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NGO VINNYTSIA CITY ORGANIZATION FOR SOCIAL DEVELOPMENT OF SPECIFIC CATEGORIES OF VULNERABLE YOUTH «PAROSTOK»

DIGITALIZATION OF ECONOMICS: INTER-DISCIPLINARY AND INTER-BRANCH APPROACH

Manual

The manual is developed in the framework of ERASMUS+ CBHE project «Digitalization of economic as an element of sustainable development of Ukraine and Tajikistan» / DigEco 618270-EPP-1-2020-1-LT-EPPKA2-CBHE-JP

This project has been funded with support from the European Commission. This document reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained there in.

видавничий дім Бук-Друк

Житомир • 2023

UDC 338:658.5:004.031
D44

Recommended for publication by the Academic Council
Zhytomyr Polytechnic State University
(Protocol No. 15 dated 12/19/2022)

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D44 **Digitalization of economics: inter-disciplinary and inter-branch approach :** manual. – Zhytomyr : Publishing House "Book-Druk", 2023. – 540 p.

ISBN 978-617-8085-89-6

The manual disclose the essence economic development in digital era, the content of the involvement of countries in the global digital economy. The processes of transformation in a new digital reality and the indicators of the effective development of the digital economy of the countries, with special attention on inclusion, has been researched.

The textbook is recommended for individuals who already hold a graduate degree, current students who have bachelor degree and continue their education on Master level Programs in “Social and behavioral sciences”, “Management and Administration”, “Information Technologies”. It will be useful for stakeholders – employers, businessmen, businesswomen, governmental institutions, non-governmental organisations for digitalizing of the processes in business and economics.

The authors are responsible for the content and presentation.

UDC 338:658.5:004.031

ISBN 978-617-8085-89-6

CONTENT

PREFACE

The modern world is rapidly transforming. Knowledge economy, sharing economy, digital economy. Educational courses, related to world economic processes, requires constant analysis of current trends and features of the functioning of local and global markets.

In manual has been proposed top-cases of digital transformation and modern economic development. Materials regardind notions of digital economy, digital marketing, blockchain, IoT, e-products, big data and others with the special attention on inclusiveness has been presenting. Models and approaches of information technologies usage in business processes, especially in the development of new products has been described. The new approaches to the formation of digital competencies of master graduates has been highlighted.

The manual has been prepared according to the objectives of the project, namely:

1. To "fill the demand of labor market in specialists in digital economics by implementation of modern trends in the digital sphere in accordance with EU best practices, … according to the Bolonia requirements and EU strategy of Digital Single Market. The aim … is to train professionals who understanding how organizations can effectively use digital technologies to innovate their business processes, products, services, and business models.

2. To create inclusuve educational enviroment acording Education 4.0. in the field of DE-implementation of methodological and technological activities ... People with disabilities will be able to gain knowledge and skills without discrimination.

3. Launch innovative partnership model for stakeholders networking – creating of basic digital services for use by citizens in the field of education, for launching partnership models of representatives of the digital industry, business and universities" (http://dig2eco.eu/about-us-2/).

UDC 004.330.1

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Chapter 1
THE NOTIONS OF DIGITAL ECONOMY

Content

1.1. Digital economy: the essence and components

At the end of 20th century, it has become clear for the whole world that the old economic model with all its shortcomings is giving way to a more advanced one – the *digital economy* based on digital computer technologies. In general, the concept "digital economy" presented in an international bestseller of the great Don Tapscott "The Digital Economy: Promise and Peril in the Age of Networked Intelligence" in 1994 [1]. One of the world's most leading authorities in the field of business strategy and on the impact of technology on business and society Don

Tapscott defined the ***digital economy*** as an economy that is based on the dominant application of digital technologies, when digital data (binary, informational, etc.) plays a key role. His further book "The Growing Up Digital" (1997) alighted the digital future. That is, the digital economy is a type of economy characterized by the active implementation and practical use of digital technologies for collecting, storing, processing, transforming and transmitting information in all spheres of human activity. From the point of view of the founder of the Media Laboratory of the Massachusetts Institute of Technology Nicholas Negroponte, the concept of digital economy is a shift from (the processing of) atoms to (the processing of bits) in his bestseller "Being Digital" (1995).

Mainly, since the early 1990s, the definition of the digital economy has evolved based on the technology trends that characterized the times, as well as the level at which technology penetrated different tasks and markets. In the mid-1990s, "digital economy" was a bit an abstract concept associated with the development of the Internet and data proceeding. Some saw it as the new networking of humans enabled by technology, and others as the convergence of computing and communication technologies that enabled e-commerce; still others defined it based on its ICT infrastructure foundations. Today, as technology rapidly evolves and becomes ubiquitous, it is widely agreed that the digital economy encompasses all those definitions [2]. According to "Arthur D. Little" the digital economy at the present stage of development is an economic activity that uses digitized infrastructure and knowledge as key factors in production and value creation [3]. Component approach prevails in most definitions of the early digital age, when the economic essence of the digital economy formed.

The Organization for Economic Co-operation and Development (OECD) and scientists identifies three components of the digital economy, in particular [4, p. 14; 5–6]: *supporting infrastructure*, which includes hardware and software, telecommunications, networks, etc.; *e-business* – any processes that the organization conducts through computer networks; *e-commerce*, that is, the distribution of goods via the Internet.

Rumana Bukht and Richard Heeks [7, p. 13] propose to present the modern digital economy by three components (Fig. 1.1):

1) **the core** – digital (IT/ICT) sector, as defined by the Organization for Economic Communication and Development (OECD), is composed of manufacturing and services industries that capture, transmit and display data and information electronically. This includes semiconductors, processors, devices (computers, phones) and enabling infrastructure (internet and telecoms networks);

2) **digital economy** (narrow scope) – the digital functions or applications that create economic value added, namely true economic profit of a company, as well as added value to business sectors and customers. This includes services and platforms (both B2C and B2B) using devices, data and connectivity infrastructure as inputs. Innovation in these sectors is widely driving spillover impacts to other sectors;

3) **the digitized economy** (broad scope) – sectors that were not traditionally digital are now being transformed by the adoption of digital technologies. These include, for instance, e-health, e-commerce, and use of digitally automated technologies in sectors such as manufacturing and agriculture, which include 4.0 and precision agriculture, among many others.

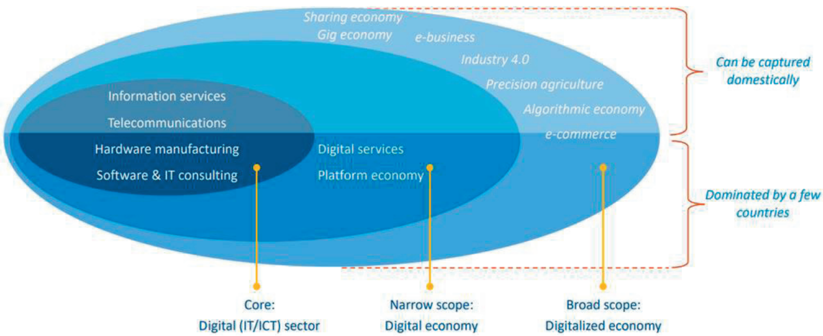

Fig. 1.1 – Scoping of digital economy [2, p. 12]

The digital economy covers everything from traditional sectors of the economy – industry, agriculture, trade, healthcare, education, transport, etc., which are transformed under the influence of the digital technologies, – through to new digital sectors. To be talking in a "narrow sense" the digital economy is digital technologies as a set of digital functions, solutions, products and services that create added value for businesses and their customers. In this way macro- and micro- digital economy developing [8].

The **digital economy** deals with activity carried out using information, communication and digital technologies, during which value added and public goods are created. In other words, it uses digitized information, data and knowledge as *key means of production*. Logically, it permeates all sectors of the economy, creating new segments, clusters and even industries. This stimulates the transformation of the traditional economy into one that creates, rather than consumes resources [9]. In practice, it is, first of all, a consumer-oriented economy (economics of demand, sharing and economy of impressions/experience economy [10]. In addition, these are online stores, Internet banking, instant messengers and other social networks for instant orders, a market for an unlimited selection of goods and services [11]. The digital economy is too intertwined with the traditional economy: the development and implementation of information and communication technologies and innovations in the field of information and communications more and more affects all sectors of the economy and society.

With the increase in population and consumption of resources in the modern world, the digital economy influences more than into the sphere of business and trade, – it also has no less impact on the educational and banking sectors, and creates new ones. The digital age continues to change approach on doing business, as well as the requirements for the information technologies usage [12]:

– marketing, sales and service management systems;

– telephony and instant messengers;

– document management and personnel management systems;

– accounting systems and many other enterprise applications into e-direction.

The main key elements of the digital economy in the process of further transformation of the traditional economy are digital infrastructure, human capital, financial resources, higher education, business environment, public policy (Fig. 1.2).

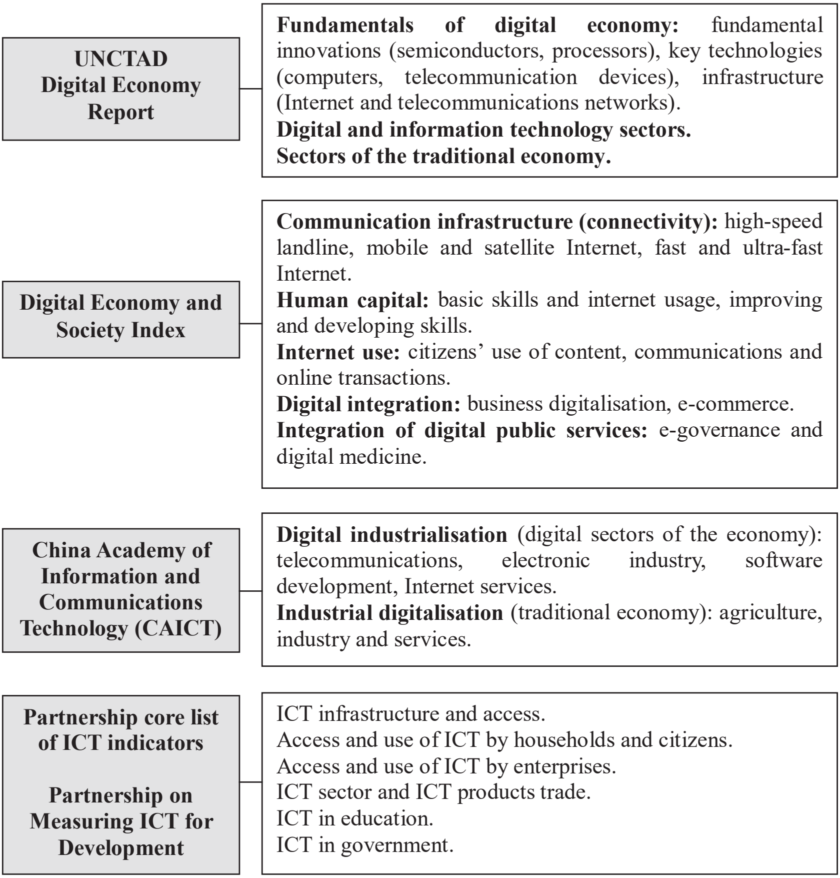

Fig. 1.2 – Systematization of approaches to the definition of digital economy components [13]

Features of the digital economy are:

– widespread use of information and communication technologies (IT/ICT) and the Internet in economic processes, widening their presence in society;

– maximum automation of business processes of entrepreneurs;

– the use of electronic document management;

– digital skills widening in creating modern technologies among participants in economic relations;

– the use of digital platforms and digital business models functioning;

– formation of an information space between the participants of economic relations: business, state and citizens;

– increase KPI from ICT functioning, information products and services in GDP;

– growth of gross domestic product due to digitalisation of the economy, increasing the part of the digital economy in GDP. Already, the digital economy based on the broad definition of measurement is estimated to be $ 11,5 trillion, or 15,5 % of world GDP. On average, it accounts for 18,4 % of GDP in developed countries, and 10 % in developing countries [14]. This includes the contribution of sectors that have not been traditionally digital, which are using digital technologies to react on the rising challenges of a competitive, growing and interconnected world [2; 7];

– access to world information resources and meeting the growing needs of consumers in information products and services;

– development of the global digital market;

– transparency information and economic integration of countries and peoples, globalization of the economy.

The digital economy is changing societies and the way people interact, introducing significant social, economic and environmental changes.

