

DIGITIZATION AND INFORMATION BASE

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The Head of State, Kassym-Jomart Tokayev, declared 2026 the “Year of Digitalization and Artificial Intelligence.” For a country striving to become a digital nation, this represents a concrete step toward the implementation of a strategic agenda. In an interview with *Turkistan* newspaper, the President stated: “Kazakhstan must become a digital state. This is the only viable way to remain a developed and competitive nation in the era of advanced technologies. I am confident that our society is ready to embrace such innovations. Kazakhstan is also prioritizing the integration of artificial intelligence into the economy and public life. Our country’s initial capacities in this area are quite promising.”

In the contemporary world, it is difficult to imagine any sphere of activity without digital technologies. In fact, it is easier to identify areas where such technologies have not yet been applied than those where they already play a dominant role. Consequently, the importance of digital technologies in national economic development is steadily increasing. The advancement and implementation of digital technologies open up new opportunities and provide numerous advantages, including improved access to public services for citizens and businesses, accelerated information exchange, expanded opportunities for entrepreneurship, and the development of innovative digital products. One of the key concepts of the modern era is “digitalization.”

At present, the concept of “digitalization” is employed in a broad sense. In general, digitalization refers to the transformation of information into digital form, which, in many cases, leads to cost reduction, the emergence of new opportunities, and other significant benefits. There are numerous examples of converting information into digital formats. It is precisely these substantial positive outcomes that have contributed to the widespread use of the term “digitalization” in an expanded sense.

Digitalization, which encompasses the transition of all aspects of economic and social life into digital information, is evolving from a set of simple methods aimed at improving individual domains of life into a global instrument of development.

Thus, in its broad interpretation, digitalization is fundamentally based on the conversion of information into digital form. It represents a contemporary global trend in the development of both the economy and society. However, digitalization can be considered a global development trend in this broader sense only if the digital transformation of information meets the following criteria: it encompasses production, business, science, the social sphere, and everyday life; its outcomes are effectively utilized; the results—namely transformed information—are accessible to users; these outcomes are not limited to specialists but are also usable by the general public; and users of digital information possess the necessary skills to work with it.

Digitalization has supplanted earlier phases of informatization and computerization, during which computing equipment, computers, and information technologies were primarily employed to address specific economic tasks.

The extensive capabilities of representing information in digital form have led to the formation of an integrated technological environment for “existence,” including ecosystems and platforms. Within this environment, users can establish a supportive and user-friendly

framework—technological, instrumental, methodological, documentary, and partnership-based—to address a range of tasks. The current stage of digitalization has been made possible by the simultaneous development and implementation of multiple enabling technologies that create favorable conditions for innovation and growth.

Today, digitalization constitutes an essential requirement of the modern world; further development is inconceivable without it. Consequently, appropriate preconditions must be established at the governmental and sectoral levels, as well as within individual households. The formation of a digital economy requires a set of enabling conditions, and it is the responsibility of the state to create opportunities that facilitate digital transformation.

In pursuit of enhanced competitiveness, Kazakhstan adopted the state program “Digital Kazakhstan” at the end of 2017. The primary objective of this program is to ensure sustainable economic growth, increase the competitiveness of the economy and the nation, and improve the quality of life of the population through the accelerated development of a digital ecosystem.

Mobile devices—such as smartphones, tablet PCs, and laptops—have evolved significantly, enabling users to perform a wide range of online activities, including web browsing, IP telephony, videoconferencing, and multimedia transmission.

Cloud computing—currently, sufficiently advanced approaches exist that allow a substantial portion of IT infrastructure to be migrated to cloud environments or for organizations to establish internal cloud infrastructures.

Big data analytics platforms—digital organizations generate vast volumes of data (measured in terabytes), which can be collected, processed, and analyzed to obtain business-critical analytical insights.

The Internet of Things (IoT)—facilitates process automation, opens new pathways to market entry, and significantly reduces operational costs.

In the context of globalization, transformations in information technologies reshape economic and cultural systems that dominate social life, as well as alter managerial and intellectual frameworks. In the contemporary era, as we transition into an information society, the ease of access to information distances individuals from traditional modes of interaction and, through information and communication technologies, integrates them into new processes of information production, protection, and dissemination.

