Innovative Approaches to Public Services Delivery through the Prism of the Industry 5.0 Paradigm

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ABSTRACT

The article analyzes case studies based on innovative approaches to the delivery of public services in Kazakhstan emerging from and interpreted through the Industry 5.0 Paradigm. These approaches are defined by a common desire to provide services that are consciously and proactively human and citizen -entered. The Industry 5.0 Paradigm is a new stage of industrialization characterized by citizen-centricity principle and advanced technology implementation. Its impact is growing, with researchers and public officials paying increasing attention to the parameters of implementation. However, analysis of the application of these approaches through digital portals, shows that a number of omissions currently prevent public services delivery from reaching their full potential.

The same perspective on difficulties associated with e-services provision was received from survey results. From January till November 2023 about 52,612 questionnaires for 373 electronic public services were distributed among all 20 regions of Kazakhstan. Besides this, 9,954 respondents have assessed the overall quality of public services delivery based on several criteria. The "Feedback" indicator had the lowest estimated average score and level of satisfaction. The analysis of quality of public services delivery shows that starting in 2020 there is an upward trend associated with the proactive digitization in Kazakhstan. The study provides several suggestions on this issue for policy decision makers, as well as for relevant government bodies and for future research.

Key words: public innovation, public services, digitization, Industry 5.0 Paradigm, Kazakhstan.

Introduction

More than 90% (1 234) of the 1 327 registered Kazakhstani public services are available electronically through the country's Electronic Government portal, found on its website at http://egov.kz. Only 42 types of public services (3%) are provided proactively. Public services may be obtained by Kazakhstani citizens using an electronic digital signature, face identification, fingerprint identification, or a one-time "SMS" texted password using various mobile applications, services and social networks (E-govmobile, Telegrambot).

While the demand for electronic services increased during the COVID-19 pandemic, some public services remained unavailable or were difficult to obtain under

COVID-19 quarantine conditions. Moreover, the Electronic Government portal proved unready for such massive and simultaneous demand and failed to provide consistent service. Problems included inadequate performance and insufficient internet server bandwidth. According to the Republic of Kazakhstan Agency for Civil Service Affairs' data on quality monitoring of public services delivery, the population generally expressed dissatisfaction with the timeliness of public services delivery and service providers' responses, as well as lack of employee competence and efficiency (Agency, 2023).

Such technical failures in these information systems have also unwittingly become a contributing cause of corruption in intermediary services. As a result, the number of citizen complaints and appeals about lack of available information on obtaining public services increased.

From the perspective of theory, content analysis and case studies, the paper aims to contribute by responding to calls for research and by assessing e-government modernization in order to improve the effectiveness of the state apparatus.

The main research hypothesis is that the digital measures taken by Kazakhstan through the prism of the Industry 5.0 Paradigm will lead to increased citizens' satisfaction with the quality of public services provided.

Literature review

The Industrial Revolution has been responsible for an unprecedented transformation in humanity's way of life, due to its effects on individuals' regular routines and the automation of their work. It continues today. While the recent digital upheaval occurred concurrent with a huge boom, it was innovative technology that prompted the improvement of personal computers (PCs), advanced control instruments, programming, and utilization of incorporated circuits that made it possible (Yadav, Arora and Dhull, 2022).

Scholars have described the ongoing industrial revolution as having, so far, five stages. Each new stage of industry addresses a pivotal evolution of the modern assembly and production system (Varshney et al., 2024).

Industry 1.0 (Manufacturing) began in the early eighteenth century. It was defined by the combination of mechanization and steam power. Key developments included steamships and steam locomotives that revolutionized long-distance transportation for both freight and passengers.

Industry 2.0 (Mass Production) appeared in the 19th century. At that time electricity became the main source of power, and new management tools were developed (e.g., pure production, agile).

Industry 3.0 (Production Automation) began in the middle of the 20th century. It was distinguished by the development of electronics and computer technology.

Industry 4.0 (Digitalization) started in the 2000s. It was distinguished by "Internet of Things" based cyber-physical systems. Widespread connections between cyber and physical systems were made possible by an increasingly sophisticated Internet platform.

Industry 5.0, the Fifth Industrial Revolution, is an emerging phase of industrialization. It was first conceptualized by the European Commission in 2021 (Breque, De Nul and Petridis, 2021). It is grounded in nascent developments of co-existence, such as human-machine co-creative, resilient and cyber-physical systems for mass customization. The main feature of the 5th Revolution is the application of advanced technology (artificial intelligence, big data, Internet of Things, robotics, machine learning, etc.) with a human-centered focus.

In particular, the human-centric Industry 5.0 could be achieved based on implementation of collaboration architecture between humans and machines. It supports user-friendly practices, fosters a more innovative work environment and involves robots and artificial Intelligence collaboration with humans to increase work effectiveness. The Industry 5.0 already adopted by USA, Canada, United Kingdom, China, South Korea and Japan. Other countries (for example, Australia, Italy, Germany, India, Saudi Arabia), including Kazakhstan named the Fifth Industrial Revolution as a strategic direction for country development. Specifically China remains a significant participant in the Industry 5.0 market due to government initiatives promoting advanced technologies adoption (Industry 5.0 Market Report, 2024).

Looking ahead, researchers predict the emergence of Industry 6.0 beginning around 2050. This future envisions a collaboration of artificial intelligence, inexhaustible cloud energy and Drone 3-D printing, utilizing satellite networks and industrial robotics (Yadav, Arora and Dhull, 2022).

In each case, development of scientific thought and industry presupposes progressive development. In this regard, innovative approaches are fundamental for obtaining a synergistic effect. Innovation in the public sector can be defined as "the implementation by a public sector organization of new or significantly improved process, methods or services aimed at improving a public sector unit's operations or outcomes" (OECD, 2016). The innovative features of Industry 5.0 compared to previous approaches is its citizen-centricity and the placing of the wellbeing of the worker at the center of the production process (European Union Commission, 2022). New technologies are used to provide prosperity, create jobs and growth, while respecting the production limits of the planet. Even with advanced technology the planet cannot support present rates of economic and population growth much beyond the year 2100. As was defined in the Report for the Club of Rome's Project on the Predicament of Mankind there are five basic factors that determine the production limits of the planet: population increase, agricultural production, nonrenewable resource depletion, industrial output, and pollution generation (Meadows et al., 1972).