Questions for self-control:

1. The economic content of the concept of the digital economy.
2. Characteristic features of the digital economy.
3. Components of the digital economy.
4. Digital sectors of the economy.

5. Information technology for business.
6. The impact of the digital economy on the state and development of traditional sectors of the economy.

1.2. Application of digital technologies and products in economic relations

Many researchers and managers in the world and in Ukraine use different names for the concepts of the digital economy: Internet economy, new economy, web economy, GAFAnomics (from the first litters of the names of companies Google, Apple, Facebook and Amazon), "on-demand economy", "data economy", etc. In general, all these describe the type of economy in which main means of production are digitized (numerical and textual) data and information.

In the digital economy we use digital *data* (sets of data) as well as *digital information* (interpretation of data). Meanwhile, new digital objects have their own specific features that distinguish data from information as an object of civil rights in the usual sense for us and determine the specificity of their legal nature.

Digital data is a set of symbols, the value of which is determined by the demand for them. Data, by form, has specific properties. They are not characterized by those signs that are characteristic of information; not amenable to moral aging, cannot spread indefinitely, which is due to the specifics of technologies, can be destroyed, have an exhaustive character and, crucially, can be separated from the person who transmits them. That is, this kind of data can be disposed of in the same way as the disposal of material things occurs [15, p. 41].

Digital economy development goes with information interaction, e-environment for economic relations further formation, ITC (information and communication technologies) improvement. The *improvement of digital technologies* contributes to increasing the competitiveness of various sectors/clusters of the world economy, creating new business opportunities by connecting to digital global value chains, emergence of new markets and segments, accelerating the launch of new digital products on the world market [16, p. 185].

Information and communication technologies are defined as a set of methods, tools and techniques used to develop information systems and build communication networks, allow users to create, access, store, transmit and change information using such systems and networks. Digital technologies, so, are the systems, networks, and devices mentioned. Information and communication technologies combine all technologies related to telecommunications, intelligent control systems (smart systems), audiovisual data processing and transmission systems and network control and monitoring functions.

The key components of ICT include [17]:

– *cloud computing:* data collection and processing centers – large cloud services;

– *software:* a set of tools, data, programs that are used to work with computers to perform specific tasks;

– *hardware:* physical infrastructure of software (computer equipment, devices, sensors, etc.);

– *digital transactions:* online transactions that take place between participants in the digital economy without the use of paper ("paperless");

– *digital data:* data forms using specific machine language systems, which allows you to interpret information using various technologies and devices;

– *Internet access:* the process of connecting users to the global Internet using hardware.

The European Patent Office (EPO) identifies ***three groups of Industry 4.0 technologies*** that influence the development of the digital economy [18]:

1) *core technologies* that make it possible to transform any object into a smart and connected device. These comprise three fields: connectivity,

IT hardware and software.

2) *enabling technologies* that are used in combination with connected objects. These comprise eight fields: data management, user interfaces, geo-positioning, data security, safety, 3D systems, power supply and core AI.

3) *application domains* where the potential of connected objects can be exploited. There are eight domains: consumer goods, services, vehicles, healthcare, industrial, home, infrastructure and agriculture.

Taking into account the EPO classification, mark the modern digital technologies (Table 1.1).

***Table 1.1* – Potential of technologies for economics [12]**

Group of technologies	Technologies	Potential for economics
1	*2*	*3*
Core technologies	– 5G; – Internet of things; – robototechnics	5G is a new infrastructure in the digital economy that provides support for the functioning of artificial intelligence (AI), cloud computing, processing of large amounts of data and the Internet of Things (IoT). The IoT allows to interconnect physical devices for the purpose of data exchange. The IoT and the robotization provide increased production productivity and effective involvement in value chains. The use of 5G technology, the IoT and robotics has potential in all sectors of the traditional economy: primary, secondary and tertiary sectors, as well as in the knowledge economy (education, science medicine).
Enabling technologies	– additive producing (3D-printing); – cloud computing; – Big Data and it's analysis; – artificial intelligence and machine learning; – augmented and virtual reality; – cybersecurity; – quantum computing; – software intelligent agents; – blockchain technologies (public, private, consortium, hybrid)	Auxiliary technologies with a developed 5G infrastructure and the introduction of the IoT allow economic entities to flexibly respond to changes in consumer needs and the latest trends. The introduction of assistive technologies in the sectors of the traditional economy allows to ensure a high level of competitiveness of the country through prompt response to changes and involvement in global value chains, as well as contribute to improving the quality of life and security.

Continuation of Table 1.1

1	2	3
Application domains	– remote control of devices (in production, unmanned vehicles, in medicine, etc.); – technological solutions using 5G; – unmanned vehicles; – Smart Cities; – digital health (status monitoring sensors, stand-alone injection devices); – digital payments	These technological solutions are aimed at the development and implementation of smart technologies. In combination with basic and assistive technologies, application domains become the basis for new digital platforms: – digital business (e-Business); – digital government (e-Government); – digital education (e-Education); – digital medicine (e-Health); – electronic commerce (e-Commerce); – agricultural technologies (Agritech); – fintech (Fintech); – smart cities (Smart city); – sharing economy (also known as collaborative consumption or peer-to-peer-based sharing).

Digital technologies are changing traditional business models, production chains and driving the cause of new products and services. Fast and structural transformations of sectors of the economy are taking place under the influence of digitalisation and intensification of research and development in the field of ICT. A significant ***social effect*** (as a result of the business activity in the spheres of the economy, which is reflected in the trends of the society development and cannot be accurately calculated) creating as well, namely for the development of smart cities, health care, education (Fig. 1.3).

It is important to note that OECD analysts determine that the modern digital economy is characterized by five trends:

– the Internet has become critical;

– there remains a gap between countries in the use of technology and the Internet;

– a growing need to manage digital threats and risks;

– data is a key resource (it is official – data is now the most valuable asset in the world, ahead of oil, according to The Economist);

– the development of digital technologies is concentrated in some countries of the Big Twenty.

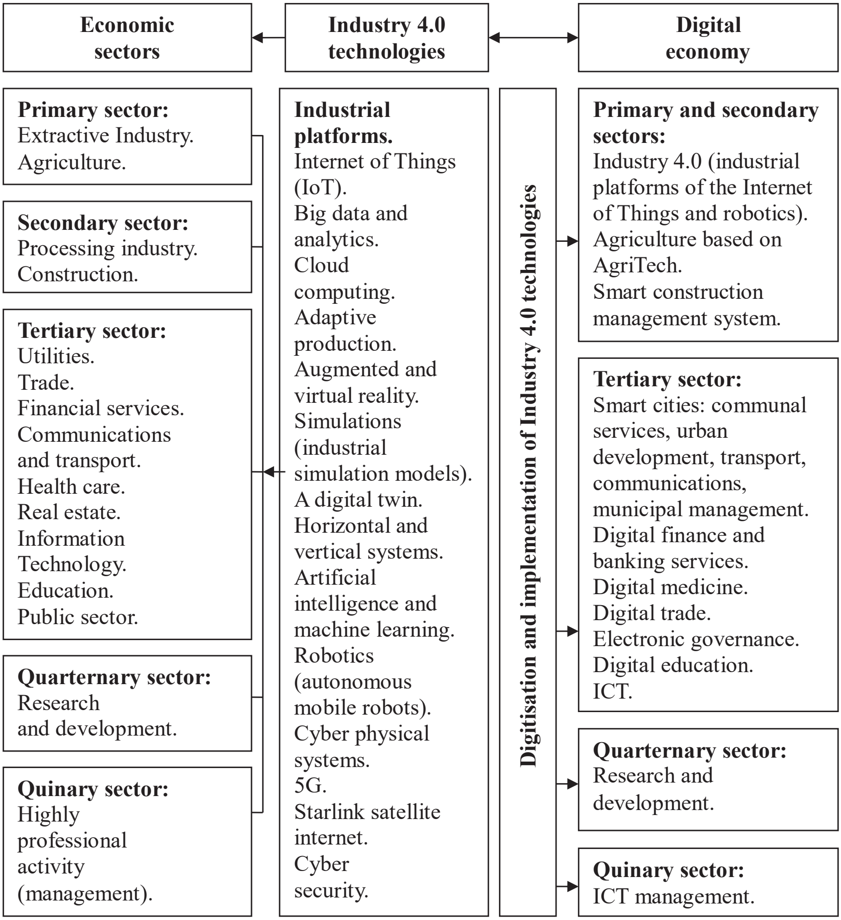

Fig. 1.3 – The impact of technologies on the development of the digital economy

Current trends in the global ICT market (Table 1.2) are characterized by:

– digital transformation (70 % of all organizations will accelerate the use of digital technologies for business sustainability, productivity and customer engagement);

– widening of artificial intelligence (77 % of consumers use artificial intelligence technologies);

– IoT development (an increase in the number of devices connected to the Internet per user from 4 in 2020 to 15 in 2030);

– the need to ensure cybersecurity (the growth of such threats as phishing, cryptojacking, cyber-physical attacks, attacks on devices via the IoT necessitate the development of cyber protection and cybersecurity programs);

– intensive use of cloud computing (the use of cloud technologies by small businesses in order to reduce costs);

– deployment of 5G infrastructure (the development of the fifth generation Internet network is the basis for accelerated digital transformation: by 2024, 5G networks will cover 40 % of the world's territory and 25 % of global traffic, by 2035 5G will contribute to the creation of 22 million jobs);

– expansion of the scope of virtual and augmented reality (medicine – treatment of post-traumatic stress disorder, paralysis, pain control; education, additional workplace opportunities);

– chatbot and blockchain technologies.

Table 1.2 **– Modern trends in development of digital technologies [19]**

TOP ICT Trends	
1. Accelerated Digital Transformation	6. 5G Network
2. Ubiquitous Artificial Intelligence	7. Virtual Reality
3. Internet of Things	8. Augmented Reality
4. Cybersecurity	9. Chatbot
5. Alternatives to Cloud Computing	10. Blockchain

Digital transformation of the economy will provide countries with productivity growth, stimulate economic development and contribute to increased competitiveness. Investments in ICT and widening of digital technologies in various sectors of the economy have a multiplier effect and contribute to the growth of added value.

Digital technologies manifest in the realm of entrepreneurship in the form of three distinct but related elements – digital artifacts, digital platforms, and digital infrastructure [20, c. 1031]. ***Digital artifact*** is a digital component, application, or media content that is part of a new product (or service) and offers a specific functionality or value to the end-user. The separation of information from its related physical form or device has led to the infusion of such digital artifacts or components into a wide range of products and services, and opened prospective opportunities for entrepreneurs. Such digital artifacts or components are present not only on smartphones and other personal devices (e.g., apps that run on smart watch fitness watch, etc.) but also as part of things for home, toys, clothes, shoes, automobiles, etc. (e.g., Amazon Dash button, Oral-B's toothbrush, Ralph Lauren the Polo Tech shirt, etc.). Digital artifacts can be either stand-alone software/hardware components on a physical device or a part of an ecosystem of offerings that operate on a digital platform.

A ***digital platform*** is defined as a shared, common set of services and architecture that serves to host complementary offerings, including digital artifacts. For example, Apple's iOS platform and Google's Android platform enable apps to run on their smartphones. Similarly, Ford's SYNC 3 is a digital platform that hosts integrated communication, navigation, and entertainment apps in cars. Digital platforms provide opportunities for entrepreneurs – opportunities that involve developing complementary products and services. Such digital platforms (and associated ecosystems) are often marked by a single firm, the platform 'leader', in establishing the modular platform and in creating both value creation and value appropriation. The potential for new ventures to deepen their specialization while offsetting their production, marketing, and distribution capabilities explain the attractiveness of digital platforms as a place for entrepreneurship.

Digital infrastructure is defined as digital technology tools and systems (e.g., cloud computing, data analytics, online communities, social media, 3D printing, digital makerspaces, etc.) that offer communication, collaboration, and/or computing capabilities to support innovation and entrepreneurship. Such digital infrastructures have led to the democratization of entrepreneurship, i.e., the engagement of a greater quantity of different people in all stages of the entrepreneurial process – from opportunity exploration to concept testing to venture funding and launch. For example, crowdsourcing and crowdfunding systems allow entrepreneurs to interact with potential customers and investors in buying varied resources (ideas, capital) in a global. Similarly, cloud computing, digital makerspaces, and data analytics have made it possible for new businesses to create effectively and test new concepts involving more potential customers. Indeed, new digital infrastructures have shown the capability to support end-to-end entrepreneurial activities.

