



Article

Approaches to the Formation of the Digital Economy

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Abstract: This article explores the role of approaches to the formation of the digital economy and presents the opinions of global experts on this topic. It provides and analyzes information on technological, process, platform, and industry approaches to the digital economy.

Keywords: Digital economy, technological approach, process approach, platform approach, industry approach, "Internet of Things," Transmission Control Protocol, Internet Protocol, 3D printing, ICT, system, technologies, devices, digital transformation.

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Introduction

Today, the rapidly advancing digitization process has given rise to a "new economy." This relatively underexplored market segment, which is increasingly taking root, offers producers effective marketing strategies to organize their businesses, achieve maximum profit with minimal costs, and present optimal methods for successfully selling goods and services. It creates quality services and conveniences for consumers, buyers, and clients. Cross-border business partnerships, electronic trade platforms, and remote offices are also encompassed through the internet.

Main Body. The program of measures being adopted in Uzbekistan indicates that the development and implementation of the "Digital Uzbekistan-2030" program primarily focuses on establishing thorough and efficient organizational and legal mechanisms. Moreover, it emphasizes ensuring seamless cooperation between state bodies and business entities in introducing innovative ideas, technologies, and developments. It also aims for the integration of digital technologies in production and services across all sectors, along with training highly qualified personnel who possess modern knowledge and intellectual potential. This, in turn, serves to create an "information society" environment in the country.

Considering the above points, various understandings of the term "digital economy" in our society delineate different directions for its formation. Currently, specialists worldwide propose the following approaches to shaping the digital economy: technological, process-oriented, platform-based, and sectoral approaches.

A technological approach to the digital economy refers to the development of new technologies. According to experts, the technologies that constitute the foundation of

digital transformation include: networks (Internet, Intranet), cloud computing, big data processing, distributed ledgers, quantum technologies, digital design and modeling, machine learning, and artificial intelligence (such as speech and image recognition, text translation, image generation, and the creation of speech and musical compositions), as well as robotics and augmented technologies.

The aforementioned technologies differ in their level of development and readiness for widespread implementation.

In our opinion, one of the most advanced and significant technical complexes is the Internet of Things (IoT) and 3D printing technology. The term "Internet of Things" (IoT) was first introduced by K. Ashton (one of the founders of the Auto-ID Research Center at the Massachusetts Institute of Technology) in 1999. However, the first "Internet of Things" device appeared earlier in 1990 when J. Romkey connected a toaster to the Internet, allowing it to be turned on and off remotely. The Transmission Control Protocol (TCP) is also referred to as the Internet Protocol (IP). By 2010, 12.5 billion devices were connected to the Internet, which equated to 1.84 devices per person on our planet.

Researchers from Cisco – IBSG marked the period when the Internet of Things "emerged" between 2008 and 2009, when the number of connected devices exceeded the total population. Cisco is an American multinational corporation primarily engaged in the development and sale of networking hardware for large organizations and telecommunications companies. The company was founded in 1984 and is registered in San Jose, California.

However, despite the term and phenomenon existing since the 1990s, a precise and accurate definition has yet to be developed. For example, according to IDC specialists, the "Internet of Things" (IoT) is a network of networks that uniquely identifiable endpoints communicate with each other through two-way IP protocols, typically without human intervention.

➤ At Gartner, the IoT is considered a network of physical objects equipped with technologies that facilitate interaction with the external environment, transmitting information about the state of these interactions and receiving external data. According to representatives of McKinsey, IoT consists of physical objects embedded with sensors and actuators (executive devices) that are connected through wired or wireless networks using IP addresses.

➤ Some local experts envision IoT as distinct networks that are loosely interconnected, designed to solve specific tasks. As the Internet of Things develops, these networks will connect to one another, offering greater possibilities in security, analysis, and management. Others emphasize that the Internet of Things is a network of smart objects that allows for data collection, analysis, storage, and transmission independent of human involvement, facilitating autonomous actions and control.

➤ Due to the insufficient definition of this core concept, various identifying modifications have emerged, including terms like "Industrial Internet" (Industry Internet of Things – IIoT) and "Internet of Everything" (IoE).