"Electronic government" involves citizens in governance based on their interests, using technological advances such as the internet and its social communication capabilities, with the aim of providing high-quality public services delivery (Helbig, Gil-García and Ferro, 2009). The role of citizens in this context is fundamental. Increasing needs of the population have resulted in significant modernization of technology and development of science. The issues of citizen-centricity and customer orientation have been key elements of digital transformation over the past thirty years.

With increased citizen involvement in the decision-making process, the quality of services provided by state bodies is increasing on the basis of principles such as clear standards, information openness, increased access to the public, and active consideration of feedback (Kassen, 2020). Countries also have the capacity to learn from each other, as each country typically has its own approaches to public services delivery and assessments of their quality (Syvertsen, 2012; Bokayev et al., 2021). World practice is accumulating tremendous experience in the development and implementation of electronic government.

For example, many countries, including Canada, the United States, South Korea, Malaysia and Singapore are implementing information development strategies for both society as a whole and in certain areas (Çaldağ, Gökalp and Alkış, 2019). Singapore has strategically identified the development of e-government as one of the most important processes to improve public services delivery. This is because e-government aims and tools increase the transparency of public services delivery by eliminating the human factor and optimizing both procedures and state administration efficiency, while providing greater opportunities for interaction between the state and the population. At the same time, provision of integrated e-services, government responsiveness and transparency, and the primary use of information and communication technologies are becoming basic principles.

The Industry 5.0 Paradigm is permeates strategic documents for the development of the digitalization sector in developed and developing countries of the world. South Korea, Singapore and Estonia are considered the leading countries in the implementation of digital innovations. The main components of Industry 5.0 that have given the greatest effect in the development of the public sector in these countries are Artificial Intelligence, Big Data, Internet of Things, etc. Kazakhstan could learn from this success.

Ethics of the Industry 5.0 Paradigm

The Industry 5.0 Paradigm as significant technological transformation raises important ethical issues. Based on its multifaceted context, the main ethical concerns could be:

- Environmental issues. Technology production and large-scale data centers should take into account a responsible use of resources (energy and carbon consumption, waste, including digital waste, management, etc.);

- Privacy issues. Data collection raises significant concerns about privacy, cyber security, and transparency;

- Bias, discrimination and dehumanization issues. The human-machine collaboration might diminish autonomy, creativeness and decision-making skills of workers. Besides this, limited design and content of advanced technologies (for example, artificial intelligence) could lead to manipulation of public perception and overlook the needs of underrepresented groups in the population;

- Workforce transformation issues. The robotization and widespread introduction of information technologies make a significant contribution to a shift in labour markets (job loss, reskilling);

- Global inequality issue. Less economically powerful regions may be primarily affected by the digital divide and social gaps. Social responsibility should become a key aspect when considering the territorial location of digital innovation or information technology (IT) companies.

While applying the Industry 5.0 Paradigm governments should adhere to ethical frameworks and a balanced approach that considers the well-being of workers, citizens, and the environment, and mitigates negative consequences.

Summarization

According to the OECD (2023), the key characteristics of governance are continuity, voluntary participation, decentralization and transparency. In-depth study of this issue and, in particular, constant criticism from society, leads us to three considerations that are vitally important to the implementation of good governance through the prism of Industry 5.0 Paradigm. The first addresses the possibilities and conditions for the functioning of government institutions and employees of these organizations. The second involves citizens' interests and motives for participation. The third considers ethical aspects of rapid dissemination of advanced information technologies.

The first consideration is based on fundamental works and cases devoted to the analysis of organizational transformations that improve the quality of human capital, as well as strategic and project management (Drucker, 2008; Kotter, 2012; Adizes, 2016). The key themes that appear to unite the works of these authors include an emphasis on organizational changes implemented with the involvement of all employees, the leader of transformations and a source of strategic priorities, and the development of employee competencies, taking into account the strengths and weaknesses of each employee. These researchers agree that improving productivity, efficiency and quality of work must begin with an analysis of internal and external factors in the organization, taking it as a "living organism" characterized by stages in a life cycle.

The second consideration is focused on the creation of comfortable conditions for the delivery of services to the population, the openness of departmental data and transparency of state bodies, and the search for motives that would involve citizens in decision-making processes and forms of organizing public hearings, including through the active use of modern information technologies. At the same time, current realities dictate the need for more proactive interaction in the provision of services with respect to citizens' life situations and their participation in decision-making, crowdsourcing, public councils, and public hearings. Thus, both aspects should be considered together as they have a mutual impact on the end result – cooperation of the parties concerned (Newman, Barnes, Sullivan and Knops, 2004).

The third consideration is based on potential ethical challenges of Industry 5.0 implementation. Ethical implications are becoming increasingly important since technologies are being rapidly introduced into all areas of our lives (from education and health care to aerospace industry).

To summarize the literature analysis, we note the current lack of theoretical and practical work that examines the three considerations simultaneously in relation to a single research target.

Research Questions

The main research questions are as follows:

1. How have approaches to the provision of public services changed taking into account a permanent shift from one industrial revolution to the next one?

2. What are the main ethical concerns of Industry 5.0 implementation?

3. What cases of the Industry 5.0 Paradigm are noteworthy for Kazakhstan?

4. What other innovative approaches of the Industry 5.0 Paradigm could be implemented in the Kazakhstani public sector?

5. How has digitization affected citizens' satisfaction with the quality of public services?

Methodology

This section reflects key methodological procedures and innovative approaches of public services' digitization in Kazakhstan. For this purpose a comprehensive analysis based on a case study and a survey are used in the study.

Research design

The effectiveness and efficiency of a study significantly depends on the research instruments applied. Methods include qualitative and quantitative, empirical and theoretical, general and particular, as well as other types. Few tools exist for measuring collaboration, and those that do exist are difficult to adapt outside the immediate context of a specific research project (Thomson and Perry, 2006).

The goal is to determine the level of service recipients' satisfaction with quality, availability, and procedures of public services delivery by service providers.

The main research methods employed in this work are a case study and two surveys. The authors conducted a comprehensive analysis of the normative legal documents regulating the activities of government bodies in the provision of public services, as well as preparation of policy and strategic planning documents of the Republic of Kazakhstan. The documents consisted of official data, including statistical, reporting and analytical materials from government bodies, and materials from official websites of international organizations.