Thus, digital technologies increasingly become an inherent part of the entrepreneurial opportunity in terms of both the outcome as well as the process. Specifically, doing Davidsson's "entrepreneurial opportunity framework", digital artifacts and digital platforms serve as part of the new venture idea (outcome) while digital infrastructure serves as an external enabler (supporting the process). The characteristics and other aspects of these digital technology elements critically shape the changing assumptions regarding the nature of innovation and entrepreneurship and the distribution of entrepreneurial agents.

So, digital technologies, services and systems are extremely important for economic and social development. They can provide growth and job creation in all types of economic activities, the opportunity for quickly adaptation business models to the realities, and a place in the global economy.

Questions for self-control:

1. Digital data and digital information.
2. Formation of the digital environment of economic relations in a turbulent economy.
3. Key components of information and computer technologies.
4. Industry 4.0 Technologies.
5. Systematization of digital technologies.
6. The impact of digital technologies on the development of the digital economy.

1.3. Advantages and challenges of the digital economy

Digital technologies have already transformed jobs, education, leisure, entertainment, formed new market opportunities, which has caused socioeconomic consequences in various sectors of the economy and society, because:

– reducing the cost of digital technologies in combination with existing cloud services reduces the investment required to start a business;

– the use of digital technologies reduces costs, digitalisation of documents leads to general optimization of the process, decentralization of production increases productivity and efficiency of real-time decision-making;

– digitalisation is changing business culture, and transforming the management;

– free content and services (to low marginal costs): users pay only a part of the cost that is created in the digital economy;

– digital technologies can be used to create unique products that are fully adapted to the preferences of the client;

– digital technologies in the service sector allow to operate from anywhere in the world, sell and buy goods and services via the Internet;

– digitalisation can contribute to solving social problems by facilitating access to health services (e-health), education (distance learning), financial services, transparency and efficiency of government activities (e-government: system of electronic regulations and registrations);

– increase the level of environmental friendliness of production, product quality.

One of the key advantages of the digital economy is the implementation of the possibility of "automatic control" of both the entire system and its individual components, as well as "its scaling" without loss of efficiency, which allows to increase "the efficiency of economic management" (economic activities and resources of the country in various industries) at the micro- and macro- levels [21–23].

At the level of society, the following advantages of the digital economy are highlighted:

– economic and social effects of digital technologies for business and society;

– improving the quality of life, first of all, by improving the satisfaction of people's needs;

– increasing the productivity of labor;

– new models and forms of business allow to increase the profitability and competitiveness of activities;

– increasing the transparency of economic operations and ensuring the possibility of their monitoring;

– ensuring the availability and promotion of goods and services globally.

Advantages of the digital economy ***at the level of companies and industries*** are:

– the ability to work directly;

– cost optimization as a result of reducing the cost for searching, processing and analyzing information, transaction costs, the cost of promoting goods and services, the cost of negotiating, etc.;

– acceleration of all business processes, including by reducing the time for communications;

– reducing time on a market changes response, for developing products and services and bringing them to market;

– better understanding of consumers and improving the quality of products and services;

– creation of new products and services, increasing the flexibility of the products offered and their high adaptability to new expectations or needs of the consumer.

Technological advantages due to digitalisation:

– sharing of information and “lack of competition in the consumption” of knowledge and information, because the use of a database or knowledge base by one consumer does not interfere with their simultaneous use by other consumers;

– accumulation of large amounts of data, implementation of their automatic processing and analysis;

– synchronization of information flows, the possibility of point distribution of data throughout the business and, as a result, the ability to track a large number of chains between suppliers and consumers, as well as conducting intellectual and point analytics;

– awareness of the potential of digital innovation contributes to the creation of new innovative products;

– transition from paper documents to electronic ones.

For the person (consumer, employee) advantages of the digital economy are:

– reducing the cost of payments;

– new sources of income;

– the cost of Internet services is lower than in the traditional economy (mainly by reducing marketing costs), which makes services more affordable (including public services);

– goods and services become available anywhere in the world to any customer;

– goods and services take into account consumer preferences and customer needs as much as possible;

– the range of information, educational and entertainment services is significantly expanding, the level of provision and speed of which are also growing.

Generalization of the world experience of digital transformation of national economies allowed to mark the following positive consequences of these changes [21–24]:

1. Creating new opportunities for business development based on the use of digital technologies (mobile networks, social technologies, big data analysis, cloud computing) that increase the potential of enterprises, attract new customers, etc.

2. Improving the competitiveness of the national economy through the development of new business models and digital technologies (big data analytics, digital platforms, robotization, 3D printing, IoT, neural networks, artificial intelligence, blockchain, etc.).

3. Increasing the transparency of the process of interaction between business and the citizens with the state and improving the business climate in the country as a result (simplification of procedures for the provision of public services, development of a system of electronic services and online services for business and the people.

4. Saving time and erasing boundaries, including in communication.

5. Improving the quality and convenience of obtaining medical, educational, cultural, logistics services, services in the field of public safety.

6. Mitigation of the regulatory regime, development of unify standards in for digital technologies.

7. Stimulating interest for use of digital innovation and the development of digital culture.

The development of the digital economy is becoming a source of not only new opportunities, but also threats and problems. ***The negative consequences of the digital transformation of the economy could be following [24]:***

1. Digital divide, digital inequality and polarization; increased tensions between states for technological dominance.

2. Transformation of international markets and consumer behavior patterns; increased price competition.

3. Loss of jobs. First, the automation of processes will leave some part of the people without work. Secondly, there will be new needs and demands from the

market for new professions and the transformation of existing ones. In particular, over the past 30 years around the world, human participation in production has decreased from 64 % to 59 %. Therefore, according to experts, by 2040 the automation of industry will lead to a reduction in jobs by about 40 %, primarily due to low-paid positions in production.

Digitalisation can leave millions of people in the world without work. It is assumed that by 2030 more than 60 % of professions will be automated.

4. “Polarization” of human resources according to the level of development of digital skills, which increases the risks of non-compliance of quality educational and professional knowledge, personnel skills with the requirements and needs of the labor market.

5. Deepening the social polarization of society, the precarization of labor, the loss of labor potential due to the growth of labor migration.

6. The emergence of socio-psychological problems of individuals and society, which are associated with threats of segregation of the country’s citizens according to the criteria of their competencies in digital technologies, deterioration of functional capabilities and labor skills of personnel and changes in motivation, digital autism and hyperinformation environment.

7. The problem of security of confidentiality, cyberattacks as a more important danger and the growth of cybercrimes (theft of personal data, money from accounts, collection of a lot of confidential and commercial information, blocking activities, etc.).

Digitalisation of the economy and society carries with it certain ***risks*** [22–24]:

1. Risks associated with the use of the IoT: vulnerability (unauthorized influence, cyberterrorism) and illegal use of technologies (video monitoring systems etc.). As IoT facilitates much higher collection and consumption of data, the use of these technologies poses increasing privacy and security concerns. These considerations accumulate further in the case of cross-border data flows, as

sensitive data can be transferred to a country where the jurisdiction may not apply the same standards of data protection as in the country where the data are collected. In exploring the governance landscape for IoT, the World Economic Forum (WEF) concludes that “the many risks inherent in IoT have not yet been effectively mitigated, and the state of IoT governance remains immature. At the same time, however, the effort to manage these risks can lead, in some cases, to inappropriate regulation, which in turn can threaten the value and effectiveness of many IoT applications. The issue of cross-border data exchange is a case in point… As important as it is to govern the use of many IoT applications, privacy and cybersecurity regulations remain fragmented across the globe”.

2. Risks from using artificial intelligence, robotization, automation: increasing social tension due to job losses, rising unemployment; total control on lives of citizens, possible leakage of information that is a trade secret.

3. Risks from using blockchain technology associated with a vulnerability in the security of the blockchain system itself, the service infrastructure built on it, the inability to change information on the network (inability to correct the error, change incorrectly entered information), the use of tokens as a means for “money laundering”, terrorist financing.

4. Risks associated with the use of import, namely microelectronics. For example, most of the hardware, computer equipment used in Ukraine are imported (it is possible that they may contain special chips for spying).

5. Risks associated with the use of cloud – dependence on the reliability of the telecommunications system; erosion of responsibility for information security and reduction of the level of control due to their distribution between user companies, organization and owner of the cloud platform, Internet provider.

6. Risks associated with the stability of the Internet – during the pandemic and (and in general with a great interest in using remote workers), everything shifted online; from work to education, everything was done virtually. Today’s businesses are increasingly reliant on cloud-based software solutions and Web-

based communications to function. Productivity is contingent on the ability to stay connected to the web and its resources. And an increasingly connected workplace often demands high-speed internet to ensure efficient operational processes within the enterprise. It becomes imperative that the Internet connections of business remain both fast and stable to maintain effective internal operations. However, many connections cannot take a lot of loads and are forced into a loop of disconnecting and reconnecting. In this regard, a strong, fast, reliable internet connection is vital for the day-to-day operations of any business. First, it allows employees to stay connected and be productive from anywhere. Second, it enables businesses to take advantage of cloud-based applications and services. Third, it helps businesses keep their customer data safe and secure. Lastly, a stable internet connection can help businesses save money on their telecommunications costs.

7. Risks of influence on public consciousness. The development of big data technologies, the growth of the network space, and achievements in the cognitive and behavioral sciences led to the emergence of developments, which focuses on implicit data collection and hidden management of group behavior of big teams.

8. Risks associated with increasing the level of complexity of business models and the lack of qualified personnel.

The digital economy has a number of challenges that neither society nor business may be ready for. To overcome these challenges and strengthen positions at the international and national levels, it is *need to pay attention to the following* [21–24]:

1. Promoting digital compatibility between countries around the world. Creating global rules taking into account the economic, political and cultural differences of countries. The key set of rules provides the development of a global document to determine the principles and priorities proven by international practice for the dissemination of digital technologies, in order to ensure their interoperability, prevent fragmentation of global space and the formation of digital "islands".

2. Leveling the digital “gap” by enhancing digital development for all. World leaders must help bridge the digital divide between developing countries and developed countries, as well as between different social groups in any country.

3. Creating reliable technologies for everyone. Digital technologies should reach more people, reduce costs and inefficiencies, especially for small and medium-sized businesses. Digital technologies must be reliably implemented for all participants, including enhanced data privacy protection, better online dispute systems, and algorithms that do not discriminate against any of the “players”. This requires the development of e-public-private partnerships with a people-centered approach.

4. Creation of an international platform for helping to solve the negative impacts of digital technologies (in particular, overcoming digital inequalities in society among countries) and overcoming security and privacy challenges.

5. Increasing the level of functioning of systems for adequate and continuous tracking of the processes of introduction of digital technologies and their socio-economic consequences in dynamics, with an improvement in monitoring of statistical data at the micro level (enterprises, households, individual entrepreneurs).

6. Creation of a support fund, the money of which should be directed to the development of digital infrastructure and the dissemination of technical education in less developed countries of the world, taking into account the lack of domestic investment resources and in order to reduce the digital “gap”.

Questions for self-control:

1. Socioeconomic consequences of the impact of digital technologies in various sectors of the economy and society.
2. The advantages of the digital economy at the level of society, at the level of industries and companies, as well as at the level of person.
3. Technological advantages due to digitalisation.

4. Negative consequences of digital transformation of the economy.
5. Risks of digitalisation of the economy.
6. Solutions for the challenges of the digital economy.

1.4. Digital platforms as the core of the digital economy

The digitalisation of the economy is the necessary process for creating a "normal future".

One of the key tools for digital transformation is a digital platform that provides information exchange and transactions between a large number of users. ***Digital platforms*** are central for today's global economy, and offer great potential for economies and societies. On the other hand, it is an online platform (website) where two or more groups of users create utility (value) to each other. For example, the digital platform Uber combines the interests of carriers (taxi drivers) and passengers.

There are platforms, where there are transitions from using its own resources to using the resources of users of the platform, or coordinating them (for example, Airbnb, unlike the Hilton network, uses not its own housing stock, but the property of platform users to meet the need for short-term rental real estate). Although not every site is a digital online platform, but every global digital online platform has a web interface. For example, the site zakupki.prom.ua is a digital platform – it combines the interests of manufacturers and customers of goods and service.

So, ***digital platforms have certain characteristics:***

– are technologically mediated;

– clear how a set of digital resources (services, content, etc.) provides interaction between groups of users;

– allow groups of users to perform specific tasks;

– the specific nature of the platform depends on the type of task that its participants are trying to perform;

– evolve in an ecosystem in which heterogeneous components constantly adapt to relentless changes.