➤ Specifically, analysts divide the Internet of Things market into four main components: equipment, software, services, and communication. As of 2016, the shares of all these components are comparable, but sales of equipment (29%) and services (30%) exceed those of software (22%) and communication channels (19%). According to IDC's forecasts, by 2020, there will be 1.4 billion connected devices in Central and Eastern Europe, and the IoT market size will reach \$24 billion. Approximately 36% of this amount will correspond to Russia, totaling \$8.76 billion. The market has grown from \$3.92 billion, as recorded by IDC in 2016, to this level. The average growth rate of the IoT market in Russia from 2016 to 2020 is projected to be 21.3%.

➤ However, there are factors that could slow down the development of the Internet of Things. The three most significant ones are:

- The necessity to transition to the IPv6 protocol due to the scarcity of electronic addresses;
- Ensuring the power supply for sensors;
- Adoption of common standards.

3D printing, or "additive manufacturing," is the process of creating entire three-dimensional objects of nearly any geometric shape by sequentially adding layers of various materials based on a digital model. In fact, 3D printing is completely opposed to traditional mechanical manufacturing and processing methods, such as milling or cutting, where the appearance of the product is formed by removing excess material (thus, "subtractive manufacturing").

The first active 3D printer was created by C. Hall, one of the founders of 3D Systems. Although 3D printing technology emerged in the 1980s, 3D printers began to see widespread commercial use only in the early 2010s. According to data from Wohlers Associates, in 2012, the global market for 3D printers and related services reached \$2.2 billion, showing a 29% increase compared to 2011. The significant growth in sales led to a sharp decline in the prices of devices [4].

3D printing technology is evolving and currently has at least 10 different types. It is used for prototyping and distributed manufacturing in architecture, construction, and industrial design; in the automotive, aerospace, defense, engineering, and medical sectors; in bioengineering (for creating artificial tissues); in the production of fashion garments and footwear, jewelry, education, geographic information systems, the food industry, and many other fields, including the production of items in home settings.

According to the 3D today.ru portal, there are currently 295 manufacturers of 3D printing equipment in 36 countries around the world, including 64 in the USA, 44 in Russia, 42 in China, and 21 in Germany [5]. Additionally, two local companies—"Irvin," which manufactures equipment under the Magnum brand, and PICASO—rank among the global leaders in this field. However, as experts point out, most Russian manufacturers rely on imported parts and components. The most "locally produced" 3D printer on the market is the Magnum 3D, which features electronics and other components (such as indicator modules, heating plates, mechanical parts, and others) manufactured directly in Russia [6].

The characteristic of modern changes is that new information and communication technologies (ICT) enable the automation of not only physical actions but also certain cognitive functions. The greatest opportunities arise from the ability to integrate and harmonize various new ICTs. For example, technologies for automating business processes are based on the use of software robots and artificial intelligence bots—Robotic Process Automation (RPA). A bot (shortened from the Czech word for robot) is a specialized program that operates according to a specified algorithm and uses pre-designed interfaces intended for human interaction. AI bots are self-learning programs or systems created based on artificial intelligence technology.

According to research by Grand View Research, an American research and consulting firm registered in California with its headquarters in San Francisco, the RPA market is expected to reach \$8.75 billion by 2024 [7].

The process-oriented and platform-based approaches to the digital economy signify changes in business organization and management models. Currently, most of the solutions being implemented in the IoT field are considered by experts to belong to the first-generation business model—Internet of Things 1.0. This model focuses on installing various sensors and devices and connecting them to a network. When transitioning to the Internet of Things 2.0 model, the focus shifts to analytics, including intersecting analytics, cloud and cognitive computing, and the use of machine learning tools. The success of companies is linked to their flexibility (the ability to adapt to changing conditions) and mobilization (focus on the use of mobile devices).

One of the most important development directions for modern business is the personalization resulting from the implementation of new ICTs, which allows for the involvement of consumers in the production process and takes individual preferences into account in mass production.

Proponents of digital transformation emphasize that data and the ability to process it are now the primary production factors, rather than physical assets. In such conditions, each corporation cannot merely accept ICT as an auxiliary tool. It must transform itself into an ICT company, where new technologies need to encompass nearly every area—from the human resources department to the management board. Consequently, companies should divide their ICT departments into two parts. The first would be responsible for traditional ICT functions, while the second would be accountable for flexible work, rapid market supply, fast application development, and maximum collaboration with business units [8].