The public monitoring of the quality of public services covered all 20 regions of the country. Assessment of the quality of public services is based on a 5-point Likert scale. The survey included 9,954 respondents. Also, the results of an online survey on the e-government portal are analyzed. The survey period was from January until November 2023, involving 52,612 questionnaires for 373 public services (Appendix A).

The assessment of the quality of public services is based on the following criteria:

- Availability and convenience. Along with convenience, availability of public services is a determining factor for opportunities to obtain it. Accessibility mostly means the availability of physical and non-physical access to the service;

- Information and communication. Information provided by all links service providers must be accessible, open, complete, reliable and up-to-date, and completion steps and additional explanations are clear to anyone service recipient, regardless of age, gender, language of communication, level education and other features;

- Procedure. The collection procedure and document submission process should be simple and clear, both organizationally and technically;

- Cost. According to the 2023 register of public services, a significant part of public services is provided for the population free of charge (58% or 782 services). Also, regardless of whether the service has a fee or is free, there will be additional costs to obtain services, such as making photocopy of documents, photo costs, travel to another location, receiving additional documents (for example, an assessment), etc. These circumstances may be a financial barrier to receiving public services for socially vulnerable groups in the population;

- Feedback (complaints with the authorized government body or organization providing this service);

- Deadlines and Virtual Assistant (chatbot).

Demographic profile of respondents

According to the results of public monitoring of the quality of public services, among the survey participants about 50.5% were female and 49.5% were male, about the same proportion as in the population. The largest age categories were service recipients 30-39 years old (37.4%) and 40-49 years old (25.4%). Older people (50 years and older) are also an active category of service recipients (25.4%). The smallest category is youth under 29 years of age - in total 16.8%.

Among electronic portals and services, respondents indicated that in most cases, the service was received through the "e-government" portal (E-gov.kz, 65.7%), a substantial portion of the services were received on the electronic licensing portal (elicense.kz, 30.8%), the mobile applications of the e-government web portal (eGovmobile, 2.3%), additional online services – telegram bot EgovKZBot (0.2%) and other portals (11%).

Findings

This section offers an historical overview of e-government development in Kazakhstan and case studies of digital transformation based on the country's innovative approaches.

Kazakhstani e-government retrospective context

Since 2005, Kazakhstan has been reforming its system for providing public services. Public Services Centers (PSC) were created throughout the country, that employed the "one-

stop" operating principle. A typical PSC is a non-governmental counter service located in a modern and functional facility, accessible to citizens for the purpose of processing their applications for official documents, payment of registration fees, and a variety of other government systems in a professional atmosphere (Knox, 2008).

In 2006, the e-government portal eGov.kz was launched, through which public services were to be provided to Kazakhstan's 13.5 million citizens. That year, citizens received 415 million public services using the eGov.kz portal. Today, the e-government portal is considered an important and primary tool for both the population and businesses to interact with government agencies. It has not only improved the quality of public services, but also Kazakhstan's international ratings.

As an example, according to UN ratings, Kazakhstan held 24th place in the development of e-government (UN Global E-Government Development Index) among 193 states. In particular, Kazakhstan ranked 10th in the Online Services Index (OSI). The leaders in the world OSI rankings were South Korea, Denmark and Estonia. Kazakhstan continues to lead among the Commonwealth of Independent States, ahead of the Russian Federation (43rd), Armenia (48th), Uzbekistan (63rd) and Azerbaijan (74th). Kazakhstan also significantly improved its position in the Telecommunications Infrastructure Index (TII), rising 23 positions to 41st place since 2022.

The UN Global E-Government Development Index report also noted that Kazakhstan has made significant progress in digital transformation, actively investing in digital infrastructure and introducing advanced technologies such as artificial intelligence, blockchain and the Internet of Things (IoT). These initiatives have improved the management and delivery of public services, making them more accessible and transparent, including through solutions such as E-License and Smart Data Ukimet.

The Concept for the Development of Public Administration in the Republic of Kazakhstan to 2030 (Ministry of National Economy, 2021) determined that, in practice, only 10% of the 698 services then included in the Register of Public Services were actually in demand. The Concept assumes that the formation of a new model of public administration, focused on the people, directly depends on the construction of a service and "people-centric" model of public administration. In this regard, the government apparatus has been tasked with creating a client-oriented and open government apparatus, by transitioning to proactive public services based on the real needs of its citizens. To implement this, a single center for receiving citizens' appeals (109) has been created on the basis of the Public Service Center - a "single entry point", through which citizens will have the opportunity to submit appeals to various government bodies for convenience and prompt resolution of issues.

Since 2017, it has been possible to receive public services without using an electronic digital signature, using instead a one-time password and login/password. The unified contact center (phone number 1414) provides information regarding public services delivery procedures, documents and terms. Continuing with a proactive approach to meeting the people where they are, a service for the birth of a child was also launched by receiving Short Message Service confirmation from citizens. Since 2018, a service has been available on the e-government web portal for third parties to obtain electronic certificates upon receipt of confirmation from a

citizen, such as an address certificate for the place of residence, certificates of the absence (presence) of real estate, and of registered rights to real estate.

Also beginning in 2017, a new composite service "Registration of a legal entity", including a proactive opening of a bank account and compulsory insurance of the employee, has been available on the egov.kz portal. Upon registration of a legal entity, it is now possible to submit an application for the electronic opening of a bank account and the conclusion of an employee insurance agreement. The Top-5 most significant digital initiatives are presented in Table 1.

Table 1: Top-5 Initiatives and Projects of the e-government of Kazakhstan

Digital initiative	Launch year	Description	Innovation (Improvements)
E-government portal	2006	Combined information about the work of various departments and provided a single access point.	Improving the quality and accessibility of public services
E-licensing system	1st stage (2008-2012)	Foundations of the system were laid, the basic infrastructure was created and the necessary regulatory acts were developed to regulate the electronic licensing process	Simplification of interaction between the business community and government agencies
	2nd stage 2012-2014)	Automation of permits, integration with other government information systems	
Open government	2013	Components of "Open Government": - Open data; - Open legislation; - Open dialogue; - Open budgets; - Evaluating the effectiveness of government agencies.	Strengthening trust between the state and society. Formation of an effective management system
eGov Mobile	2019	- A wide range of services; - Millions of active users; - Improving accessibility; - Convenience and ease of use; - Contribution to digital transformation.	Strengthening of the connection between state and citizens. Contribution to development of digital economy, stimulating further innovations in public services.
Smart Bridge and "Showcase of Services" platform	2020	- Simplify integration; - Stimulating competition and innovation; - Facilitating access to public services; - Impact on the economic environment.	Facilitating integration of business processes with government systems and public services. Accelerating digital transformation.

