



# THE EVOLUTION OF COMPUTERS AND THEIR IMPACT ON THE DIGITAL ECONOMY

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<b>Article history:</b>	<b>Abstract:</b>
<p><b>Received:</b> 14<sup>th</sup> July 2025 <b>Accepted:</b> 11<sup>th</sup> August 2025</p>	<p>The development of computing machines has fundamentally transformed many aspects of human life and played a decisive role in shaping the digital economy. Digital market relations have become a central element of the global economy, driven by the rapid advancement of information technologies and modern economic interactions. Technological progress serves as a catalyst for economic growth, generating new forms and structures of activity, which provides clear evidence of its impact. This article explores the historical stages of computing technology, the fundamental principles of digital technologies and information and communication systems, as well as the types of computers and their impact on the digital economy. Special attention is given to the significance of computing technologies in areas such as Big Data analytics, financial technologies (fintech), digital services, and cybersecurity. Based on collected data, analytical results, and comparative insights, the article highlights the importance of computing technologies in the expansion of Uzbekistan's digital economy</p>
<p><b>Keywords:</b> Computer, transistor, microprocessor, computer, law, Big Data analysis, finance technologies (fintech), digital services and cybersecurity.</p>	

**METHODOLOGY.** The article employs a historical-analytical method to study the stages of computing machine development and to determine their impact on the modern digital economy. A systematic approach is applied to examine the relationship between the digital economy and computing technologies, identifying their role within economic systems and digital markets. Research sources and relevant data were studied comprehensively, with particular attention to the development of Uzbekistan's digital economy and its comparison with international processes. Additionally, an analytical approach was used to assess the significance of computing technologies in the fields of Big Data, fintech, digital services, and cybersecurity.

**INTRODUCTION.** The modern stage of human economic development is closely linked to the digital economy, which has emerged as a result of the progress of computing machines and communication networks. The rapid advancement of computing technologies and information and communication systems has brought about not only improvements in labor productivity but also fundamental transformations in education, healthcare, finance, management, and public services. In particular, computing technologies occupy a central place in the formation and evolution of the digital economy, making it essential to study this field more

deeply from a scientific perspective. Research directions such as Big Data, fintech, digital services, and cybersecurity have had a profound impact on the development of the global free market and remain critical to understanding contemporary economic processes.

Digital technologies form the foundation of the digital economy by replacing traditional economic models and creating new market segments, employment opportunities, and sources of growth. For this reason, conducting scientific research in areas such as Big Data, fintech, digital services, and cybersecurity is of vital importance. In Uzbekistan, strengthening digital infrastructure is seen as a key factor for ensuring economic stability, fostering innovation, and expanding the role of digital knowledge in economic development.

**LITERATURE REVIEW.** The development of computing technologies and their impact on the digital economy has become one of the central directions of contemporary scientific research. Numerous international organizations, research institutions, and higher education centers have devoted significant attention to this subject. Among the prominent scholars in this field are C.E. Shannon, A. Turing, J. von Neumann, R. Sebesta, N. Srnicek, and E. Brynjolfsson,



whose theoretical and practical contributions have laid the foundations of digital technologies.

The scientific works of Shannon, Turing, and von Neumann defined the fundamental principles of computing systems and established the theoretical basis for modern information technologies. Similarly, R. Sebesta's *Concepts of Programming Languages* provides valuable insights into the historical evolution of programming languages and their role in the development of computing technologies. These contributions collectively offer an essential framework for understanding the foundations of digital systems and their economic implications.

Nick Srnicek's *Platform Capitalism* (2016) stands out as a significant work analyzing how digital platforms reshape economic systems and transform market dynamics. His theoretical approach explains the central role of computing technologies in the emergence and consolidation of digital markets, providing a deeper understanding of the structural changes within the global economy.

Modern digital technologies—including Big Data, fintech, digital services, and cybersecurity—have been further conceptualized by E. Brynjolfsson and A. McAfee, particularly in *The Second Machine Age*. They highlight the transformative role of artificial intelligence, advanced data analytics, and financial innovations in redefining the digital marketplace. Additionally, industry leaders such as Kaspersky Lab, Cisco, and IBM Security have contributed through analytical reports, offering empirical foundations for the study and enhancement of cybersecurity systems. Collectively, these scholarly and practical insights demonstrate the theoretical depth and applied significance of digital technologies in shaping the modern economy.