Over the last 20 years, the share of high-tech companies in the S&P 500 index has doubled. The S&P 500 is a ranking of 500 large-cap U.S. companies whose stocks are traded on the two largest American stock exchanges (the New York Stock Exchange and NASDAQ). This ranking is managed by Standard & Poor's (S&P), a subsidiary of McGraw-Hill that analyzes financial markets. In 2000, 52% of the companies listed in the Fortune 500 had already disappeared. The list of the 500 largest companies in the world is compiled by Fortune magazine (published by Time Inc., USA), using company revenue as a key criterion for ranking. In 2016, the U.S. high-tech sector rose to first place, accounting for 19% of the total market capitalization of the top 500 companies (i.e., \$17.4 trillion). At the top of this list are Apple (1st place in 2016), Google (2nd place), Amazon.com (4th place), and Facebook (18th place).

The formation of a new type of economy comes with structural and organizational changes: large companies are "fragmenting" into services and solutions that utilize digital technologies, alongside the emergence and spread of new virtual and electronic business models. This latter phenomenon is reflected in the platform concept.

The platform approach to the digital economy has primarily been developed and implemented in the trade and logistics segments. Its essence is focused on providing special services to businesses and the population to coordinate the activities of various market participants. These platforms can provide transaction participants with services across almost the entire globe without geographical restrictions. Examples of digital platforms include Uber, Airbnb, Amazon.com, Alibaba, and others.

Uber Technologies Inc. is an American international private company based in San Francisco that has created a mobile app for searching, calling, and paying for taxi or private drivers. Founded in March 2009, this app is now available in over 600 cities worldwide. In most countries, 80% of the payment goes to the driver, while 20% goes to Uber.

Airbnb is an American company founded in August 2008 in San Francisco, offering an online platform for listing, searching, and short-term renting of private accommodations worldwide. During its operations, Airbnb charges hosts 3% of the reservation amount and tenants between 6% and 12%.

Amazon.com Inc. is the largest American company selling goods and services over the Internet, and it was one of the first internet services aimed at mass consumer goods. Founded in 1994, its headquarters is located in Seattle, Washington.

Alibaba Group is a Chinese public company founded in Hangzhou in 1999 by Jack Ma and 17 partners. Its main activities are B2B trading operations and online retail. It has its own electronic payment system—Alipay.

Today, various digital platforms are merging into interconnected "ecosystems," which are built on data exchange. The creation and launch of a new generation of digital platforms that cover various markets and enterprises is one of the pressing issues.

Industrial Approach to the Digital Economy. Rather than limiting the digital economy to electronic commerce and services, it can be seen as a new stage of automation that allows

for solving complex problems. Experts have analyzed the modern production cycle, from product development to sales and service. According to their conclusions, all existing stages can be replaced with new technological complexes, including:

- Digital R&D Center;
- Digital Factory;
- Digital Warehouse;
- Digital Transport;
- E-commerce;
- Digital Services.

A Research and Development (R&D) center is a form of organizing practical scientific research and experimental work within companies and corporations, somewhat similar to the design and experimental structures of the former Soviet era. Based on this, various projects have already been developed and implemented. For example, let's consider some of them:

- FoodNet – food and water production and delivery systems
- TechNet – "smart" (digital factory) plant
- EnergeNet – distributed energy system
- AutoNet – autonomous (driverless) vehicles
- AeroNet – unmanned aerial vehicles
- FinTech – digital financial technologies
- SafeNet – security systems and software development
- Digital Quarry – "smart" resource extraction system
- Digital Railway
- Digital Media
- E-Trade – electronic commerce.

Digital transformation, which includes automation and corresponding changes, is occurring not only in industry but also in the service and management sectors. Currently, the most developed sector of the digital economy is e-commerce. While often conflated with the digital economy, it is actually much broader. The implementation of digital technologies allows for significant organizational and technological improvements within various sectors.

The financial sector, particularly banking, is actively undergoing digitization. Unexpected competitors are entering the financial market, challenging traditional players (banks). For example, Alibaba Group distinguishes itself with its payment system compared to Amazon.com and others. Consequently, banks are starting to engage in new ("non-core") activities.

In the realm of transportation, real advancements in digitization are still scarce, but the anticipated outcomes resemble fantastic innovations. Experts predict the emergence of the first self-driving cars by 2024. Currently, Uber is using self-driving Volvo XC90, Volvo S90, and Ford Fusion vehicles for transport in Pittsburgh, Pennsylvania. Several private companies are also developing self-driving shuttles and buses, while KAMAZ is advancing autonomous technologies in Russia.