Source: https://www.digitaldonut.kz/post/top-5-iniciativ-i-proektov-elektronnogo-pravitelstva-kazahstana?ysclid=m2bprztrz6726206468

In 2018, with the exception of service assessment, which is within the competence of the Agency of the Republic of Kazakhstan for Civil Service Affairs and Anti-Corruption, the functions of maintaining state policy in the provision of public services were transferred from the Ministry of National Economy of the Republic of Kazakhstan to the authorized body for digitalization, due to their direct oversight of all digital tools involved. The main platforms for obtaining public services for citizens were fixed as the e-government portal and the State Corporation "Government for Citizens".

By the Law of May 24, 2018, the functions related to state registration of rights to real estate were transferred from the jurisdiction of the Justice authorities to the State Corporation. Since July 30, 2018, the State Corporation has been registering real estate. From July 1, 2023, state registration (e.g., of private entities) was transferred to the State Corporation.

In order to increase the efficiency of electronic public services, reduce paperwork, popularize the services of the "electronic government" portal and promote digital culture among citizens, a Digital Public Service Center has been launched in the city of Astana. Citizens can independently obtain electronic services in the self-service point, as well as take a training course in obtaining electronic services.

In 2022 the "e-Otinish" system was first implemented as a unified database of citizens' appeals, accessible to all levels of government, that allows applicants to track the progress of their appeals. The system will eventually allow government bodies to focus on identifying and solving pressing problems that concern citizens on the scale of an individual locality, region or at the national level. The e-Otinish platform also allowed observers to identify 200 "hidden" services that are not included in the Register of Public Services.

In Kazakhstan, the number of proactive services offered has reached 40; offering more than two million instances of service have been provided in 2023. A proactive state provides composite services through the principle of one application with the integration of information systems and databases. Thus, the activities of the state apparatus are focused on the proactive provision of services to citizens, reformatted to meet the needs of the population.

Case studies of Kazakhstani innovative approaches

This section consists of several case studies analyzing efforts aimed at improving the quality of public services delivery.

Case 1. *Life situation services.*

Life situation services are provided proactively, for example, with the birth of a child. Previously, in order to receive a birth certificate and related benefits, a mother was forced to visit the public service center with her child in her arms. After that, she had to write several applications to receive benefits, waiting on various institutions for two weeks before receiving responses.

Now, the state congratulates new mothers who pre-registered their pregnancy via SMS at the time of birth, and asks them to indicate the name of their newborn in a response SMS. The personal registration number and birth certificate are prepared and benefits are assigned, and the attending nurse is notified about discharges from the maternity hospital via SMS. About 400 thousand children are born in the country every year, with 68% of them registered in this proactive online format.

A second example of a life situation service regards the digital family card. Present data on 6.3 million families has been digitized, and of the 18 socially significant services, including benefits and payments to large families, persons with disabilities, or those who have lost their

breadwinner, all can be provided proactively. About 800 thousand digital family cards have been issued, providing access to these services.

Case 2. Exclusion of electronic certificates via the gathering of necessary documentation from connected data platforms (Big data).

Every year the government must provide 50 million certificates accounting for people moving from one place to another. They have been converted to digital format. However, analysis has shown that the issue of requiring paper certificates has not yet been completely resolved: citizens continue to receive requests for hard copy certificates from employers and schools.

By using Big Data tools, the electronic government portal also proactively sends messages notifying the population about the impending expiration of documents. Moreover, it is prohibited to request the hard copy of document if citizen provided it to public authorities at least once.

Case 3. Blockchain technologies and biometric identification.

When buying or selling real estate, such as a house, apartment or office, there is now no need to contact a notary or a public service center, as before. An online service has been provided using Blockchain technologies and biometric identification. All actions and video materials performed for each person are stored in the "electronic government". Thus, a process that once took several days has been reduced to 1 hour.

The key guidelines for the further digital modernization of Kazakhstan based on innovative approaches are laid down in the Concept of Digital Transformation, governing the country's development of the information and communication technologies and cybersecurity industry for 2023-2029, as well as the Concept of Artificial Intelligence Development for 2024-2029. The connecting link between the two concepts is the innovative orientation of the proposed IT solutions. The implementation of these concepts is intended to contribute to the comprehensive development of the country's innovation potential, as well as strengthen the domestic innovation system and its transition to a qualitatively higher level (Ministry of Digital Development and Aerospace Industry, 2023). As a result, a single e-government platform will provide for end-to-end interdepartmental digitalization of processes and the creation of an integrated organizational and technical infrastructure both for the provision of services and for ensuring the activities of the public administration system. Some successful cases are presented in Table 2.

Table 2: Successful Cases in the Framework of Digitalization of Kazakhstan

Field	Case	Description	Innovation (Actual Improvements)
Healthcare	Smart Clinic	Digital routing and alternative ways for doctor's appointments (Call Center, e-government portal, eGov Mobile, self-recording terminal)	Simplified and affordable procedure for obtaining medical services
	Mobile healthcare (mHealth) and "remote	Online consultations between doctors and patients in rural areas	Reducing the average number of patient visits from 9 to 6