In Russia and the CIS countries, significant research has been conducted on the history of computing technologies and their role in the digital economy. The electronic library *DisserCat* contains 291 dissertations related to this topic, while the open-access platform *CyberLeninka* hosts a large number of scientific articles. An analysis of these resources shows that research on computing and its economic implications spans multiple fields: 1,899 publications in economics and business, 1,453 in education, 1,453 in law, 1,032 in sociology, 637 in mass communication, 357 in computer and information technologies, 357 in philosophy, ethics, and religious studies, 410 in linguistics and literary studies, and 222 in political science.

In terms of academic indexing, 5,327 articles are listed in the Higher Attestation Commission (OAK/VAK) journals, 520 in the Russian Science Citation Index

(RSCI), 560 in *Scopus*, 401 in *ESCI*, and 132 in *Web of Science (WOS)*. These figures confirm that research in this direction has become a central priority for economists and technologists across the region, reflecting its growing importance within the modern scientific environment.

**MAIN PART.** The history of computing technologies can be divided into four major stages of progress. The earliest stage was linked to the expansion of labor distribution, the emergence of private property, and the development of primitive forms of economic relations, which created the need for calculation tools.

The first known calculating device was the abacus, which was used to represent numbers and perform basic arithmetic operations such as addition, subtraction, multiplication, and division. This marked the beginning of humanity's attempts to formalize and simplify numerical operations. In 1642, Blaise Pascal successfully designed and constructed the first mechanical adding machine, known as the *Pascaline*. This invention represented a significant step in the mechanization of calculations. Later, in 1673, the German scientist Gottfried Wilhelm Leibniz, a member of the Berlin Academy, introduced his invention known as the *Stepped Reckoner (Step Drum)*. By 1694, he had completed a fully functional model. This mechanical device was capable of performing more complex operations than Pascal's design. These early developments defined what is often referred to as the "mechanical period" of computing (from the 3rd millennium BC up to the 18th century).

The second stage, emerging in the 19th century, is commonly described as the era of programmable mechanical devices. The most notable achievement of this period was Charles Babbage's Analytical Engine, a theoretical design for a general-purpose computer. Although never completed during his lifetime, the Analytical Engine laid the groundwork for future computing systems. Importantly, Ada Lovelace, who worked with Babbage, is recognized as the first programmer, as she successfully developed algorithms intended for execution on the Analytical Engine. This pioneering collaboration provided the intellectual foundation for the invention of modern computers.

During the 1930s and 1940s, the development of computing entered the "electromechanical era" Notable achievements of this period included the creation of the Z3 computer in Germany and the Harvard Mark I in the United States, both of which were among the first programmable computing machines. These devices operated using electricity and relied on magnetic relays, performing approximately 40–45 operations per minute.



The next and most important stage in the history of computing was the “electronic era” which can be divided into five generations of technological progress: vacuum tube computers, transistor computers, integrated circuit computers, microprocessor-based computers, and systems integrating artificial intelligence with digital networks.

The first generation (1940–1956) was based on vacuum tube technology. The most famous example, the ENIAC, weighed about 30 tons and contained thousands of vacuum tubes. Although it was a major breakthrough, its enormous size, high energy consumption, and heat output made it impractical for widespread use.

On December 16, 1947, scientists John Bardeen, Walter Brattain, and William Shockley at Bell Laboratories in New Jersey invented the transistor, which marked the beginning of the second generation (1956–1964). Transistor-based computers, such as the UNIVAC-II and the IBM 1401, were faster, smaller, more reliable, and consumed less energy compared to vacuum tube machines.

The third generation (1964–1971) introduced integrated circuits (ICs), which revolutionized computing by allowing thousands of electronic components to be placed onto a single chip. The first working integrated circuit was developed at Texas Instruments in 1958 by Jack Kilby, and soon after, Robert Noyce improved the design, making it more practical for industrial use. This innovation paved the way for powerful computers such as the IBM 360, which became one of the most widely used universal computers.

The IBM 360 had significant applications across various sectors. In finance and banking, it was used for settlements, payments, lending, insurance, and deposit management. In government and defense, it was employed for data storage, encryption, and statistical analysis. For NASA, it played a critical role in executing space exploration projects. The IBM 360 also became a valuable tool in research institutions, enabling advanced modeling and data analysis in physics, chemistry, engineering, and statistics. Its introduction provided solutions to many complex problems and laid the groundwork for future scientific innovation.