Digital rail transport has been developing for over a decade, with its main architecture created in the UK. In 2017, the Australian-British mining group Rio Tinto tested its first fully autonomous train, which traveled nearly 100 kilometers through the Australian outback, monitored remotely by company and government representatives. Rio Tinto plans to establish a network of autonomous long-distance freight trains by the end of 2018 and currently operates 71 autonomous trucks that transport approximately 20% of extracted iron ore.

There are great expectations for digital agriculture, which encompasses increasing logistics efficiency, smart irrigation, and monitoring soil and crops (including plant disease detection systems) using "smart" technology equipped with sensors. While fully autonomous tractors are not yet operational in fields, their prototypes are undergoing

testing. The most advanced company in this area is Case, which presented its Autonomous Concept Vehicle in 2016 and followed up with the driverless Case IH Magnum tractor in collaboration with CNH Industrial in 2017. In Russia, the testing of the "Agro-Bot" driverless tractor, developed by Avrova Robotics, began in a Ryazan agricultural complex in 2016, while Cognitive Technologies has conducted tests of driverless tractors equipped with computer vision systems in Tatarstan.

The use of modern ICTs is fundamentally transforming the service sector, particularly in healthcare and social welfare, providing new opportunities for timely disease prevention and early diagnosis, as well as monitoring the condition of patients and individuals with chronic diseases. The development of genomic medicine and its convergence with ICT is leading to a new direction in individual medicine, which allows for personalized treatment plans based on patients' DNA characteristics and high levels of automation, such as genetic testing services. Telemedicine, individual medicine, and healthcare information networks are transforming traditional healthcare organizations and requiring specific competencies from medical staff.

The travel and hospitality sectors also have significant potential for digitization. For instance, automated systems can customize travel selections according to specific customer needs, recognize faces during check-in, service, and check-out at hotels, and control room environments through gestures and voice commands. The use of robots in the hotel business can significantly reduce staff numbers and automate hotel operations.

The proliferation of modern ICTs has led to the emergence of distance education. Leading global educational institutions are now offering their courses entirely online, with the number of distance education students increasing. Traditional educational institutions are also becoming more flexible and individualized through the use of the Internet, Intranet, interactive television, computers, and multimedia tools. Between 2008 and 2012, the growth rate of direct investments in the academic e-learning segment was estimated at 48%.

Additionally, the digitization of certain activities has facilitated the implementation of systematic projects such as "smart homes" (intellectual services designed to optimize safety and resource use in households) and "smart cities," which encompass the development of urban environments and infrastructure, including transport systems, energy, water supply networks, waste collection and recycling systems, and other social services.

According to estimates by the United Nations, by 2050, 67% of the world's population will reside in urban areas. Currently, many global metropolises face high population density and often struggle with effective waste collection. The integration of new ICT and IoT technologies has led to the concept of "smart cities," which addresses numerous urban challenges and provides quality services to residents. The British Standards Institution defines a smart city as "the effective integration of physical, digital, and human systems to ensure a sustainable, prosperous, and well-rounded future in the built environment." Indicators of a smart city, as recognized by the European Economic Commission, include the availability and quality of utility resources, innovative infrastructure, and a safe and comfortable environment. Smart cities are managed through data, which enhances the quality of life for residents through municipal services. Data sources include cameras, various sensors, information systems, and more. Smart cities are already being developed in 18 countries, with London, Berlin, and Barcelona planning to become smart cities by 2020, followed by New York and Dubai in 2021, and Singapore by 2025. Smart city technologies are being implemented in places like Sydney, Toronto, Madrid, Tel Aviv, and Rio de Janeiro.

In Uzbekistan, several regulatory documents have been adopted to establish smart cities. Examples include the Presidential Decree on "Digital Uzbekistan – 2030" issued on October 5, 2020, and the decree from September 8, 2020, outlining principles for developing the digital economy and establishing smart cities. The "New Uzbekistan Development

Strategy for 2022-2026," adopted on September 6, 2021, aims to ensure the social and economic development of the country, create a stable economy that meets modern requirements, and improve the living standards of the population.

Conclusion

In conclusion, it can be said that the processes of digitization require the implementation of several cross-cutting projects: information resources, digital platforms, and the conditions necessary for their functioning (legal, economic, and social). Furthermore, the transition to a digital economy necessitates the expansion of the production of sensors, devices, and robots, as well as the development of the components base.

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