Field	Case	Description	Innovation (Actual Improvements)
	consultations"		
	Robot Surgeon	The first such project in the post-soviet region	Three-dimensional observation of the surgical field; minimal risks of infection; absence of serious pain after surgery
Education	Smart School	Implementation of an access control system. Equipping with information and interactive terminals and panels to display information about the study curriculum.	Improving the quality of educational process
	Smart Kindergarten	Electronic attendance records, monitoring of children's development, automated internal processes	
E-services	Paying taxes online	Mechanism for banks to transfer information about the payment of tax and customs payments online	Reducing the time required to transfer payment information to information systems to a few minutes
	Proactive public services	Provision of services by the state to citizens without their request, based on data contained in information systems upon the occurrence of a certain life situation	Reducing the service delivery time by 2 working days, reducing the paper document flow by 300 thousand documents
Employment	Electronic Labour Exchange Enbek.kz	More than 98 thousand employers and about 486 thousand applicants have been registered. The number of jobs in the database has increased by 18%	The time of employment from registration has declined by 1/2.
Postal services	Use of drones in postal services in Kazpost JSC	Delivery using drones with a payload capacity of up to 2 kg.	Reducing the delivery time by 1/4
Agriculture	Smart Farms	The use of electronic field maps as a basis for precise agriculture.	73.3% of the arable land, or 3.5 million hectares, has been digitized.
Transport	Implementation of the "Sergek" traffic control AI system	AI photo and video recording system to issue tickets and prevent traffic violations	Prevention of corruption and elimination of the ability to pay fines on the spot

Source: https://egov.kz/cms/ru/succeedcases

A national artificial intelligence system based on Smart Data Ukimet is being created, which will allow predictions and decision-making by models trained on reliable data. The key shift in direction is toward a data-driven government model. The implementation of this initiative involves decision-making at the state level, considering verified evidence, analytics and reliable informed forecasts. This will allow the implementation of evidence-based policies and clearer predictions of the potential impact of new initiatives to help policymakers make appropriate decisions (Ministry of Digital Development and Aerospace Industry, 2024). The digitization initiatives are mostly covered by government budget.

Implementation of these initiatives will lead to the building of an effective state apparatus aimed at solving citizens' life situations in the most convenient way, as well as maximizing and aggregating relevant online data for the possibility of using artificial intelligence tools in scenario modeling and decision-making.

Kazakhstani experience of Industry 5.0 Paradigm adoption

Kazakhstan officially adopted the Industry 5.0 Paradigm starting this year by approval government policy as the Concepts for the Development of Artificial Intelligence for 2024-2029. At the same time, the foundation was laid earlier (in 2021) when the Concepts for the development of public administration in the Republic of Kazakhstan until 2030 was approved. There were separate initiatives to create chat bots, analyze big data and generally have a human-centric approach in human and machine interactions.

Industry 5.0 in Kazakhstan holds significant potential to modernize the country's industrial landscape, enhance economic diversification, improve productivity, and foster innovation. The uniqueness of the Kazakhstani approach lies in the fact that the state had previously laid the foundation for a human-centric and client-oriented approach. The entire system of interaction between government agencies and citizens starting from the first introduction of an e-government portal was rebuilt in this direction. At the moment, the main focus is on the development of human capital with skills in artificial intelligence. Relevant scholarship training programs, grants for starting private entreprizes are linked to this paradigm.

Kazakhstan faces challenges with unequal access to advanced technology between urban and rural areas. While cities like Almaty and Astana are experiencing faster technological adoption, remote and rural areas may struggle with the infrastructure required for Industry 5.0.

Industry 5.0 can help Kazakhstan diversify its economy by reducing dependence on oil and gas exports and fostering innovation in high-tech sectors like IT, renewable energy, and digital services. By integrating human intelligence Kazakhstan's industries can achieve higher productivity, smart energy management systems, and green manufacturing. The implementation of advanced technologies still requires raw materials, some of which are not renewable. Kazakhstan must carefully manage its resource extraction and avoid overconsumption of non-renewable resources, which could contribute to environmental degradation.

Overall, establishing an ethical framework for Industry 5.0 technologies will be essential for Kazakhstan, especially in sensitive areas like healthcare, education, privacy, cybersecurity and data protection.

Survey results

Public monitoring of the quality of public services has been taking place since 2015. It is conducted annually by independent public organizations with the financial support of the Agency for Civil Service Affairs. This allows government and society to track the dynamics of the quality of public services (Table 3).

According to Table 3 the dynamics of assessing the quality of public services delivery shows the variability of the trend. From 2015 to 2019 there is an upward trend, and from 2020 to 2023 there is an upward trend.

Table 3: Assessing the quality of public services delivery 2015-2023

Year	Average score	Level of satisfaction	Sample	Quantity of public services
2023	4,75	81,3%	62401	423
2022	4,70	81,2%	32572	415
2021	4,59	75,4%	23217	95
2020	4,58	75,1%	9181	70
2019	4,73	74,8%	14500	65
2018	4,66	72,4%	10000	60
2017	4,57	65,9%	9517	55
2016	4,59	72,8%	9082	50
2015*	7,90	79,0%	8327	39

Note: * - In 2015, the methodology for assessing the quality of public services was carried out on 10-point scale. Starting in 2016 the rating scale changed to 5 points.

It is reasonable to assume that the upward trend is associated with the proactive development of automation processes, optimization, promotion of the "one window" principle and transfer of public services into electronic format. In general, there is on an upward trend influenced by the development of "electronic government" and other online services. Bringing public services to external platforms has a significant effect such as optimization and automation of the process, as well as saving time and costs for citizens.

Table 4: Assessment of quality of public services delivery in 2023

Criteria	Description	Average score	Satisfaction level
Availability and Convenience	Ease of registration on the portal to receive an e-service	4,78	81,9%
	Ease of obtaining digital signature	4,76	78,7%
	Ease of use of digital signature	4,77	80,0%
	Appearance (design) and structural assessment organization of a portal	4,77	81,1%
	Average score	**4,77**	**80,4%**
Information and Communication	Ease and speed of information retrieval for the service of interest on the portal (online platform)	4,74	80,0%
	Relevance and understandability of information on the portal (online platform) according to requirements (necessary documents) to receive services	4,69	75,0%
	Simplicity and understandability of information to obtain services on the portal	4,75	79,4%
	Information on the portal is available in Kazakh/Russian language	4,81	84,3%
	Instructions for using the portal completely understandable and easy to use	4,75	79,4%