The IBM 360 and other third-generation computers found wide application in industry and services. They were used for production planning, inventory management, automation, and logistics systems in major corporations such as General Motors and Boeing. In addition, these computers were introduced into medicine and healthcare, telecommunications, transportation, education, and even sports, laying the

foundation for large-scale digitization processes. The spread of digitization across many sectors stimulated the expansion of digital market relations and motivated new trends in economic progress. Enterprises that adopted computing technologies significantly improved labor productivity, reduced operational costs, and increased efficiency. This recognition of the economic benefits encouraged large-scale investments in the computing industry.

A major milestone occurred on November 15, 1971, when Intel engineers Marcian Hoff, Federico Faggin, Stanley Mazor, together with Masatoshi Shima from the Japanese company Busicom, introduced the world’s first microprocessor, the Intel 4004, consisting of 2,300 transistors. This innovation marked the birth of personal computers (PCs). PCs quickly gained popularity and began to enter households worldwide. Their rapid spread accelerated digitization, making computers the “heart of the digital economy.” Scholars highlighted their pivotal role in enabling the development of digital products and services such as e-commerce, office software, online payment systems, robotics, sensor networks, smart devices, and digital communication infrastructures.

The fifth generation of computers is characterized by the integration of multiple advanced technologies, including artificial intelligence (AI), digital networks, cloud computing, self-learning applications, and Big Data analytics. These systems function collaboratively, enabling intelligent decision-making.

Fifth-generation computing offers significant advantages to users. Artificial intelligence ensures speed, accuracy, stability, automation, and the ability to conduct deep data analysis. It also facilitates machine learning, as well as recognition of languages, images, and speech. Meanwhile, digital networks, the internet, mobile communication, and computer networks provide modern infrastructure with global connectivity, fast information exchange, opportunities for remote work and education, e-commerce, flexibility, and enhanced security. Together, these elements establish the foundation for more efficient and integrated digital relationships across economies and societies.

In the field of digital technologies and information and communication systems (ICT), a number of fundamental laws are applicable. These laws are based on technical, mathematical, and systematic principles that govern the processes of information transmission, storage, retrieval, and evaluation. They serve as the scientific-theoretical foundation for the effective performance and continuous development of digital systems. By guiding technological advancement, these



principles enhance efficiency and provide users with greater opportunities for adaptation in a rapidly evolving digital environment.

Modern ICT performance is shaped by technical capacity, network efficiency, information theory, and algorithmic approaches. Their joint application ensures effective utilization of digital technologies for economic and social development. The main guiding principles include:

- Moore's Law – The number of transistors on a microchip doubles approximately every 18–24 months, leading to exponential growth in computing power.
- Metcalfe's Law – The value of a network is proportional to the square of the number of its connected users.
- Shannon's Law – Reliable information transmission requires sufficient redundancy to correct possible signal errors.
- Complexity and Efficiency Principle – As systems become more complex, artificial intelligence, automation, and optimization are increasingly required for effective management.
- Nyquist–Shannon Sampling Theorem – For accurate digitization of an analog signal, the sampling frequency must be at least twice the highest frequency present in the signal.
- Information Capacity Law – The greater the volume of information in a system, the more resources are required for its storage, transmission, and analysis.
- Principle of Reusability – Any technological solution or algorithm can often be adapted and reused across different fields of application.

The development of digital technologies can, to a large extent, be predicted through established theoretical principles. For example, Moore's Law, formulated by Gordon Moore, states that the number of transistors on a microchip doubles approximately every 18 months, leading to exponential growth in computational power. This principle has been repeatedly confirmed in practice. For instance, by 2023 Apple's smartphones achieved a level of efficiency that would have been impossible with the computing capabilities available in 1985. As highlighted in lectures by Stanford University Professor Ilya Strebulaev, Moore's Law continues to

serve as a basis for anticipating the future evolution of digital systems, enabling improvements across all spheres of digital interaction.

Another fundamental principle is Metcalfe's Law, which emphasizes that the value of a network is proportional to the square of its number of users. As the number of participants in a network increases, so do the opportunities for information exchange and economic gains. Similarly, Shannon's Capacity Law provides the theoretical framework for determining the maximum speed at which digital signals can be transmitted, forming the scientific basis for the performance of telecommunications networks, fiber-optic communication, mobile systems, and satellite technologies.