It is good to understand the essence of the digital platform through technological and social aspects. Digital platforms are a type of information technology (IT) with distinct properties, which lend particular affordances for development [25, p. 871]. Technical, technological and digital characteristics, multi-level architecture and modularity of platforms differ depending on their type and purpose. Instead, digital platforms are a socio-technical phenomenon, since they are created for the purpose of interconnection and communication, the performance of certain functions. The socio-technical dimension of digital platforms is the impact on organizational structures or international standards.

Digital platform is a set of:

– digital data;

– models (logic);

– and tools (methods, means),

informationally and technologically combined into a single automated system with controls for the target subject area and the organization of interaction between subjects.

It is a set of technological solutions (technologies) that create the basis for the functioning of a specialized system of digital interaction, reducing the cost of transactions. Thus, the hypothesis is that digital data becomes a factor in production.

Modern companies use various digital platforms, and build business models with special attention to them, and this is not only the field of e-commerce and e-business, but also the whole range of communications in the triangle "business-consumers-state". Their use leads to an increase in the completeness of market information, increased trust between counterparties through the transparency of transactions, creates opportunities for free competition on a fundamentally new technological basis and ensures the development of a successful business. At the same time, digital platforms are becoming the centers of global digital information ecosystems, combining virtual (VR), augmented (AR) and real worlds.

Digital platforms hold a central position in the business models of the largest companies in the world, transforming traditional roles in areas like employment, productivity and innovation activities. Four of the largest firms in the world in terms of market value in late 2018 were Microsoft, Apple, Amazon and Alphabet – all platform companies. If adding the three other platform leaders, Facebook, Tencent and Alibaba, these seven companies represented close to $ 5 trillion in market value and were reported to account for two-thirds of the total market value of the world's 70 largest digital platforms in 2018 [25, p. 870].

The three most capitalized companies in the world at the beginning of September 2018 belong to the technology sector (Apple, Amazon, Google). Their shares are collectively valued at more than 2,8 trillion USD. The world market was dominated by financial conglomerates (HSBC Holdings, Bank of America, JPMorgan Chase) and well-known industrial corporations (General Electric, ExxonMobil, Royal Dutch Shell, BP, Toyota Motor, etc.).

There are several approaches to the classification of digital platforms (Table 1.3); the complexity of the classification of such structures lies in the fact that each popular platform unites characteristics of several types.

***Table 1.3* – Approaches to the classification of digital platforms [26]**

Classification principle	Type of platforms	Example
1	*2*	*3*
According to the classification of *The Centre for Global Enterprise*		
According to the functions of the platforms	Operating platforms	Uber, Gett
	Innovative platforms	Android, IOS, Microsoft Service
	Integrated platforms	App Store, iCloud
	Investment platforms	Kickstarter
According to the classification of *European Commission*		

Continuation of Table 1.3

1	*2*	*3*
Online platforms according to their functional purpose	Search systems	Google, Bing, Search.com.ua, Yahoo.com
	Social platforms	Facebook, LinkedIn
	E-commerce platforms	X-Cart
	App buying stores	
	Price comparison sites	Price.UA, Hotline.ua
According to the classification of *Deloitte University*		
According to the functions of the platforms	Aggregated platforms	Alibaba
	Social platforms	Facebook, Instagram
	Learning platforms	Coursera
	Mobilization platforms	CRM
According to the general vision		
According to the functions of the platforms	Social networks	Facebook, LinkedIn, Snapchat
	Online auction and retail	Amazon, eBay, Angie's List, Flipkart, Snapdeal, Etsy
	Financial and HR functions	Workday, Elance, Freelancer, WorkFusion
	Transport	Uber, Lyft, Sidecar, BlaBlaCar, Ola, JustPark
	Mobile payments	Mahala, Square
	Clean energy	SolarCity, EnterNOC
	Crowdfunding	Kickstarter, Gofundme, Yomken, Ulule
	Public services	G-Cloud
According to the classification of scales of activity		
According to scale of activity	Global platforms	PayPal, Facebook
	National platform	Diia, eHealth
	Regional platforms	Megogo

Depending on the main goal, there are two types of digital platforms: transaction platforms and innovation platforms. The ***main characteristics and differences*** are given in Table 1.4.

***Table 1.4* – Key characteristics of innovation and transaction platforms [25]**

Category of digital platform	Transaction	Innovation
1	*2*	*3*
Purpose	Matches users or user groups, the value for a user increases with the number of users in a user group.	Enables the creation of applications and services by third party developers based on combining and recombining functionality sourced from a platform core.
Focus with literacy platforms	Driven by economics perspectives of direct and indirect network effects.	Driven by innovation management and software engineering perspective.

Continuation of Table 1.4

1	2	3
Underlying digital characteristics	Massive processing on platforms enables the search and exchange of information reducing costs, which are traditionally associated with these operations.	Driven by the re-combinability of digital information and functionality; ready access to cheap easy to use digital tools to facilitate software development at scale.
Basis of value creation	Facilitating the exchange of information and services between third parties; matchmaking – value from increasing the size of the pool and then increasing the likelihood of a better match (quality); making interactions and transactions as easy as possible.	Facilitating the innovation of new services by third parties (generally and without supplier contracts); opening up functional capabilities for third parties to innovate; resourcing developers with the capabilities they need to innovate.
Source of value capture	Charging for access to the platform or charging commission on sales of services that platform enables; additional sources of revenue include advertising.	Charging for access to the platform through licensing arrangements or charging commission on sales of complementary services that platform enables; advertising.
Examples	Alibaba.com, Mercado Libre, Whatsapp, Taobao, MPesa, Jumia, Esoko, GoJek, Uber.	Android, SAP, DHIS2, iOS, AliOS.

Digital transaction platforms are also called multilateral markets or exchange platforms. Their main goal is to facilitate transactions between different organizations, legal entities and individuals, for example, to connect buyers with sellers, recruiters with job seekers, drivers with passengers. Transaction platforms can be classified according to their main purpose. For example, social media platforms (e.g., Facebook – on a global basis), e-commerce (Mercado Libre – originating from Argentina), the 'gig' economy (Gojek – originating platforms from Indonesia), platforms built around the notion of the sharing economy (Afristay – originating from South Africa), online portals and app stores (Freebasics – originating from internet.org) and platforms enabling digital identity (Aadhaar – originating from India) [25, p. 873].

Innovative digital platforms are the platforms on which other companies can create additional products, services or technologies. The technical architecture of the innovation platform contains modules or building blocks that provide innovative opportunities. These modules can then be accessed and combined by apps developers (complementors) to build apps and services (known as platform complements). Innovation platforms are exemplified by mobile operating systems such as Android and iOS, whose functionality is drawn upon through APIs by a platform ecosystem of third-party developers to build and innovate apps as services. Other forms of innovation platform extend to cloud services such as Amazon Web Services, Google and Microsoft Azure, enterprise platforms such as Salesforce.com and SAP, as well as enterprise IoT platforms such as Siemens Mindsphere. There are, in addition, innovation platforms that are designed for development.

Digital platforms operate in a certain socio-technical environment. They exist within a network of stakeholders, which are unite and interact. Their existence, use and evolution are influenced by a set of economic, organisational, institutional and spatial factors. Therefore, digital platforms create a specific ecosystem that brings together stakeholders. Relationships in ecosystems go beyond "typical" relationships with suppliers and customers, and business models are complicated in terms of financial transactions. The concept of "platform economy" has appeared in the scientific literature, which is the use for organizations of external platforms and related ecosystems that are not owned by the organization and are not controlled by it.

"A *digital ecosystem* is a group of interconnected information technology resources that can function as a unit. *Digital ecosystems* are made up of suppliers, customers, trading partners, applications, third-party data service providers and all respective technologies. Interoperability is the key to the ecosystem's success. There are *three main types of digital ecosystems*: the digitizer ecosystem, the platform ecosystem and the super platform ecosystem:

1) *digitizer ecosystems* focus on digitizing an existing product with the help of business partners, while also maintaining low managerial complexity. Digitizer

ecosystems can add new functionality to systems and create digital service revenue; usually incorporates 20 to 100 existing partners across five industries, and best suited for businesses with strong product capabilities, limited digital abilities and a primarily internal focus;

2) *platform ecosystems* are more advanced, and focus on flawlessly connecting users and smart devices on a platform, while simultaneously guaranteeing high service levels and limited obstacles. They create revenue streams from platform usage. The data generated by the ecosystem can be used for similar businesses and service models. Platform ecosystems typically have 50 to 10 million partners across a maximum of five industries; works best with companies that have solid digital capabilities and a strong focus on external expertise. Established tech startups and companies are more likely to adapt this platform as their core business model than nanotech companies (Xiaomi);

3) *super platform ecosystems* are the most complex type of digital ecosystem. They focus on integrating several platforms into one integrated service, while also capturing user data from the integrated platform. This type of ecosystem provides a wide range of user data and also turns the data into money using adjacent business models. The super platform ecosystem typically has at least 10 million partners across at least 10 different industries" [27].

"A monetized platform is an online space that hosts creators' content and allows them to earn money off of it" [28].

There are some approaches regarding solutions for increasing the network effect to monetize the platform [29]:

1. ***Shift to transaction-based model*** – digital platforms function as a marketplace facilitator by bringing supply and demand together, creating opportunities to drive incremental revenue on a per-transaction basis. PayPal and eBay have become massive successes by just taking a few dollars or a couple percentage points from each sale – not enough to create a hurdle to individual adoption, but enough to create incredibly large and durable revenue streams.

Platforms that adopt this model must be focused on removing friction from all aspects of the matchmaking process to grow the userbase and make it as easy as possible for buyers to find sellers and vice versa.

2. ***Leverage emerging trends from network to increase usages*** – as the number of participants increases on the platform, unexplored trends will emerge, which can be discovered through extensive data analysis using predictive machine learning and AI capabilities. Best of all, these insights can only be known and acted on by the platform itself, delivering a sustainable competitive advantage. *For example,* Netflix continually studies what its customers watch, then use those viewing patterns to invest in new content that delivers a steady pipeline what its customers are looking for. To capitalize on this monetization strategy, platforms must be agile enough to quickly create additional content, products, and services that align with user's requirements, keeping users engaged and the competitors in the rearview mirror.

3. ***Cross-selling and up-selling*** – the use of data models to understand purchase history patterns can create a powerful recommendation system. Amazon is the gold standard in this regard, using powerful recommendation algorithms to cross-sell or up-sell customers and deliver uniquely personalized engagement experiences that delight customers and create significant loyalty.

4. ***Ad revenue model and audience targeting capabilities*** – platforms can take years to implement an ad revenue model and turn a profit once the platform has reached enough critical mass to interest advertisers. But that adoption curve gets steeper all the time as the digitisation of society increases. *For example,* Facebook may have taken three years to reach 50 million users – a massive number to be sure – but WeChat reached that milestone in just one year.

To be successful, a platform must offer unique audience targeting capabilities to differentiate from other advertising options, ensuring that every advertising investment is maximized. ML/AI capabilities can dig into the rich history of first-person data the platform captures, parsing the data in such a way that advertisers can’t help but invest more in these digital channels.

5. ***Dynamic and innovative pricing methods*** – product pricing is usually fixed, no matter how much of the product is consumed over a period of time. The only opportunity to pay less per license is with volume pricing. Platforms, however, can take advantage of dynamic and innovative pricing models based on the ways users derive value from the platform. Some options include:

– “freemium” pricing that allow users to engage with some or all of the platform for a period of time before any payment must be made. The “30-day trial” is a common example. Membership fees with unlimited use (think Amazon Prime) or subscription offerings that deliver consistent value for less cost (annual pricing at 20 % less than the monthly rate, for example) encourage frequency of usage or to reward customer loyalty;

– pay-for-what-you-use pricing models function like your utility bills: the less you use, the less you pay. Marketing automation companies offer tiers of pricing based on the number of target records in your database, or the number of emails you send out each month. Cloud storage vendors often charge based on the number of gigabytes used.

These adaptive pricing methods, which are in context with business needs and phases of its lifecycle, helps in increasing the adoption and scale of the platform. And, there’re several models of monetization of digital platforms (Table 1.5).