Digitalization is the process of enhancing management efficiency within the education system through the widespread implementation of information and communication technologies, the automation of public services, and data-driven decision-making.

Within the framework of digitalization, key tasks include the implementation and maintenance of large-scale information systems such as the National Education Database, the integration and coordination of learning management systems (LMS), the automation of teacher certification and recruitment processes, the evaluation of educational materials, and the organization of the learning process in online formats.

In addition, particular emphasis is placed on improving the quality of public service delivery, managing digital data, refining the regulatory and legal framework, and implementing digital transformation through project-based management approaches. Digitalization initiatives are carried out in accordance with the priorities set forth in the Presidential Addresses and strategic policy documents.

More broadly, digitalization refers to the integration of modern digital technologies into various sectors of life and production.

At the end of the twentieth century, discussions surrounding IoT technologies and the digital economy began to emerge, while in Kazakhstan the first mobile phones were being introduced. Over the past two decades, the Internet of Things has evolved into a commonplace and integral component of everyday life.

In the contemporary information society, data constitute one of the most valuable resources. Across various sectors—education, healthcare, business, and public administration—the role of

information systems is steadily increasing. The effectiveness of these systems is directly dependent on the quality of the underlying information bases.

The digitalization of information base development is a comprehensive process aimed at automating data collection, structuring, storage, and processing. This approach reduces the impact of human factors while enhancing the accuracy and accessibility of information.

Concept and Structure of an Information Base. An information base (database) is a structured set of data related to a specific domain. It serves as a core component of information systems.

The main elements of an information base include:

- data;
- data structure (tables, relationships);
- database management system (DBMS);
- metadata.

A well-organized information base ensures efficient data storage and enables rapid data processing.

Stages of Information Base Digitalization. The digitalization of an information base consists of several key stages:

1. **Data Collection.** Data are gathered from various sources, including:
 - paper-based documents;
 - sensors and devices;
 - web applications;
 - social media platforms.
2. **Conversion to Digital Format.** At this stage, analog information is transformed into digital form using technologies such as scanning and optical character recognition (OCR).
3. **Data Cleaning and Processing.** This involves error correction, removal of duplicate records, and the completion of missing values to ensure data quality.
4. **Data Structuring.** Data are organized into tables, and relationships between datasets are defined.
5. **Database Implementation and Testing.** The system's functionality is evaluated, and optimization procedures are carried out to ensure efficient performance.

Modern Technologies. The following technologies are widely used in the digitalization of information bases:

1. **Cloud Technologies.** Cloud computing enables remote access to data from any location and supports scalable storage solutions.
2. **Big Data Technologies.** Platforms such as Hadoop and Spark are utilized for processing large volumes of data.
3. **Artificial Intelligence and Machine Learning.** These technologies are applied for data analysis, predictive modeling, and process automation.
4. **NoSQL Databases.** Designed for handling unstructured data, examples include MongoDB and Cassandra.

Advantages. The digitalization of information bases provides the following benefits:

- increased accessibility and speed of data retrieval;
- reduction of human error;
- the ability to process large volumes of information;
- facilitation of data-driven analytical decision-making;
- automation of processes.

Challenges and Limitations. Alongside its advantages, digitalization also presents several challenges:

- data security concerns;
- high initial implementation costs;
- the need for advanced technical infrastructure;
- shortage of qualified specialists;

- issues related to low data quality.

Application Areas. The digitalization of information bases is widely applied across multiple sectors:

- healthcare (electronic medical records);
- education (online systems and platforms);
- business (CRM and ERP systems);
- agriculture (smart farming technologies);
- public administration (e-government systems).

Conclusion. The digitalization of information base development represents one of the key directions of the modern information society. It enables efficient data management, improves decision-making processes, and enhances productivity across various domains.

In the future, digitalization technologies will continue to evolve and become increasingly integrated with artificial intelligence, big data, and automation. Therefore, the effective organization and digitalization of information bases remain a highly relevant issue from both scientific and practical perspectives.

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