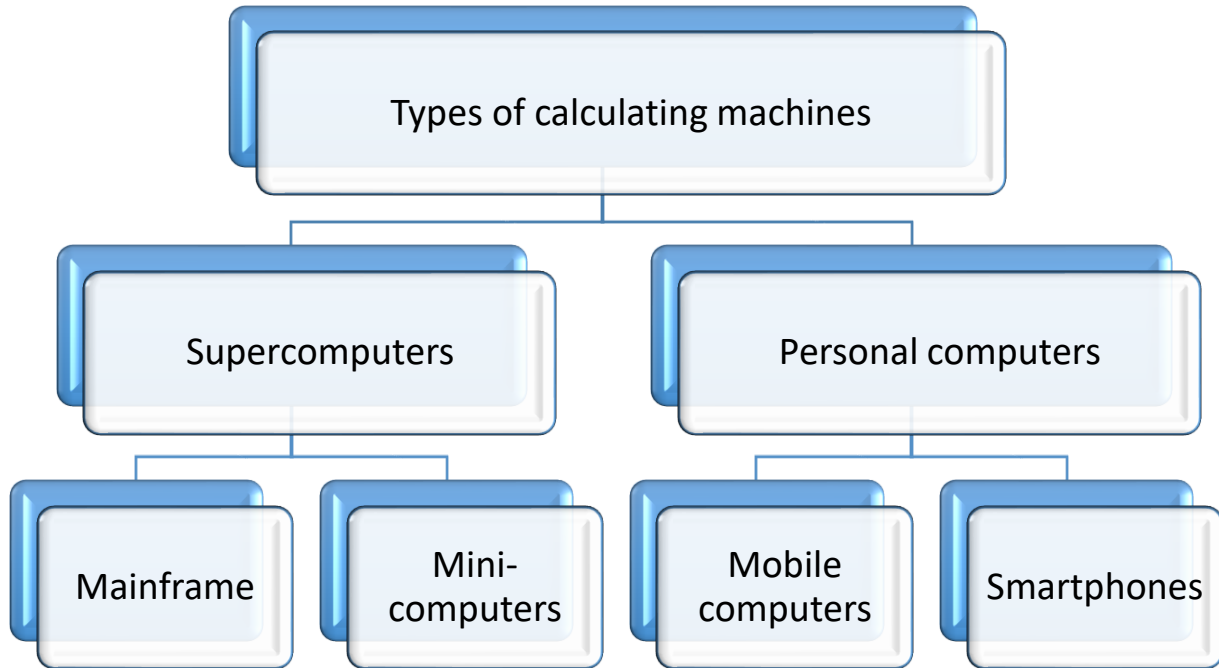
Equally important are algorithmic approaches, which play a decisive role in fields such as artificial intelligence, automation, data analysis, and machine learning. Algorithms allow computing technologies to be used more effectively, saving time and resources while offering powerful solutions to complex problems. Modern artificial intelligence systems, in particular, are built on algorithmic principles of self-learning and adaptation.

Taken together, these scientific, mathematical, and systematic laws form the foundation of today's digital technologies. They have opened pathways for the advancement of the modern economy, industry, education, and governance.

The study of the historical development of electronic computing machines is therefore essential for a deeper understanding of the digital economy. Many economists emphasize that computers occupy a central and indispensable position in the formation and growth of digital economic systems. As the backbone of the digital economy, computer technologies make possible all major processes of data storage, retrieval, processing, and transmission. They enable the rapid and efficient analysis of vast amounts of information, facilitate the automation of economic activities, and expand opportunities for e-commerce and online services. Furthermore, computers play a vital role in the creation of new products and services, in the automation of production processes, and in the functioning of software and supply systems. Thus, computing technologies remain one of the most critical drivers of digital economic development.

Calculation of cars types:

Figure 1.



One of the most significant contributions of computing technologies to the digital economy can be observed in the role of supercomputers. As advanced tools for scientific calculations, supercomputers have become central to digital economic development. Their primary value lies in their ability to process Big Data—analyzing massive and complex datasets in real time. This enables market participants to make faster and more accurate decisions, identify new opportunities, and gain a competitive advantage in the global digital marketplace. For example, in the first decade of the 2000s, major companies such as Google, Amazon, Facebook, Netflix, and Tesla successfully leveraged Big Data analytics to expand their customer base and improve efficiency, often with relatively modest investments compared to their returns. Since 2003, Google has focused on enhancing advertising efficiency through data-driven technologies. Its Google AdSense platform allowed websites to display advertisements automatically tailored to user content, creating a revolutionary model for digital marketing.