***Table 1.5* – Monetization strategies for digital platforms [26; 30]**

Model (relating to the consumer)	Implementation mechanism
Free	The platform provides free services. Monetization takes place by delivering advertising content to users (Facebook)
Shareware (conditionally free)	The platform provides free services in the basic version, the user pays for the extended format (Spotify)
Commissions	Withholding a fee for each transaction (eBay, Uber)
Payment for access (subscription model)	Fee for access to information on the platform (Science Direct, paid electronic media)
Differentiated access fees (“partly” access is fees)	Part of users who are more interested in the platform’s services pay for the access to the platform’s services (dating sites)

For example, in Ukraine very popular platforms as marketplaces (Prom, Rozetka, etc.). For the buyer they are free, but for users-sellers a set of services can be implemented either according to the conditionally free model (a limited number of free ads, without additional services), or according to the payment for access or subscription model (payment once in a certain period of a certain set of services, such as, for example, design, promotion, automatic filling of ads, etc.). Ukraine is also developing digital platforms, but to reach the level of a global one with a relevant and good functioning business ecosystem will take time. The clear advantages are represented mainly in agro-industrial and mining and metallurgical complexes, platforms with good communications presented in the Table 1.6 [31, pp. 64–65].

Table 1.6 **– Examples of digital platforms in Ukraine in accordance with basic communication models**

Subject (producer of goods and services)	Object (consumers of goods and services)		
	Business	**Customers**	**Government**
Business	Model "Business-to-Business". Electronic commercial procurements (prom.ua).	Model "Business-to-Consumers". Online stores (rozetka.com.ua).	Model "Business-to-Government". Electronic public procurement (prozorro.gov.ua).
Customers	Model "Consumers-to-Business". Digital employment services (work.ua, rabota.ua).	Model "Consumer-to-Consumer". Online services for ordering services (kabanchik.ua).	Model "Consumer-to-Government". Digital platforms for petitions, participatory budgeting (petition.president.gov.ua).
Government	Model "Government-to-Business. The possibilities for business development; ability to submit reports in electronic form (business.diia.gov.ua).	Model "Government-to-Customers" (or, "Government-to-Citizens"). Public digital services for citizens (igov.org.ua), grants.vzaemo.diia.gov.ua).	Model "Government-to-Government". E-government.

The analysis of the top-50 sites by traffic in Ukraine showed that less than half of the sites are of national origin [32]. Among the top-10 – nine represent foreign companies. These are mainly social networks (youtube.com, facebook.com, instagram.com) and search systems (google.com, yahoo.com, bing.com). The only national site in this ranking is the ukr.net that represents the field of “News and Media”. In the second ten are privatbank.ua, prom.ua and rozetka.com.ua, which are full-fledged digital platforms. The rest of the sites mainly represent the field of news (censor.net.ua, obozrevatel.com, korrespondent.net, segodnya.ua) and trade (rozetka.com.ua, kidstaff.com.ua).

Top-10 websites ranking for all categories in Ukraine as of October 2022 given in the Table 1.7 [33].

Table 1.7 **– Top-10 Websites Ranking for all categories in Ukraine**

Rank	Website	Category
1	google.com	Computers Electronics and Technology > Search Engines
2	youtube.com	Arts & Entertainment > Streaming & Online TV
3	facebook.com	Computers Electronics and Technology > Social Media Networks
4	ukr.net	News & Media Publishers
5	sinoptik.ua	Science and Education > Weather
6	obozrevatel.com	News & Media Publishers
7	censor.net	
8	pravda.com.ua	
9	olx.ua	eCommerce & Shopping > Classifieds
10	alerts.in.ua	News & Media Publishers

An important limitation for the growth of Ukrainian digital platforms is their focus on the local market, while foreign ones form most of the traffic outside their country of origin. For example, in facebook.com, more than 80 % of traffic is generated outside the United States; domestic digital platforms provide themselves with more than 90 % of traffic at the expense of users in Ukraine – for example, ukr.net receives 93 % of traffic from Ukraine.

The prospects for the creating the global digital platforms in Ukraine are partly optimistic. On the one hand, there is still not enough sources for domestic investment and a full level political lobby for the entire digital sector. On the other hand, the growing IT sector should look for opportunities for global expansion.

Digital platforms are a breakthrough innovation that radically change the structure of the national markets. On the one hand, digital platforms make it possible to avoid the chain of intermediaries, offer the end user the maximum list of opportunities. On the other hand, in case of a "digital monopoly", owners of successful platforms receive control over the market and can impose their own pricing policy. That is, the "traditional" business benefits greatly from the digital boards, but strategically it is at risk of losing distribution channels and becoming completely dependent on platform owners. An important feature of digital platforms as a basis for the functioning of an online community is minimization of transaction costs. Thanks to its architecture, platforms grow synchronously with the needs of their users. The platforms' architecture and interfaces enable to work with individual user behavior.

Anything that is not based on complex technology is more profitable to organize on the basis of platforms. An interesting situation is when there are two or more digital platforms in one market – in this case, there is still one that absorbs (destroys) all the others, primarily due to a more successful strategy and a better environment that it is able to provide to its consumers.

Digital platforms are a logical step for the evolution of business, which was created as a result of the computer technologies, information and communication technologies development, spread of devices for Internet access among people.

Questions for self-control:

1. The essence of the concept of a digital platform.
2. Features of using digital platforms in companies (and their business-models).
3. Modern key characteristics of innovative and transactional digital platforms.
4. Elements of the digital platform ecosystem.
5. Restrictions in the growth of Ukrainian digital platforms.
6. Prospects for the global digital platforms' creation by Ukrainian developers.

1.5. Digital competencies and the quality of human capital formation

The development of the digital economy and the use of digital technologies opens up new opportunities for the growth of the national economy and improving the quality of life of society. The application of these opportunities in the economy, business, and society requires appropriate *digital competencies* for education, employment, work, leisure and civic activities. The Institute for the Future (IFTF) report on "Future Work Skills 2020" identifies six key factors that will change the work landscape and determine the basic skills for the different jobs and working conditions that employers will need in the next 10 years. ***The main factors influencing the sphere of labor and social and labor relations*** [34]:

1) *extreme longevity* – increasing global lifespans change the nature of careers and learning;

2) *rise of smart machines and systems* – workplace automation nudges human workers out of rote, repetitive tasks;

3) *computational world* – massive increases in sensors and processing power make the world a programmable system;

4) *new media ecology* – new communication tools require new media literacies beyond text;

5) *superstructed organizations* – social technologies drive new forms of production and value creation;

6) *globally connected world* – increased global interconnectivity puts diversity and adaptability at the center of organizational operations.

The driving force of the digital economy is **human capital** – knowledge, talents, skills, abilities, experience, intelligence. The rapid adoption of digital technologies makes the digital competencies of citizens key among other skills. According to experts, by 2020 more than 1/3 of the knowledge and skills important for today's work activity should have changed. In the new digital reality in the field of labor and human resource management, financial, legal, economic, social, cultural, psychological issues arise, among which it is worth highlighting:

– guarantees of human security, society, state; finding a balance between privacy and ensuring personal safety in the online environment;

– issues of paid or free access to online resources, including educational ones;

– emergence and protection of digital rights, intellectual property rights;

– social and labor rights and freedoms in the digital economy;

– finding a balance between economic efficiency and social justice;

– preservation of cultural values and national identity, psychological health of the population;

– ensuring national security in the context of the dissemination and application of digital technologies.

Accordingly, there is a transformation of the labor market and labor relations. ***The following features of the transformation of social and labor relations in the conditions of the formation of the digital economy*** can be distinguished [35–36]:

1) the boundaries of the traditional division of labor are changing, the boundaries of professions are erased, the pace of "extinction" of traditional professions is accelerating, new, previously unpredictable ones arise;

2) forms of employment are changing (freelancing, remote work, flexible forms of work, informal employment on online platforms, part-time or week, employment in seasonal episodic work, project form of employment);

3) mobility of employees increases (migration processes, interprofessional, intersectoral, intra-company mobility are activated);

4) the structure of enterprise management and the personnel management system are changing (abandonment of cumbersome management systems, transition from manager-subordinate relationship to customer-performer relations, digitalisation of the personnel management system);

5) competition in the labor market for unique human resources – creative, creative, inventive abilities – increases;

6) lifelong learning is the principle and concept of changing social and labor relations. As noted in the Report on Human Development, mastering the skills necessary for the 21st century should become part of the process of education throughout life, aimed at critical thinking, collaboration, creativity and communication [37];

7) the level of precarization of the active population is growing, which is determined by the characteristics of employment, working conditions, but in most cases, they do not meet the criteria of decent work and productive employment. Employed in the informal sector; officially unemployed, working without registration of labor and collective agreements; part of migrant workers; People of free professions, employed on freelance conditions and those who are involved in the shadow or illegitimate labor market – these are the categories of labor for which the problem of prescriptiveness is relevant. **Precarity** is an unstable way of life and work without long-term guarantees and reliable earnings, especially in relation to the spread of non-standard employment;

8) the formation of a new segment of the population is typical – NEET: not in education neither in employment nor training among young people aged 15–29 years. This category of the population is excluded from both the unemployed and the employed population.

Such challenges and transformations were met by the first IT industry; Other industries today adopt this experience, introduce atypical forms of employment (outsourcing, outstaffing, borrowed labor, etc.) and create remote jobs. The development of digital competencies is becoming one of the most important conditions of any country today.

For a note, in Davos published the results of Deloitte Global's "Fourth Industrial Revolution on the Threshold – Are You Ready for It?" (2018), the main conclusion of which is that CEOs and government leaders from around the world do not feel full confidence in the willingness of their organizations to influence and seize the opportunities that the fourth industrial revolution brings with it

("Industry 4.0"). Was a vision that in 2020–2030 the generation of "millennials" (born in the 1980s–1990s) and the next generation born after 2000 will enter the markets as the main consumer, with their value system and the benefits of "smart" consumption, and then assisted (supported by computer analytics) consumption, with labor strategies focused not so much on a narrow professional career as on building flexible and adaptive personal and group competencies with unique career trajectories [38].

Digital competencies are a set of knowledge, abilities, character traits and behaviors that are necessary for a person to use ICT and digital technologies to achieve goals in his personal or professional life [39, p. 6]. Competence in the field of digital technologies should be perceived not only as knowledge relevant to technical skills, but also as knowledge more focused on the cognitive, social and emotional aspects of work and life in the digital environment. Digital competence is a multifaceted evolving process that is constantly changing with the emergence of new technologies.

The Digital Competence Framework is a tool created to improve the level of digital competence of Ukrainians, help in creating public policy and planning educational initiatives aimed at increasing digital literacy and practical use of IT technology tools and services by specific target groups of the population. The framework was adapted by Ukrainian experts. It is based on the relevant Framework for EU citizens (DigComp 2.1: The Digital Competence Framework for Citizens), as well as other recommendations in the field of digital competences from European and international institutions, which are adapted to the national, cultural, educational and economic characteristics of Ukraine [40].

The digital competence framework contains a description of the main areas in the field of digital competence that a modern citizen should possess. These are such areas as: information and digital literacy, communication and cooperation, creation of digital content, safety of problem solving [41]. ***Digital competencies can be summarized into five large groups:***

1. *Information and ability to work with data:* view, search and filter data, information and digital content (formulate information needs, search for data, information and content in digital environments, access and move between data, information and content); create and update personal search strategies (evaluate data, information and digital content; analyze, compare and critically evaluate the reliability and reliability of data sources, information and digital content); data management, information and digital content (organize, store and select data, information and content in digital environments; organize and process them in a structured environment).

2. *Communication and collaboration:* interaction through digital technologies (interact through a wide range of digital technologies and understand what means of digital communication are appropriate for this context; share data, information and digital content with others through appropriate digital technologies; act as a mediator, know practical methods of reference and attribution); implementation of civic position through digital technologies (to participate in the life of society through the use of public and private digital services; to look for opportunities for self-improvement and implementation of active citizenship using appropriate digital technologies); cooperation through digital technologies (to use digital means and technologies for cooperation processes, as well as for joint development and joint creation of resources and knowledge); network etiquette (know the rules of conduct and know-how regarding the use of digital technologies and interaction in digital environments; adapt communication strategies to a specific audience and take into account cultural diversity and generational contradictions in digital environments); digital identity management (create and manage one or more digital identities, be able to protect your own reputation, work with data created using several digital tools, environments and services).

3. *Creation of digital content:* development of digital content (create and edit digital content in various formats, express themselves by digital means);

integration and processing of digital content (to change, refine, improve and integrate information and content into an existing body of knowledge to create new, original and relevant knowledge and content); copyright and licenses (understand how copyright and licenses apply to data, information, and digital content); programming (plan and develop a sequence of clear instructions for the computing system to solve this problem or to perform a specific task).