Criteria	Description	Average score	Satisfaction level
	Average score	**4,75**	**79,6%**
Procedure	Collection of documents required to obtain electronic service went ahead without unnecessary bureaucracy (including going through the authorities, offices)	4,81	84,4%
	The process of collecting necessary/required documents to receive e-service automated (can be obtained online)	4,79	82,8%
	Uploading necessary/required documents to portal (online platform) for receiving e-service went smoothly	4,77	80,4%
	In the received document (certificate, etc.) there were no errors or omissions	4,82	85,4%
	Average score	**4,80**	**83,3%**
Deadlines	Received document/electronic service was provided promptly/according to deadlines	4,78	84,9%
	Average score	**4,78**	**84,9%**
Cost	Fee is acceptable ("I completely agree")	4,75	86,7
	The payment method was clear and convenient ("Completely agree")	4,82	86,7
	I did not incur any additional costs to receive the service ("I completely agree")	4,91	88,1
	I didn't suffer any unofficial costs for receiving the service ("Completely agree")	4,93	88,9
	Average score	**4,85**	**87,60**
Feedback	I received a response to my complaint promptly	2,45	16,7%
	I was completely satisfied with the measures taken in response to my appeal	2,62	19,4%
	Average score	**2,54**	**18,1%**
Virtual Assistant	Ease of use	4,50	61,4%
	Completeness of the answer to my request	4,49	61,1%
	Speed of response to my request	4,45	57,5%
	Average score	**4,48**	**60,0%**

Source: Republican Public Association "Zhana Shabyt", 2023. The Association is independent public organizations. https://nationalbank.kz/ru/news/rezultaty-obshchestvennogo-monitoringa-kachestva-okazaniya-gosudarstvennyh-uslug

Among all criteria for assessing the quality of public services, the "Feedback" indicator had the lowest estimated average score and level of satisfaction.

Discussion

In 2023, public responses were selected for 423 of the most actively used public services, in which 62,823 citizens took part (of a population of 20.3 million). In order to comply with research ethics standards, before completing the survey, respondents were notified of the purpose and anonymity of the study by and their written consent to participate in the survey was secured. According to the results, the population's level of satisfaction with the quality of public services

was 81.3%, which is the highest value in the 9 years of the appraisal system. There remained, however, room for improvement.

First, there were problems with the availability of services. Forty public services have been implemented that were not available on the "electronic government" portal, despite being able to be. The functionality of 14 government systems has been restored (since the restoration of access to these services, instances of their use total about 200 thousand) in the areas of education, property rights, registration of citizens, agriculture, entrepreneurship, architectural and urban planning, environmental protection, physical education and sports. Work is currently underway on the remaining 26 government systems.

Second, there were shortcomings in the regulatory framework and automation. As a result of the work subsequently carried out, 16 public services were automated, contradictions in regulatory legislation for 10 services were eliminated, and 65 "hidden" public services were identified.

Third, there were service performance issues. During the analysis, it was found that 104 public services were incompletely implemented and did not provide results. Information about 38 reference services should have been contained in the information systems of government agencies, 110 services should have been provided proactively without citizens' requests, and 75 services should have been provided compositely according to the "one application" principle. They were not, and it was also found to be necessary to exclude 35 commissions and 13 approvals from the provision of public services due to the inexpediency of these services.

Meanwhile, without waiting for complaints from service recipients, during remote monitoring (through information systems), more than 11 thousand violations were identified (11 times more than in 2022). As a result, the rights of 95 service recipients were protected (2.5 times more than in 2022), and 498 inspections were carried out (285 of them on a preventive basis, 213 on an unscheduled basis), during which 65,791 additional violations were identified. More than 1,200 officials were disciplined or suspended for administrative liability.

In the process of interaction with government bodies and organizations, respondents noted additional reasons why difficulties arose. More than half of respondents (61.6%) indicated the difficulties were associated with:

- service provided over a long period of time and poor performance of the portal/service (didn't open, didn't load, didn't work);

- lack of required Internet connection speed and difficulty loading the necessary documents;

- unknown technical problems and lack of access to the Internet;

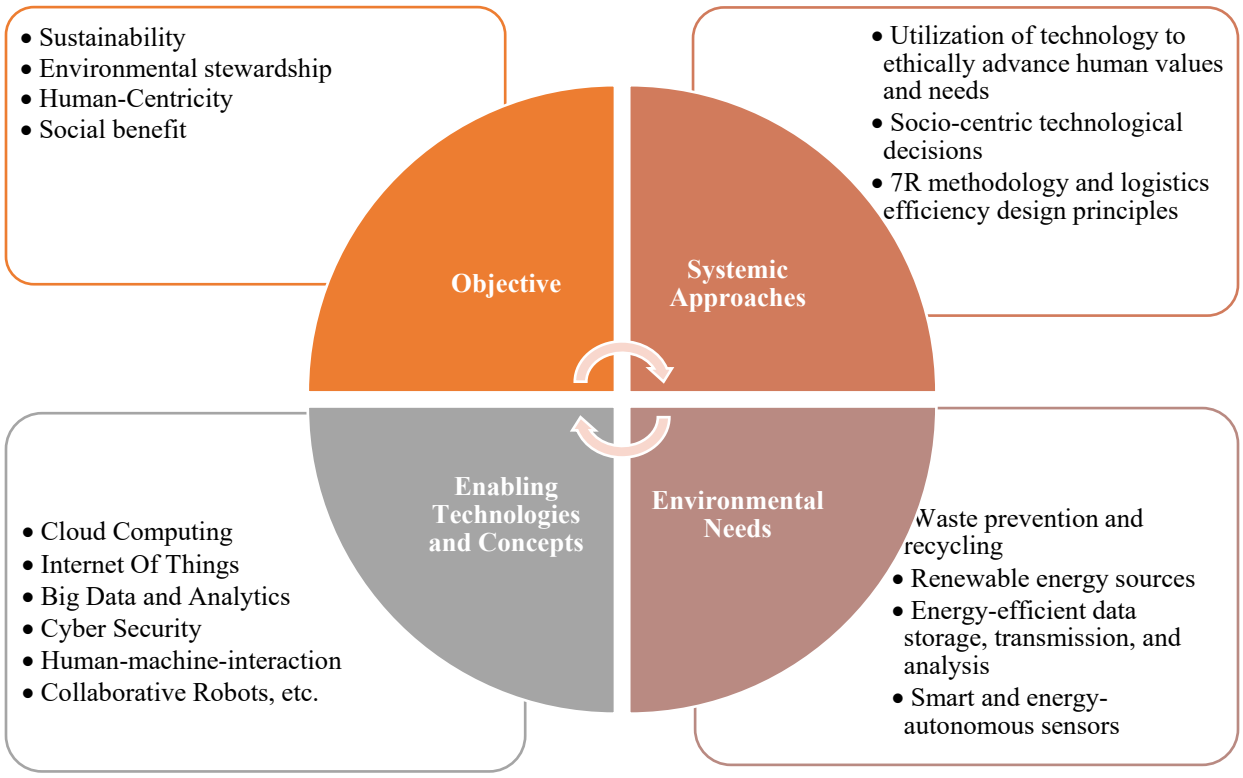
- difficulty finding information about the service, about the requirements for receiving service on the portal;

- difficulty finding information about where to get an electronic service.