In 2006, Google's acquisition of YouTube further strengthened this approach. By analyzing user viewing habits, Google developed algorithms capable of predicting consumer preferences and delivering relevant advertising content. This not only increased engagement but also transformed online advertising into a highly profitable industry.

Similarly, the Android system, introduced in 2007, integrated Big Data analytics to study user behavior,

needs, and interests. Based on these insights, the Google Play Store began recommending applications that matched users' preferences. As a result, application downloads rose dramatically. Personalized advertising also became more sophisticated, presenting users with advertisements tailored to their individual interests, which in turn generated substantial revenue growth.

Big Data analytics also enhanced user experience: Android systems optimized device functionality by predicting user needs and offering relevant services more quickly. From 2010 onwards, the integration of artificial intelligence (AI) and machine learning (ML) marked a new stage. Algorithms advanced from merely analyzing information to performing real-time predictive analytics, allowing companies to anticipate user behavior and adapt their services proactively.

Machine learning systems continuously improve by training on large datasets and interacting with users, which allows them to produce more precise outcomes. When combined with Big Data analytics, supercomputers have become one of the most important driving forces of the digital economy. They enable customer-centered services, real-time decision-making, and personalized offerings, thereby increasing the efficiency and competitiveness of businesses on a global scale. These advances have also contributed to the rapid growth of digital products, services, and platforms. In the field of artificial intelligence (AI), the powerful computational capacity of supercomputers has enabled the training of complex AI models. This has



given rise to automated services, chatbots, and smart assistants, which reduce the workload of humans while improving efficiency across various sectors. Supercomputers are also applied in climate and energy modeling, including weather forecasting, heat flow analysis, and energy system simulations. Such models help create stable energy infrastructure, enhance resource management, and strengthen ecological security. In the financial sector, supercomputers support market simulations, risk assessments, and algorithmic trading systems, thus stimulating the development of financial technologies (fintech) and leading to more informed investment decisions. In healthcare and pharmaceuticals, supercomputers are employed to test medical tools, simulate genetic models, and develop personalized treatments. These technologies accelerate diagnosis and drug

development, thereby advancing the digital transformation of medicine. Supercomputers also play a vital role in cybersecurity, where they are used to design cryptographic algorithms, detect potential digital threats, and simulate attacks in advance. In this way, they ensure the security of online systems and protect user information.

1. Mainframes (central computers) – Mainframes are highly reliable and powerful systems capable of processing vast amounts of information. They are widely used by large corporations, government agencies, and financial institutions, making them one of the central pillars of the modern digital economy. Their contribution lies in ensuring the efficient management of critical data and supporting large-scale organizational operations. See Table 1.

Table 1.

Direction	Functions Performed by Mainframes	Impact on the Digital Economy
<b>Banking systems</b>	Processing daily transactions, managing customer data, and ensuring secure payments	Fintech develops, and online banking becomes more widespread
<b>Insurance companies</b>	Managing information of millions of customers	Digital insurance systems operate more effectively
<b>Tax and state finance</b>	Handling tax reports, audits, and real-time monitoring	State financial systems become digitized
<b>Aviation and railway systems</b>	Managing ticket reservations and passenger information	Transport infrastructure undergoes digital transformation
<b>Online trade and logistics</b>	Recording orders and controlling warehouse operations	E-commerce networks function more reliably
<b>Cybersecurity</b>	Ensuring the security of multi-user systems	Information protection is strengthened

2. Minicomputers, also known as midrange computers, were designed to serve multiple users simultaneously, functioning as devices positioned between supercomputers and personal computers. During their peak, these systems were widely used by small and medium-sized enterprises (SMEs) as well as scientific research institutions for handling business operations and technical tasks. Although today minicomputers have largely been replaced by servers and cloud technologies, they played an important historical and technological role in the development of the digital economy. By enabling multi-user access, resource sharing, and local automation, minicomputers laid the groundwork for modern distributed computing systems and enterprise-level digital infrastructure. See Table 2.

Table 2.