4. *Security:* protect devices (protect devices and digital content, understand risks and threats in digital environments; be aware of security and security measures, and properly consider trust and privacy issues); protection of personal data and privacy (protect personal data and privacy in digital environments; understand how to use and share personally identifiable information while maintaining the ability to protect yourself and others from harm; understand that digital services use the "Privacy Policy" to inform about how personal data is used; be able to avoid health risks and threats to physical and psychological comfort when using digital technologies; be able to protect yourself and others from possible dangers in digital environments; know about digital technologies to ensure social well-being and social integration; be aware of the impact of digital technologies and their use on the environment).

5. *Solving the problem of the digital environment and lifelong learning:* solving technical problems (identifying technical problems in the operation of devices and using digital environments and solving them: from troubleshooting to solving more complex problems); identification of needs and their technological solutions (assess needs, identify, evaluate, select and use digital means and possible technological response measures to meet these needs; establish and adapt digital environments according to personal needs, for example, to ensure accessibility); self-assessment of the level of own digital competence, identification and elimination of gaps (understand in what aspects their own digital competence needs to be increased or updated, identify gaps, build their own profile for the development of their own digital competence; be

able to support others in the development of their digital competence, keep up with the process of evolution of digital technologies); solving life problems with the help of digital technologies (be able to use digital technologies to solve their own life problems in the field of everyday life, social communications, health care, education, etc.); lifelong learning and professional development in the digital environment (be able to use open digital educational resources – trainers, courses, educational programs – for your professional and personal development anywhere and anytime throughout your life; improve professional practices, look for opportunities for self-development and further training, create and fill your own e-portfolio as an addition to your own resume).

Through the EU4 Digital initiative, the European Union supports ***the implementation of digital skills strategies in Ukraine***, in particular by [42]:

– development of methodology for measuring and forecasting gaps in national digital skills;

– defining a common competence framework for SMEs and microbusinesses;

– supporting the establishment of national coalitions for skills and jobs in the Eastern Partnership countries;

– conducting training seminars and trainings;

– conducting advertising campaigns in partner countries.

Many organizations have focused on identifying and developing the digital skills and knowledge needed for the future. Implementing a system of training in professional digital competencies such as coding, data analysis and e-business skills can help young people take advantage of new opportunities in the digital economy and meet the requirements of employers in the labor market.

Questions for self-control:

1. The main factors influencing the sphere of labor and socio-labor relations in digital era.

2. Features of the transformation of socio-labor relations in the context of the digital economy development.
3. Digital competence framework.
4. Groups of digital competences.
5. Digital skills development strategies in Ukraine.
6. Implementation of a system of trainings for digital competencies development in professional spheres.

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UDC 004.330.1

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Chapter 2
THE SYSTEM OF DIGITALIZATION ECONOMICS IN THE PARTNER-COUNTRIES

Content

2.1. General tendencies of digitalization in the partner-countries

Today the development of economics and society undergoes constant changes due to the rapid spread of digital technologies. The development of digital economics is a priority value for all countries. Certainly, the vector of development and trends are set by economic leaders: the USA, Great Britain, Germany, Japan, et al. These countries have already demonstrated that transition to a new system of functioning of economics and society can be implemented through the development of basic information and communication infrastructure, the formation of policy in the digital economics sphere, coordinated between all its participants, the development of support programs for digital technologies implementation at all levels of state, and business, especially for educating digital skills and abilities.

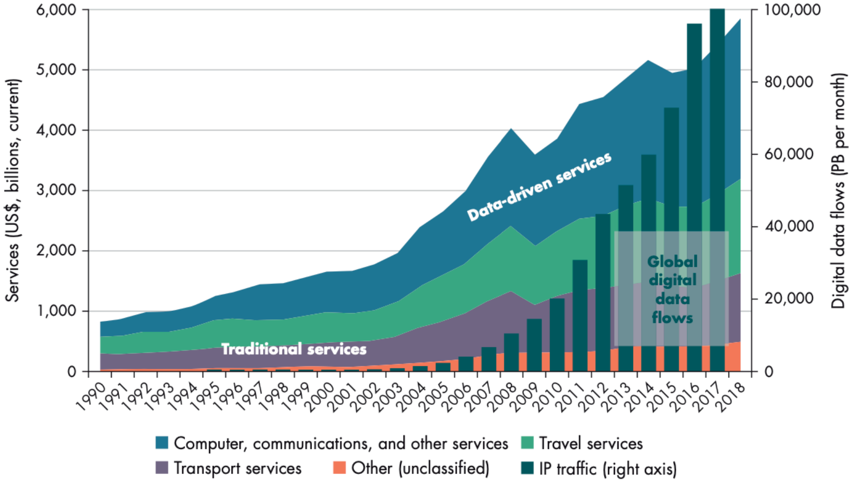
During last years another wave of transformation of activity models in business and social sphere can be observed. Artificial Intelligence, robotics, IoT (Internet of Things), Big Data, Wireless network are the technologies of new generation. These technologies change existing systems and structures of social and economic relations. According to the World Bank estimations, new technologies implementation is able to increase labor productivity in companies by 40 % [10]. In the nearest future it is the efficient use of new digital technologies that will define international competitiveness of individual companies, as well as of countries. Only those who are able to form infrastructure and legal environment for digitalization will develop sustainably.

New stage of digital technologies development is characterized, first, by exponential increase of quantity, quality, and diversity of relations between business, individuals, and social and economic systems. Diversity in the use of data and dynamic growth of data volumes results in complex and synchronized "all to all" integration, the consequences of which are not fully understood yet. Since 1990 the world trade of data-driven services has grown exponentially and now accounts for half of services trade (Fig. 2.1).

Such transformations require new skills and competencies from people, their readiness to use new technologies in everyday life. The special importance is acquired by formation of educational programs, which will be in compliance with global trends and personalized learning trajectories, capable to support "digital literacy".

At the same time, new challenges emerge. The society needs to understand the possible and current negative consequences of digitalization. The negative consequences include shrinking or even disappearance of traditional markets;

professions disappearance due to systems automatization; increase of the cybercrime scales; vulnerability of human's rights in digital space. To solve the mentioned problems and to minimize the related risks it is necessary to form regulatory procedures for these problems solving at the institutional level.



Source: WDR 2021 team calculations, based on World Bank, WITS (World Integrated Trade Solution) database, http://wits.worldbank.org/WITS/. Data at http://bit.do/WDR2021-Fig-O_5.

Note: IP = Internet Protocol; PB = petabytes.

Fig. 2.1 – Dynamics of global trade in data-driven services [6]

The sector of information and communication technologies (ICT) is an important factor of digital economics and society development. According to the World Bank data, the share of ICT in the GDP of OECD countries is about 6 % and is much less in the developing countries. In the USA where 8 out of 14 the world's largest hi-tech companies in terms of revenue are operating, the contribution of the ICT sector to GDP is about 7 %.

It should be mentioned that the developed countries pay considerable attention to the digital economy development. The European Commission identifies five dimensions of the digital entrepreneurship program:

a) digital knowledge and ICT market;

b) digital business environment;

c) access to finances for business;

d) digital skills of employees and e-leadership;

e) formation of the supportive entrepreneurial culture.

The DESI Index (The Digital Economy and Society Index) is used in the countries of European Union for estimation of the level of technological development and the innovative technologies adoption degree in society and, particularly, in economy [42]. The index is calculated from 0 to 1. The amount of human capital, the integration of digital technologies, digital public services, the quality of communication means, and the use of the Internet are evaluated.

The structure of digital economy system can be presented as follows (Fig. 2.2).

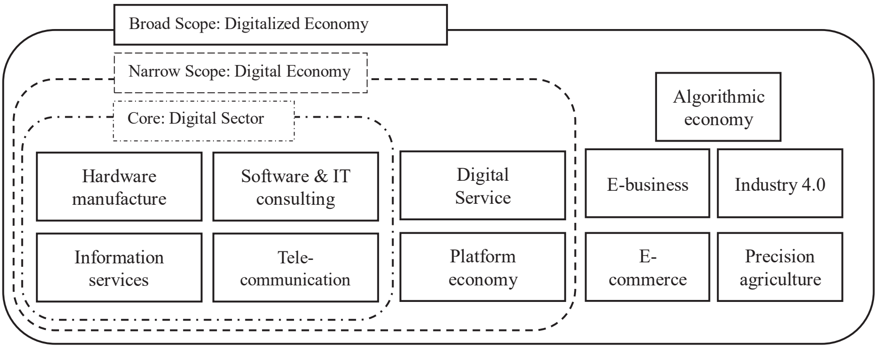


Fig. 2.2 – Scoping the digital economy [3]

To analyze the system of digitalization of the country's economy, it is important to study the following indicators: connectivity, Internet use, level of integration of digital technologies, Digital Government, digital trade.

The connectivity is the level of access to the Internet network in the country. This indicator is characterized by the availability of both fixed and mobile broadband network access to the network. The Network Readiness Index [4] data reflects that the highest level of mobile connection among the analyzed countries is in Germany – 78,95, followed by Slovenia – 67,30, Lithuania – 65,32, Ukraine – 55,7, and Tajikistan – 34,55. At the same time, the data of the report show that Ukraine is the leader among countries with income below the average, and Tajikistan is in second place among countries with a low-income level.

According to the International Telecommunication Union (via World Bank) data the share of population that uses Internet in Lithuania, Slovenia, and Germany is above 80 %, and Ukraine is approaching this mark. At the same time Tajikistan still lags significantly behind this indicator (Fig. 2.3).

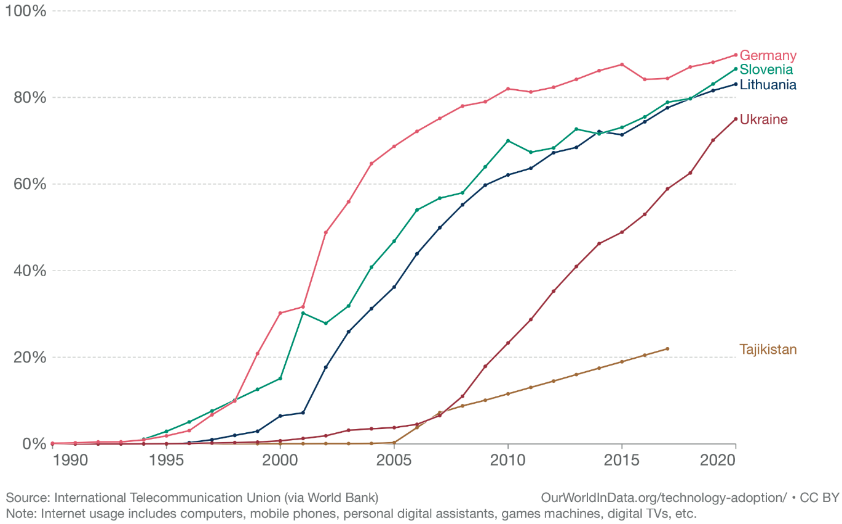


Fig. 2.3 – Internet penetration by country [8]

Today, Internet is a media system which is a tool for work, education and communication, information dissemination and conducting business. The layer of reliable information that is presented on the network is so powerful that it actually affects the ways of obtaining it. The appearance of cloud libraries has significantly reduced the number of real ones. In addition, the amount of information on the Internet is constantly growing, the dynamics of development is increasing daily.

One of the most important network laws is the law of Robert Metcalfe. This scientist is a representative of Massachusetts Institute of Technology and the inventor of Ethernet – one of the most wide-spread technologies of local networks organization. According to the Metcalfe theory, the value of the whole system increases faster than the number of network elements. Thus, networks are able to generate new value.

According to Metcalfe's law, the more components are in a computing network – for example, in the Internet – the higher is its value to users. This means that more new users will be willing to connect to it. The network growth influences its value simultaneously, and the overall value as the network grows further can affect the entire economy.

It is with the expansion of the Internet use that its influence on the development of the digital economy increases new opportunities and problems at the same time arise that require a modern approach to their solution. Marketing and services industry have changed under the Internet influence: the geographical boundaries expanded, the opportunities of target approach to the Internet audience and formation of organizational connections with partners have emerged.

Enterprises productivity increase is one of the main factors of the Internet influence. It is possible due to simplification of communication, acceleration, and automation of business processes, as well as reduction of transaction costs.

