV.UK portal.

Collaboration with the business sector accelerates innovation and expands the functionality of e-government services. Therefore, it is important to implement joint projects, as, for example, in the UAE, where a partnership with Du allowed the creation of a single platform for paying fines, registering businesses, and accessing medical services.

As global experience shows, a systematic approach allows for the creation of a transparent, convenient, and sustainable ecosystem that meets the challenges of the digital age [7].

To assess the level of e-government development in countries around the world, the United Nations (UN) calculates the E-Government Development Index (EGDI) – a global indicator published every two years as part of the UN E-Government Survey report [8]. It serves as a tool for analyzing progress in the digitalization of public services, ensuring inclusiveness, and the efficiency of governance.

The index combines three key components, each of which reflects different aspects of e-government:

Online Services Index (OSI) – the quality and availability of public services provided via the Internet

Telecommunication Infrastructure Index (TII) – measures the technological base for accessing digital services.

Human Capital Index (HCI) – analyzes the ability of the population to use digital services (literacy rate of the adult population, the average number of years of schooling, the proportion of the population with higher education, the gender equality index in access to education).

Countries are divided into four groups by EGDI level: very high (0.75-1.0), high (0.50-0.75), medium (0.25-0.50), low (0-0.25) [8].

Table 4 presents the leading countries by EGDI index for 2024 compared to 2022.

Table 4

Leading countries in e-government development, 2022

Country	Region	OSI	HCI	TII	EGDI (2024)	EGDI (2022)
1. Denmark	Europe	0,9992	0,9584	0,9966	0,9847	0,9717
2. Estonia	Europe	0,9954	0,9497	0,9731	0,9727	0,9393
3. Singapore	Asia	0,9831	0,9362	0,9881	0,9691	0,9133
4. Republic of Korea	Asia	1	0,912	0,9917	0,9679	0,9529
5. Iceland	Europe	0,9076	0,9953	0,9983	0,9671	0,941
6. Saudi Arabia	Asia	0,9899	0,9067	0,9841	0,9602	0,8539
7. United Kingdom	Europe	0,9535	0,945	0,9747	0,9577	0,9138
8. Australia	Oceania	0,9222	1	0,9509	0,9577	0,9405
9. Finland	Europe	0,9097	0,9836	0,9791	0,9575	0,9533
10. Netherlands	Europe	0,9212	0,9688	0,9715	0,9538	0,9384
11. United Arab Emirates	Asia	0,9163	0,9436	1	0,9533	0,901
12. Germany	Europe	0,9238	0,9672	0,9236	0,9382	0,877
13. Japan	Asia	0,9427	0,9117	0,9509	0,9351	0,9002
14. Sweden	Europe	0,8836	0,9275	0,9868	0,9326	0,941
15. Norway	Europe	0,9117	0,9175	0,9654	0,9315	0,8879
16. New Zealand	Oceania	0,9453	0,9615	0,8728	0,9265	0,9432
17. Spain	Europe	0,9054	0,8961	0,9603	0,9206	0,8842
18. Bahrain	Asia	0,903	0,868	0,9877	0,9196	0,7707

Source: [8].

The Organisation for Economic Co-operation and Development also calculates the composite Digital Government Index (DGI) based on six key dimensions, each of which assesses different aspects of the digital transformation of the public sector [9]. Here is the structure of the DGI:

1. Digital by Design assesses the institutional foundations for digital government.
2. Data-Driven Public Sector analyzes data management as a strategic asset.
3. Government as a Platform assesses digital infrastructure and tools.
4. Open by Default focuses on transparency and engagement.
5. User-Driven measures the engagement of citizens and businesses.
6. Proactiveness assesses the use of new technologies for proactive management.

If the EGDI answers the question of whether citizens can conveniently receive public services online, then the DGI answers the question of whether the state is able to systematically introduce innovations and manage digital transformation. As a rule, the EGDI is high in countries with developed Internet infrastructure, even if the digital government does not provide transparent data. The DGI ranking is led by countries with strong institutions and strategies (Denmark, South Korea), even if the infrastructure is not the most advanced.

The EGDI is criticized for underestimating digital inequality, as the index averages data across the country, ignoring differences between regions, including between urban and rural areas. The quality of online services is investigated manually by UN experts who analyze portals based on their subjective assessments. In addition, data protection and privacy indicators are not included in the calculation of the EGDI index.

The DGI index is criticized for being oriented towards "ideal" management models, which is difficult to apply in countries with a low level of digitalization, as well as for not assessing the quality of services for end-users.

Below are two successful examples of the implementation of the e-government concept. According to the 2024 UN report, Singapore has significantly increased its EGDI value, which highlights its success in digital transformation [8]. The Smart Nation initiative, launched in 2014, prioritizes innovation in public services and economic competitiveness. As a result, Singapore has been at the top of the Smart City Index since 2019. The 2021 National AI Strategy has expanded the use of AI in public services, including the Accelerated AI Master's Program to develop local AI talent, as well as intelligent analytical systems for healthcare (predictive patient analytics) and transport (route optimization). The Singpass unified platform provides access to 2700+ services through 800+ departments. The Research, Innovation, and Enterprise Plan 2025 aims to strengthen technological leadership, improve digital infrastructure, and maintain cybersecurity and data protection standards.