Direction	Functions Performed by Minicomputers	Impact on the Digital Economy
<b>Small business infrastructure</b>	Resource sharing among users, data processing	Supports the growth of small digital enterprises
<b>Local network management</b>	Acting as servers, managing printers, files, and shared programs	Develops local automation and enhances digital activities
<b>Scientific and technical calculations</b>	Performing simple mathematical modeling and analyses	Provides a foundation for academic and technological research
<b>Local service provision</b>	Supporting local branches of banks and healthcare facilities	Facilitates the digitalization of service sectors
<b>Software testing and deployment</b>	Creating small programs and test environments	Assists in training developers and IT specialists



3. Personal computers (PCs) became the most widespread and fundamental tool of the digital economy, especially during the 1990s–2010s. Their wide availability, affordability, simplicity, and multifunctionality provided significant economic advantages, making them a central element of digital transformation. Through personal computers, individuals, businesses, and government organizations were able to actively interact with digital technologies. This facilitated broader participation in the digital economy and accelerated the integration of digital tools into everyday economic activities. PCs thus played a decisive role in shaping modern economic communication and enabling mass access to digital systems.

Table 3.

Direction	Task	Impact on the Digital Economy
<b>Small and medium enterprises (SMEs)</b>	Billing, e-commerce, customer communication	Automates business processes and promotes the growth of online trade
<b>Remote work (freelance, telework)</b>	Conducting work and projects via the Internet	Digitizes the labor market and provides workplace flexibility
<b>Education and skills</b>	Online courses, exams, and tests	Increases digital literacy and expands access to knowledge
<b>Government services</b>	Tax filing, applications, registrations, and other e-services	Improves accessibility and integration of electronic government systems
<b>Financial operations</b>	Internet banking and electronic payments	Expands fintech services and accelerates the transition to a cashless economy
<b>Creative and technological activities</b>	Programming, design, and content creation	Leads to the emergence of new products and digital services
<b>Information exchange</b>	Email, video conferencing, and document sharing	Enhances rapid communication and collaboration

4. Mobile computers, including laptops, netbooks, tablets, smartphones, and ultrabooks, possess all the essential characteristics of a computer—such as processors, operating systems (Android, iOS, etc.), memory, and internet connectivity. Their key advantage lies in portability, which makes them convenient and versatile devices that can be used anytime and anywhere. In today’s digital economy, mobile computers represent one of the most dynamic and widely adopted technologies. Their constant connectivity, affordability, and popularity have allowed them to surpass personal computers in terms of widespread usage and integration into everyday life. As a result, mobile devices have become central tools for digital communication, online commerce, e-learning, and mobile services, thereby strengthening their role as vital instruments of the modern digital economy.

Table 4.

Direction	Task	Impact on the Digital Economy
<b>Remote work</b>	Working from any place using laptops and tablets	Increases worker flexibility and expands digital employment opportunities
<b>E-commerce</b>	Online purchasing, payments, and advertising via mobile devices	Expands online markets and increases the scale of mobile trade
<b>Mobile banking services</b>	Banking, payments, and money management via smartphones	Enhances fintech services and accelerates the transition to a cashless economy
<b>Education and skills</b>	Online lessons and tests via tablets and smartphones	Expands digital literacy through mobile learning platforms
<b>E-health (digital healthcare)</b>	Medical consultations and test results via mobile applications	Improves public access to digital healthcare services
<b>Government services</b>	Tax filing, registrations, and appeals via mobile applications	Expands e-government services and makes them more accessible to the public
<b>Small entrepreneurship (micro-business)</b>	Service delivery and marketing via smartphones or tablets	Facilitates the integration of small businesses into the digital economy

Scholars consistently emphasize that the development of Big Data, fintech, digital services, and cybersecurity

represents some of the most important directions in shaping the modern global economy. Today, computing



technologies have become an inseparable part of the digital economy, integrating into nearly every aspect of social and economic life. Computers, servers, artificial intelligence systems, and supercomputers enable the rapid analysis of vast datasets, the automation of financial operations, the improvement of digital services, and the strengthening of information security. In this sense, digitization has fundamentally transformed economic processes worldwide.

Big Data analysis has become a cornerstone of modern computing. Big Data refers to the collection of massive, complex, and rapidly changing information that cannot be processed using traditional software tools. Converting such data into useful knowledge would be impossible without advanced computational techniques. Supercomputers and cloud computing platforms make it possible to analyze Big Data in real time, offering expanded opportunities for efficiency and innovation. Algorithms for data cleaning, clustering, and predictive modeling further enhance the value of Big Data for economic decision-making.