The greatest achievement in the sphere of Internet development is the capability to provide banking services from anywhere in the world. In connection with the consolidation of the banking sphere, a significant growth of the online banking market is expected, which will continue to expand its geography.

In the world Internet-economy, according to the Boston Consulting Group forecasts, great advantages will be possessed by those companies, which will learn to use Internet-tools:

1) mobile Internet – a new user model, which provides access to the Internet through mobile devices;

2) behavioral model change – according to the IDC forecast, smartphones will provide full access to the network that can change the behavioral model between business and consumers fundamentally;

3) formation of the connection ecosystem – initially it concerned the

infrastructure of the Apple company, now other large companies are forming their own ecosystems, among them Amazon, Facebook, Google, Baidu, Tencent, etc.;

4) expanding of the world Internet-economy – growth of investments in network development, creation of new jobs and increased competition with the traditional economy are expected.

The development of information technologies and the Internet in industry brings it to a qualitatively new level: factories and networks of suppliers form a single organism – a global industrial ecosystem (Smart Manufacturing). Modern IT-technologies (PLM-systems) provide an opportunity to gather all the information related to development, production, sales, and exploitation of products. This contributes to flexibility in business promotion, production customization and localization, consumer involvement in the process of product development on early stages.

Several research at the same time have established the positive impact of Internet speed growth on the economy. The higher the speed is, the greater are GDP, business productivity and jobs number.

The study of International Telecommunication Union [43] has identified that a 10 % increase in Internet coverage increases GDP per capita from 0,27 % to 1,38 %. It happens because high-speed Internet helps to increase the efficiency of business processes. In its report, the World Bank [48] recognized high-speed Internet as one of the tools for the growth of economies in developing regions. It called it a key driver of economic growth, job creation and improved interaction between people.

Questions for self-control:

1. What technologies change the existing systems and structures of socio-economic relations?
2. What is measured by the DESI Index?
3. How important is access to the Internet for the economy?

2.2. Digital government

Under conditions of global digitalization, the governments also have to change the approaches and forms of interaction with society. Only such changes will allow to remain effective and to be ready to respond to today's challenges. OECD together with OPSI prepare and publish annually a report on key tendencies and directions of application of innovations by the governments of the countries of the world. In 2020 such report concerned the acceleration of digital development and digital transformation of public sector [18].

In recent years, state governments have been actively working on the transition from providing public services in a traditional way to fully digital solutions. The digital directions of government policy are concentrated in three spheres:

1) transition to the services of virtual government;

2) use of digital technologies for timely and effective communication with the public;

3) transformation of public administration based on partnership, openness, and inclusivity.

The UN research on the e-government 2022 – is an assessment of the UN digital governance system in all 193 member states. The e-government survey is based on the results of long-term research that lasted for more than two decades with countries rating on the basis of E-Government Development Index of the UN, using a combination of primary data (collected and owned by the UN Department of Economic and Social Affairs) and secondary data from other UN agencies (Fig. 2.4).

According to this study, Slovenia, Germany, and Lithuania have a high level of digital governance, and their indicators exceed 0,87 points. Slightly less is the indicator in Ukraine – 0,80. At the same time, the indicators of these countries significantly exceed the world average level, which is, respectively, 0,6102.

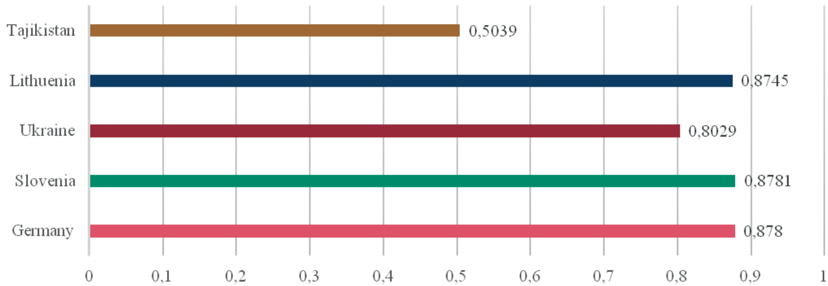


Fig. 2.4 – E-Government Development Index [46]

The indicator in Tajikistan is 0,5039, which is lower than the world average level. Mainly Tajikistan lagging is explained by the underdevelopment of telecommunication systems in the country, and by the low level of online services that a citizen can receive.

The transformation of public administration is declared as a priority direction in the EU. Modernization of e-governance and public services with the use of digital means has a crucial role in reducing the administrative burden on citizens and business as a whole [19].

According to "2030 Digital Compass: The European way for the Digital Decade" [20] public administration transformation is aimed on achieving:

a) openness and transparency of public administration. In particular, it is envisaged to achieve accountability of public administration bodies to citizens through the use of digital technologies, to provide their openness for democratic participation, as well as for the control by the society;

b) human centeredness of public administration: public sector must be focused on the needs of society in general, and of each person in particular, namely, be inclusive, accessible, providing personalized services. It is the digital public services implementation that helps to achieve high level of accessibility and inclusiveness of digital government;

c) economic efficiency of public administration. The financing of public administration takes place mainly at the expense of taxpayers. Digitalization helps to shorten excessive bureaucracy, and to control the financial issues of budget funds spending. Another aspect of digitalization is the opportunity to consider economic criteria in the pricing of electronic public services.

Digital Government concept refers to the use of digital technologies as a component of public administration modernization strategies to create public value. This concept envisages the formation of state management ecosystem, which will include representatives of government, non-governmental organizations, business, citizens associations, and individuals which supports formation and access to the data, services, and content with the help of interaction with government [35]. It is about the deepening of digital transformation in the sphere of public authority, as a result of which technologies significantly affect the content of public administration activities, and not just change the forms and tools of public administration.

Full-fledged digital government, mentioned in the Recommendation of the Council on Digital Government Strategies [35], should embody such principles: it should be digital by design; managed by data and using data; operating as a platform, be open by default and focused on human needs.

An equally important aspect in the development of digital government is the actualization of public administration based on data. Digital world produces an incredible amount of data, which can provide government with important information on the events in real time, tendencies, and human behavior, emergencies, etc. These data is really valuable and can be used during forming and implementing public policy. Digital governments acknowledge that data is a key strategic asset and can be used effectively in planning and monitoring of the public policy. However, the use of data also carries some risks. So, public government should take care of the formation of effective policy, ethical principles, reliable, safe use of data. The legal regulation of data should provide an effective protection of personal data and wide availability and publication of open data.

Separately, it is worth to mention biometric data, which is increasingly used in everyday life. By using of the simplest smartphones applications, e-banking a person provides access to his / her biometric data. Governments often use biometric technologies to develop simplified and adapted services for their citizens. Some public services are available after authorization using biometric data. So, the public administration task is to form a clear legal policy on ethics and privacy related to the use of this technology. The society needs to understand how their data are collected, stored and used. Accordingly, the openness and transparency in the legal policy on data is a basis of trust in public administration. If the legal policy is concentrated on data security, then society has a more positive attitude towards new technologies and is ready to accept them in different situations.

The rating of the analyzed countries according to the Global Cybersecurity Index 2020 [31] data formed by International Telecommunication Union is presented on the Fig. 2.5.

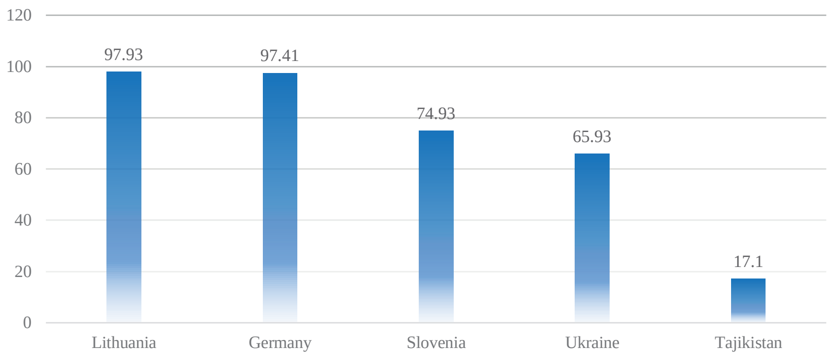


Fig. 2.5 – The Global Cybersecurity Index 2020 [31]

Lithuania and Germany have high-level indicators of cybersecurity. These countries work constantly on the cybersecurity systems improvement. Slovenia and Ukraine need to strengthen work in terms of technical capabilities of cybersecurity. It is also recommended to improve the organizational policy on cybersecurity measures in these countries.

Cybersecurity Index estimates cybersecurity level according to five main principles [31]:

– legal measures – estimating laws and regulations on cybercrime and cybersecurity;

– technical measures – assessing implementation of technical capacities of cybersecurity through national and industry agencies;

– organizational measures – estimating national strategies and organizations regarding cybersecurity measures;

– potential development measures – assessment of informational campaigns, learning, education, and incentives for cybersecurity potential development;

– cooperation measures – evaluating partnership between agencies, firms, and countries.

Digital governance completely erases the concept of “management for the sake of management” and moves to the plane of “management to meet the needs of citizens”. It is safe to say that digital governance is not just another stage of electronic governance but is its qualitative transformation. In particular, digital governance is now a certain guide for the most developed countries in terms of digital technologies and a future reference for others. Digital governance brings e-governance up to a new, higher quality level and is gaining more and more popularity in the world, envisaging the creation of a new, qualitatively different dialogue between the state and society.

Questions for self-control:

1. What does «Digital Government» mean?
2. What factors affect the level of cyber security?
3. What are the advantages and specifics of the digital government?
4. In what areas are the digital directions of state policy concentrated?

2.3. Research & development for digital transformation

Development and implementation of innovations are important tools of stimulating of digital economy development. This is particularly important for the developing countries (Ukraine, Tajikistan), as it is exactly with the help of innovative developments and new knowledge is possible for country to increase its economy productivity and competitiveness on world markets. This is what stimulates economic growth, which at the same time ensures an increase in the employment of the population. In its turn, development and implementation of innovations are actually provided by scientific research and technical development. So, to increase the economic growth level a state needs to stimulate R&D.

It is necessary to form and improve national innovative system to provide the most effective use of economic potential. The state's innovative system should be based upon the priorities of development of knowledge and technologies of its use. The developed countries experience points to the positive consequences of stimulating innovative activities on the part of the state.

Innovations need to be implemented in production. A new or improved product is implemented when it is put on the market. New processes, marketing, or organizational methods are implemented when they are put into real use in the company's activities.

The economy transformation has become a part of national as well as a part of supranational economic policies since the late 90-es of XX century. In particular, the EU, while forming the economic growth strategy on the base of increase of competitiveness on international markets, has defined the activization of scientific R&D as a main factor by increasing funding (both through budget funds and within the framework of business projects). Today, the formation of the knowledge economy in the EU involves the integration of individual life processes of society into a single system: formation of education system oriented on the knowledge development, development of business-science-education networks for new knowledge producing, encouraging business and society to effectively use knowledge and products made on its basis, formation of the support infrastructure (innovative ecosystem).

According to the Congressional Research Service [24] report on science and technologies, R&D expenses are the main indicator which reflects the level of the innovative efforts made by the country. In addition, in order to be able to compare such efforts between countries, an indicator of the specific weight of R&D expenditures in the country's GDP is used to assess the level of innovativeness (Fig. 2.6).

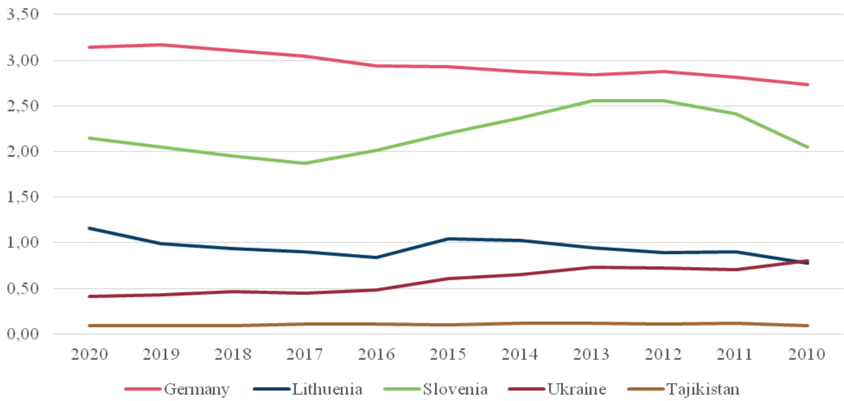


Fig. 2.6 – Dynamics of R&D expenditures by country [39]

If to analyze the dynamics of R&D specific weight in GDP in 2010–2020, the tendency of increasing the R&D expenditures in Germany, Slovenia and Lithuania becomes obvious, while there is a tendency to decrease those expenditures in Ukraine and Tajikistan. Average gross expenditure on R&D in OECD countries in 2020 was 2,36 % of GDP, and in the EU countries – 1,91 % of GDP. In addition, there are extremely few countries in the OECD and the EU that invest less than 1 % of GDP in R&D.