Issues of quality of human resources and strengthening necessary competencies, along with a shortage of highly qualified specialists and the perennial need to increase public confidence in the government apparatus remain relevant.

According to the OECD (2023), invisible and anticipatory governance is a key innovative trend for public services. Similarly, as the industrial revolution continues, the development of governance theory and practice has undergone significant changes. The main driver of invisible and anticipatory governance is the citizen, who is actively involved in shaping strategic directions and utilizing data to contribute to policy decision making through user surveys and data collection. Innovative approaches to public services delivery based on the Industry 5.0 Paradigm support these efforts (Figure 1).

Figure 1: Key Components and Requirements of Industry 5.0 Paradigm



Source: Compiled by the authors based on research by Akundi et al., 2022; Majerník et al., 2022

Future directions for Industry 5.0 implementation based on Kazakhstan's innovative approaches are envisaged to improve the processes in which the state appeals to citizens in order to provide opportunities for the realization of their legitimate rights and needs. The following innovative approaches are applied based on Kazakhstani e-government's current state and potential (Figure 2):

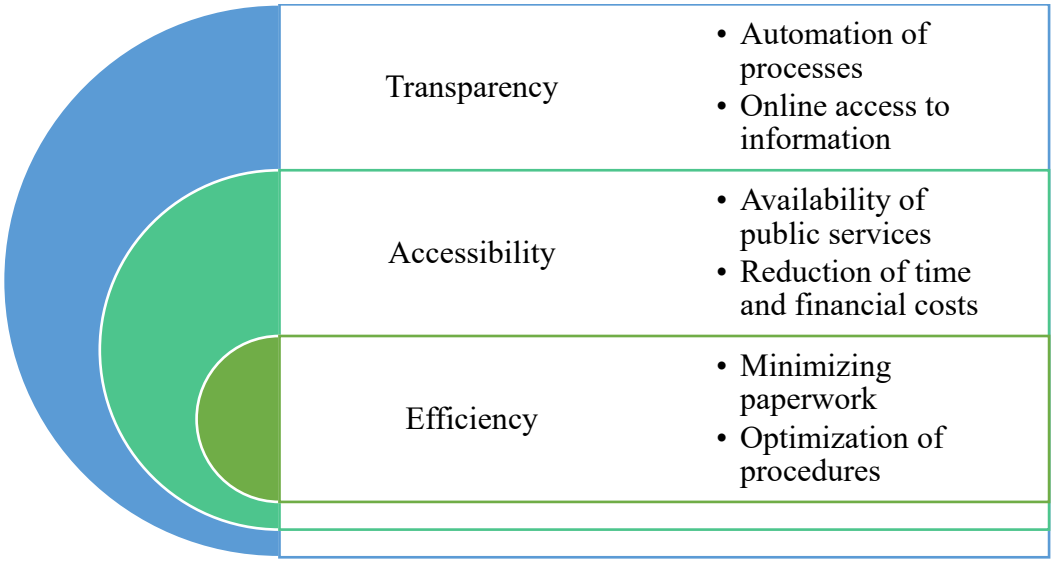
1. Digital transformation of industries to ensure maximum data collection and seamless services based on the following enabling technologies and concepts: Cloud Computing, Internet of Things, Big Data and Analytics, Cyber Security, Human-machine-interaction, Multi-lingual speech and gesture recognition, Collaborative Robots, Bio-Inspired safety and support equipment, etc.;

2. Transition to a platform-based model of digitalization, AI and in-depth analytics, and development of the country's secure digital infrastructure;

3. Systemic and sustainable involvement and integration of all sectors and spheres of the economy into a national innovation system, spurring technological development with the following objectives: Sustainability, Environmental stewardship, Human-Centricity, Social benefit. In this regard, the sustainable economy assumes a long-term economic growth with reduced resource consumption;

4. Systematization, structuring and digitization of the national innovation system and its processes in order to increase its efficiency, as well as to ensure the convenience of its participants through the following approaches: Utilization of technology to ethically advance human values and needs; socio-centric technological decisions; 7R methodology and logistics, efficiency design principles (Right product, Right customer, Right quantity, Right condition, Right place, Right time, and Right cost);

Figure 2: Main Results and Principles of Public Sector Digitization in Kazakhstan



5. Ensuring the security of the individual, society and the state in the use of ICT, taking into account environmental needs, such as: Waste prevention and recycling, renewable energy sources, energy-efficient data storage, transmission, and analysis, smart and energy-autonomous sensors. Overall, these initiatives supporting public sector innovative development meet the following principles.

From Figure 2 we can conclude that the implementation of digital initiatives in the public sector of Kazakhstan have had a positive impact on citizens' interactions with government bodies and business environments, simplifying previously time-consuming procedures and making them more predictable.

The use of Big Data analysis and AI tools will be the basis for the transition to a service model of public administration. The key direction for the transformation of approaches to the provision of services and interactions between the state, citizens, and businesses will be the transition to the principles of open architecture (Open API). This will allow the efficient use of resources, focusing on digital infrastructure. At the same time, non-governmental information resources will be frontend (the client side of the user interface), integrating public services into their own ecosystems, where citizens and entrepreneurs will be able to initiate and receive public services.

Conclusion

The approaches discussed have the intention of fostering a favourable environment for the development of Industry 5.0 tools in Kazakhstan, thus providing a multiplier effect for all sectors of the economy. More specific conclusions for each research question can be formulated as follows:

Research Question 1 *(How have approaches to the provision of public services changed taking into account a permanent shift from one industrial revolution to the next one?)*: The theoretical perspective of each industrial revolution has provided an understanding of industrialization processes and management development. The paradigm shift from manufacturing to advanced technologies has allowed countries and states to transform routine processes and introduce innovations into various aspects of life and professional activities.