Estonia continues to occupy the top lines of the ratings for the level of e-government development through the creation of a reliable infrastructure and long-term initiatives [8]. The country emphasizes the importance of proactive services, ensuring absolute digital accessibility and inclusiveness for all demographic groups by 2030. Estonia has developed a comprehensive digital identification system that provides seamless online access to public services. Focusing on data-driven governance, the country is also a pioneer in the integration of AI, cybersecurity, and next-generation technologies such as 5G.

These case studies demonstrate that the success of e-government depends on strategic planning, investment in infrastructure, and citizen engagement.

The Republic of Belarus also demonstrates certain successes in the development of e-government.

Thus, Belarus has created a unified portal of electronic services (UPES). Today, more than 570 electronic services are available for ordering on the EPES (https://e-pasluga.by/): obtaining information on real estate rights, taxes paid, offenses; information on checking whether a car is wanted, the availability of driving rights, additional funded pension insurance; registration of foreign citizens; transfer of customs documents; obtaining permits to enter the border zone, and many others.

Belarus is actively developing mobile applications to access government services. For example, the application "E-Pasluga", this allows citizens and businesses to solve various life situations online.

Electronic signature is used to sign electronic documents, which simplifies interaction with government agencies.

To realize the possibility of exchanging electronic documents between different instances, a system of interdepartmental document flow of state bodies has been created. Currently, about 12,000 Belarusian organizations and agencies work in the IDS.

Belarus belongs to countries with a high level of the EGDI index. The State Program "Digital Development of Belarus" for 2021–2025 provides for the further development of e-government technologies.

China belongs to countries with a very high level of the EGDI index. In 2014, the Chinese Social Credit System (SCS) was launched, which is a large-scale experiment on the integration of digital technologies into public administration. Although its full implementation was initially planned for 2020, the system continues to develop as a hybrid model, combining state and commercial components. The state segment of the SCS, unlike commercial credit ratings, focuses on assessing the social behavior of citizens and organizations through the prism of compliance with laws and ethical standards. Here are some characteristics of this system. Digital "blacklists" record violations – non-payment of taxes, lawsuits, violation of environmental standards. "Red lists" mark socially approved actions – charity, donation, volunteering. The lists are available on government portals (for example, https://www.creditchina.gov.cn) and are integrated into e-government platforms. Being included in the "blacklists" for individuals is fraught with restrictions on air travel, the purchase of real estate, access to premium educational programs. For companies – a ban on participation in public procurement, a decrease in the rating on the stock exchanges. For the "reliable" ones, certain privileges are possible – simplified visa issuance, preferential loans.

The SCS has become a technological framework for digital governance, combining data from more than 70 government systems. Artificial intelligence analyzes data to assign ratings, reducing bureaucratic procedures.

By 2024, 13,537 government web portals have been created [10], including www.gsxt.gov.cn – the state system of open information on the creditworthiness of Chinese enterprises.

Criticism of the SCS comes down to the lack of clear rules for the use of personal information (for example, data from facial recognition cameras), many appeals against incorrect inclusion in the "blacklists". The Chinese model of e-government through the SCS shows how mass digitalization can increase management efficiency but raises complex ethical issues.

Conclusion. E-government has become an integral element of modern public administration, transforming the interaction of government with society in the digital economy. From automating basic processes, such as online tax payments, it has evolved into a comprehensive model based on the integration of artificial intelligence, big data analysis, and blockchain technologies. This transformation has not only made it possible to optimize bureaucratic procedures but also to create personalized services, where predictive analytics in healthcare helps to prevent diseases, and benefits are assigned automatically. However, the introduction of such systems is associated with challenges: a third of the world's population still does not have access to the Internet, and the gap in digital development between countries with high and low per capita incomes reaches 55 points on the IDI index. Cyber threats and organizational barriers complicate progress.

Leading countries demonstrate that success requires not only technology but also a systematic approach. Digital literacy programs expand access for vulnerable groups, and decentralized systems, such as X-Road, ensure data security. At the same time, mass digitalization, increasing manageability in society, raises a number of ethical questions about privacy and the rights of citizens.

International indices, such as the UN EGDI and the OECD DGI, help to assess progress but have limitations. The EGDI, focusing on the availability of services and infrastructure, ignores regional inequality within countries, and the DGI, which assesses the institutional foundations, is poorly applicable to states with a low level of digitalization. The prospects for the development of e-government are related to the balance between innovation and ethics. The key areas for the development of e-government in the coming years will be the introduction of AI to predict social risks and the strengthening of international dialogue on digital rights.

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