In fintech (financial technologies), computing plays a central role in digitizing financial services, ensuring that they are delivered rapidly, securely, and conveniently to users. Key applications include algorithmic trading, blockchain-based systems, mobile banking, and digital payment platforms such as PayPal, Stripe, and Revolut. These technologies have redefined the way financial transactions are conducted worldwide.

In Uzbekistan, digital payment systems such as Humo, Uzcard, Payme, and Click have become widely integrated into mobile applications, providing broad access to financial services for the population. Their adoption has significantly increased financial inclusion, supported the transition to a cashless economy, stimulated the growth of electronic commerce, and deepened the role of digital technologies in economic relations.

**CONCLUSION.** The step-by-step evolution of computing technologies has influenced not only technological progress but also economic development in profound ways. The historical transformation from mechanical devices to systems based on artificial intelligence has laid the foundation for the formation and sustainable growth of today's digital economy. The application of computing technologies in areas such as Big Data, fintech, digital services, and cybersecurity has created opportunities for faster, more efficient, and more transparent economic activity. Supercomputers, mainframes, mobile devices, and AI-based technologies have become central pillars of the digital economy. They have enabled automated analytics, algorithmic decision-

making, and user-centered services, turning computing into a key driver of economic efficiency and competitiveness.

The collected research evidence shows that computer technologies today permeate every segment of the economy—especially markets, banking, healthcare, education, public administration, logistics, and industry—making a significant contribution to financial and economic development. Computers have become indispensable tools for strategic decision-making and market analysis, solidifying their role in economic management.

In Uzbekistan, ongoing reforms in digitization and the reinforcement of digital infrastructure are directly linked to the advancement of computing technologies. The expansion of fintech services, the growth of e-government platforms, and the integration of digital tools into education and healthcare demonstrate the increasing role of information technologies in national development.

Thus, the development of computing machines remains one of the most important drivers of human progress. Their role in the digital economy not only enhances economic efficiency but also creates the conditions for unlocking human potential on a global scale. In the future, deeper analysis and broader application of these technologies will ensure the stability of the digital economy and lay the foundation for the creation of new jobs and market opportunities.

Proposal for the Development of the Digital Economy in Uzbekistan.

The rapid advancement of computing technologies—ranging from supercomputers and mainframes to mobile devices, cloud computing, and artificial intelligence—has created unprecedented opportunities for sustainable economic development. For Uzbekistan, where digital transformation has already become a state priority, further strategic initiatives are essential to accelerate progress and ensure inclusiveness. Based on international best practices and current trends, the following recommendations are proposed:

1. Strengthening Digital Infrastructure

- Expand nationwide access to high-speed internet, 5G networks, and cloud computing platforms to ensure equal participation in the digital economy across urban and rural areas.
- Establish data centers and supercomputing facilities to support Big Data analytics, AI research, and advanced simulations for industrial and academic purposes.



2. Advancing Digital Financial Technologies (Fintech)
  - Broaden the use of cashless payment systems such as *Humo*, *Uzcard*, *Payme*, and *Click*, integrating them with international fintech platforms.
  - Promote blockchain-based solutions for secure transactions, digital identity systems, and smart contracts to enhance financial transparency.
  - Support startups and SMEs in developing innovative fintech services tailored to the needs of Uzbekistan's population.
3. Expanding E-Government and Digital Public Services
  - Strengthen e-government platforms to deliver efficient online services in taxation, healthcare, education, and social protection.
  - Introduce mobile government (m-gov) applications to improve accessibility for citizens in remote regions.
  - Ensure interoperability between government databases to improve efficiency and data-driven decision-making.
4. Promoting Education and Digital Literacy
  - Integrate digital literacy and programming skills into the national education system, from primary schools to higher education.
  - Establish AI and cybersecurity training centers in cooperation with international universities and tech companies.
  - Encourage lifelong learning through online courses, digital platforms, and distance education.
5. Enhancing Cybersecurity and Data Protection
  - Develop a national cybersecurity framework aligned with global standards to protect critical infrastructure and user data.
  - Invest in AI-based threat detection systems to anticipate and mitigate cyberattacks.
  - Encourage private-public partnerships in strengthening digital security and promoting public trust in digital platforms.
6. Encouraging Innovation and Entrepreneurship
  - Establish digital innovation hubs and technology parks to foster research, startups, and partnerships between academia and industry.
  - Provide tax incentives and investment opportunities for businesses engaged in digital products, services, and AI-based solutions.

- Promote international cooperation in research and development to integrate Uzbekistan into the global digital economy.

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