Research Question 2 *(What are the main ethical concerns of Industry 5.0 implementation?):* The introduction of the Industry 5.0 Paradigm implies ethical issues, such as environmental, privacy, bias, discrimination, dehumanization, workforce transformation and global inequality issues. The implementation of the Industry 5.0 strategy in Kazakhstan will require a comprehensive approach that includes legislative initiatives, development of educational programs and attracting investments.

Research Question 3 (*What cases of the Industry 5.0 Paradigm are noteworthy for Kazakhstan?):* Several case studies were analyzed in this study. The most recent cases are linked to the life situation services, big data, blockchain technologies and biometric identification. Besides these initiatives, the 11 cases have shown improvement in the quality of educational processes, healthcare, employment, agriculture, transport, and postal services. Overall, in order to establish productive feedback loops between individuals and legal entities, government should consistently measure the population's satisfaction with the quality of responses to their requests. Moreover, some services remain difficult to obtain in digital format. For example, every user faces difficulties with obtaining an electronic signature, installing it on a computer, or and? losing a password. To deal with these problems, the capacity to transfer services to a smartphone or a proactive format should be introduced for all areas. Confirmation of requests should only be done by using biometrics or QR.

Research Question 4 (*What other innovative approaches of the Industry 5.0 Paradigm could be implemented in the Kazakhstani public sector?):* Artificial intelligence technology, such as ChatGPT, could be quickly and efficiently implemented to fulfill citizens' demands. Thoughtful deployment of large language models could allow services to process citizens' documents and generally provide answers to questions regarding services directly in the chat. One of the key risks, however, is non-compliance with information security and confidentiality. Thus, a regulatory framework is needed for the use of artificial intelligence in the public sector. This requires the definition of artificial intelligence risk categories, including the establishment of a duty to ensure the cyber security of artificial intelligence products. Legislation should clarify the main areas of responsibility of artificial intelligence stakeholders, as well as the distinction between organizational and individual responsibility for the consequences of using artificial intelligence in the course of their activities. However, the degree and allocation of this responsibility remains vague in the absence of complete information about artificial intelligence, creating inherent risk to legislative actions in this area.

Research Question 5 *(How has digitization affected citizens' satisfaction with the quality of public services?):* Starting in 2020 (due to COVID-19) more active introduction of innovative digital technologies has had a positive effect on service recipient satisfaction. As the Government of Kazakhstan also plans to develop services for businesspeople, it is necessary to categorize and reimagine the different stages of business creation and management, and consequently introduce a new and more relevant format for services delivery. Thus, not only should increased use of digital services continue, but also the reengineering of old processes and the introduction of new technologies meant to transform public administration performance based on a citizen-centric, innovative and proactive approach.

As for the future, more work is needed on potential biases imbedded in information technology implementation, as well as on forecasting of the new Industry 6.0 patterns. Specifically, "What kind of promising cutting-edge technologies and new innovative solutions create a basis for development of a digital public system in Kazakhstan?" The answer to this question opens an "opportunity window" for further promising research in this area.

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Appendix A: Fragment of the survey methodology[2]

[…]

Study sample (on a territorial basis):

$$X = (N \times P):100,$$

N - sample population;
P - share of the population expressed in percent (according to statistical data).

Assessment of the quality of provision of public services by service providers produced on a 5-point scale:
"5" – "completely satisfied", "completely agree", "excellent";
"4" points – "good", the service was provided with minor complaints and/or costs, and/or barriers were present;
"3" points – "satisfactory", the service was provided with a number of complaints, costs, and barriers;
"2" points – "unsatisfactory", the service was provided with numerous violations, there were corruption or other barriers;
"1" point – "no work", the service was not provided due to insurmountable circumstances barriers, costs.

Formula for calculating on a 5-point scale for assessing the quality of public services delivery:

$$Q = (n1*x1+n2*x2+n3*x3+n4*x4+n5*x5)/N1…5,$$

Q - level of satisfaction with the quality of public service provision;
x1 - score "1 point";
x2 - score "2 points";
x3 - score "3 points";
x4 - score "4 points";
x5 - score "5 points";
N - number of respondents, who gave the appropriate rating;
n1-5 - total number of surveyed respondents who gave a given rating criteria (from 1 to 5 points).

A massive survey of service recipients covered all 20 regions of the country, including 3 cities of republican significance for 50 public services and appropriate providers on central and local level of public administration (Table A.1).

[2] This section is a part of a larger study on the quality of public services delivery. https://nationalbank.kz/ru/news/rezultaty-obshchestvennogo-monitoringa-kachestva-okazaniya-gosudarstvennyh-uslug

Table A.1: Study sample, number of respondents and public services of public monitoring in 2023

№	Public authority	Number of respondents
1.	Ministry of Trade and Integration	8
2.	Supreme Court of Audit	10
3.	Ministry of Culture and Information	11
4.	Agency for Strategic Planning and Reforms	12
5.	Competition Agency	12
6.	Agency for Regulation and Development of Financial Market	13
7.	Ministry of Digital Development and Aerospace Industry	16
8.	National Bank	33
9.	Ministry of Culture and Information	46
10.	Ministry of Ecology and Natural Resources	66
11.	General Prosecutor's Office	75
12.	Ministry of Foreign Affairs	85
13.	Ministry of Finance	95
14.	Ministry of National Economy	96
15.	Ministry of Water Resources and Irrigation	97
16.	National Security Committee	100
17.	Judicial administration	114
18.	Ministry of Emergency Situations	125
19.	Agency for Civil Service Affairs	140
20.	Ministry of Health	165
21.	Ministry of Transport	168
22.	Ministry of Defense	171
23.	Ministry of Energy	184
24.	Ministry of Education	198
25.	Ministry of Tourism and Sports	257
26.	Ministry of Science and Higher Education	316
27.	Ministry of Justice	354
28.	Ministry of the Interior	393
29.	State Corporation "Government for Citizens"	409
30.	Ministry of Agriculture	416
31.	Ministry of Labor and Social Protection of the Population	579
32.	Local Public Authorities	5190
Total		**9954**

[…]