Promoting the development of digital economy on the regional and national levels in Germany, Slovenia and Lithuania is carried out by encouraging the clustering policy. It is the clusters that are assigned the role of an accelerator of network interaction between economic entities of the region that have complementary competences or technological capacities, of mediator of productive dialogue about formation and commercialization of innovations between academic circles and business representatives. To increase the export capabilities at the level of the EU regions the concept of smart specialization is used, which is related to the cluster concept. It provides an opportunity to define strategic directions of regional development on the basis of formation of value-added chains with a focus on exporting globally competitive products.

The emergence of clusters that are based on knowledge is expedient to consider as a reaction on the relative lack of dynamism in the relationship between researchers and industry. And the main directions of cooperation concentration are defined as follows: renewal of regional R&D systems, formation of R&D institutions networks, joint funding on the first stages of commercialization.

Germany is one of the leading countries in the world in terms of R&D. It is due to the powerful research support system. This system is aimed at the development of effective network for cooperation between industry and science for innovative start-ups.

According to the Germany government plan by 2025 the country will spend 3,5 % of GDP on R&D annually. This is one of the highest indicators in the world. The state development programs should be mentioned:

– High-Tech Strategy 2025 [27] – the main task of the program is to create real products on the basis of research results. Business, universities, and R&D centers should also form international networks to achieve that;

– Research and academic relations policy [40] – scientific diplomacy of Germany helps to form scientific cooperation within the country, as well as on the international level.

Lithuania also actively supports R&D on the state level. The government of Republic of Lithuania has invested 1 bn euro in the network with 5 integrated

R&D and business valleys. Such scientific centers are built in the three biggest cities of the country – Vilnius, the capital, Kaunas, the second largest city and the industrial center, and Klaipeda, seaport city. In addition to that, such state policy promotes the increase of not only state investments in R&D, but also private sector investments. R&D centers have facilitated the acceleration of transformation processes of interaction between the state and business, as well as development of digital economy.

R&D expenditures increase in real sector is a determining factor of economic growth, as it promotes raise of the country competitiveness. The increase of the importance of high-tech and knowledge-intensive industries for the economic development of countries causes the limitation of traditional resources and the need for more effective use of the resource base for the introduction of new, including "green", technologies, the expansion and creation of new sales markets, the increase of labor productivity, the creation of a multiplier effect from the results of R&D in high-tech and knowledge-intensive products and accelerating the development of other sectors of the economy.

Questions for self-control:

1. How does innovation affect economic development?
2. What is the level of R&D in partner countries?
3. What legislative initiatives have been adopted in partner countries for R&D?

2.4. Open data

Open data is information that anyone has access to and that anyone can use and share. Open data is used by individuals, companies, journalists, and civil society to learn more about the government activity and to create new tools and ideas.

Modern open data concept provides for the open access to use and sharing of socially significant information by any person for any purpose. In most cases open data is related to the access to state information for providing transparent functioning of government. However, now open data is more and more often used by business representatives to increase its efficiency.

Opening data in different spheres promotes for creation of services which help entrepreneurs to avoid corruption risks and to solve problems, which can be faced by business in Ukraine.

In particular, data from the Unified State Register of Legal Entities, Individual Entrepreneurs, and Public Organizations, registers of court decisions, notaries, taxpayers, tax debtors can be useful.

Several areas of using open data to increase economic growth can be singled out. Their existence open opportunities for creation of new business models, optimization of operating companies' activity, creation of new jobs and increasing employment, as well as improving the climate for attracting foreign investment. In some studies the attempts to estimate the value of open data for the world economy are made. According to the global institute MCKinsey [*33*] estimations, open data (from governmental and non-governmental sources) in seven sectors of the world economy (education, transport, consumer goods manufacturing, electricity, petroleum sector, healthcare, and consumer services) can contribute to the creation of an economic effect in the amount of 3 to 5 billion dollars annually.

In the whole world in the most economy sectors the emergence of new companies, which rely on open data for their activities support, can be observed [37]. In general, new companies, which operate with data, implement in their activity one of the two models. The first one involves providing data as a resource for other companies; for this, the quality of data is improved, new platforms and data presentation formats are created. The second model provides informational and analytical services and products, ready to be used by companies or consumers. Besides that, a lot of companies are working to make state open data more comfortable for use, to simplify access to it and its analysis.

Open data can be used for more effective job search by applicants and for finding staff by employers, thereby contributing to the growth of the overall level of employment in the country. A 2013 World Bank report [28] shows how job search services that use open data can benefit both employers and potential employees. Open data is also a tool which helps youth to develop skills of work with technologies, which increases their chances for successful employment. Today governments of different countries hold contests and "hackathons" in which open data of national, regional, and local level is used, and teachers can form teams of applicants studying computer science to participate in such events. The success of such initiatives will depend on the demand and supply of employees with technical skills. At the same time, in some regions, thanks to such training, it is possible to form a more qualified workforce and at the same time open wider employment prospects for it.

Another benefit of open data use is their positive impact on the investments attracting perspectives. Investors can be interested in data from census statistics, workforce skills, tariffs, land relations or national information infrastructure. Such open data provides an opportunity to form the understanding on resources and infrastructure which can be involved for support of investments in new projects. For foreign investors, who are concerned about the risks, the open data on the state governing mechanisms will be particularly valuable.

More and more often in the process of decision-making investors use state open data provided by the countries themselves (and not only data provided by third parties). The scale of the country's own open data program is now seen as an indicator of the country's openness, and this is an important factor for investors. Monitoring of the open data programs implementation in the world is conducted within the framework of two initiatives: Open Data Barometer – the global estimation of how governments publish and use open data for accountability, innovations, and social impact [36], and Open Data Index calculated by Open Knowledge Foundation. Open Data Index forms the rating on the basis of 15 different categories: Government Budget, National Statistics, Procurement, National Laws, Administrative Boundaries, Draft Legislation, Air Quality, National Maps, Weather Forecast, Company Register, Election Results, Locations, Water Quality, Government Spending, Land Ownership. The last rating results are available for Germany, Slovenia, and Ukraine (Fig. 2.7, 2.8, 2.9).

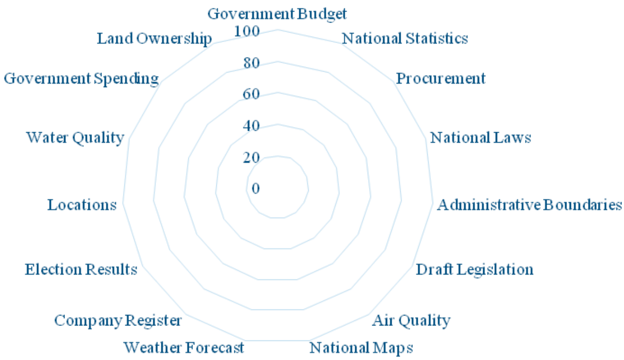


Fig 2.7 – Slovenia Open Data Index

Thanks to open data governments and companies in different countries find new opportunities to provide economic growth and to implement innovations in the private sector.

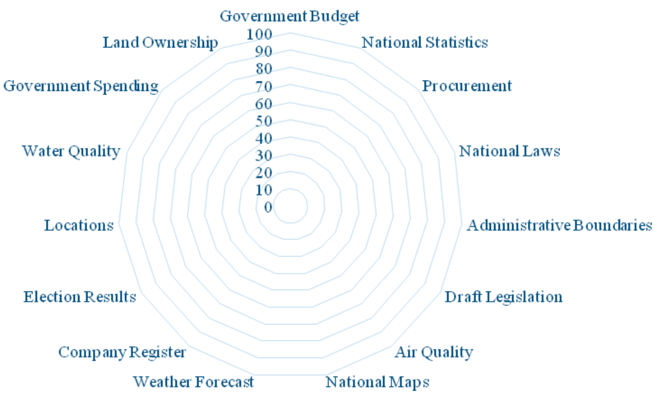


Fig 2.8 – Germany Open Data Index

Using the results of open data analysis and processing it is possible to start a new business, to make operating company more efficient and profitable, to increase employment and to attract foreign investments.

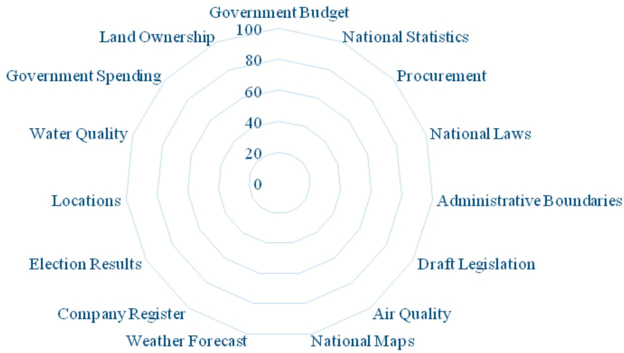


Fig 2.9 – Ukraine Open Data Index

Open data is a diversified and agile resource, which can be useful for companies, individuals, and economies.

Questions for self-control:

1. How open data affects economic development?
2. How can open data be used for business development?
3. What exactly does the Open Data Index measure?

2.5. E-commerce

On the modern stage of social development, the spere of e-commerce have become an integral part of human life, as evidenced by the dynamics of its development indicators in individual countries as well as in the whole world. E-commerce has a lot of advantages, which result in decrease of prices for goods and services. In its turn, it promotes the increase of volume of online sales. Thanks to the use of modern data transmission systems, making commercial transactions has become more convenient. For example, the process of document exchange has been significantly simplified: instead of printed invoices, stock quotes, purchase orders and other documents, electronic versions are sent to the counterparty. A similar situation has developed in the sphere of electronic payments (transfers). An effective mechanism of interaction between financial institutions has been created and is functioning in terms of crediting and debiting customer accounts.

E-commerce provides an opportunity for small and medium businesses to compete effectively with large corporations. Statistical data shows that small organizations which actively use opportunities of Internet, expand much faster than those which do not use them in activity.

In addition, e-commerce helps commercial structures to overcome the consequences of financial and economic crises with the least losses. Thus, the global crisis of 2008 has become one of the causes of small entrepreneurship development in the Internet. Despite the general tendency of decrease of the business activity the growth in this sector hasn't stopped. This is due to the fact that under the conditions of a general decline in business activity and staff reduction, some young professionals decided to start their own business. In addition, starting a business on the Internet does not require significant investments. This advantage makes online trading attractive for all economic entities – both small and large businesses.

The activation of the use of information and communication technologies and the Internet by the population and business became the basis for the rapid development of e-commerce on a global scale. The number of digital buyers is growing annually that is presented in Fig. 2.10. The share of users who make online purchases in much lower in countries with low income. That shows the importance of increasing readiness for e-commerce not only from the standpoint of connection to the global network, but also in other spheres.

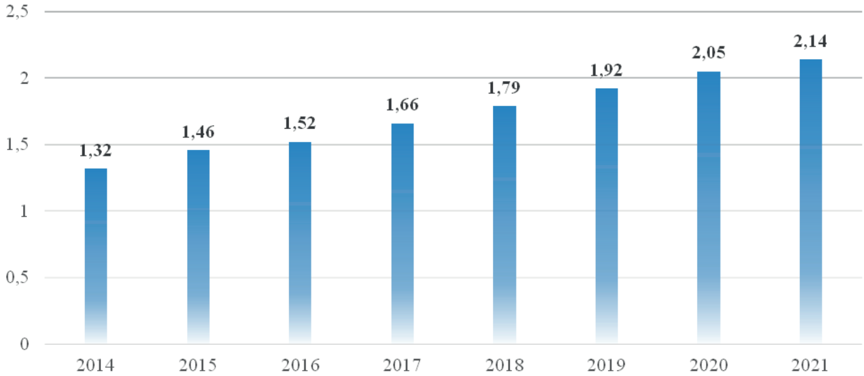


Fig. 2.10 – Number of Digital Buyers Worldwide from 2014 to 2021 [36]

In developed countries such as Denmark, Germany, Netherlands, Norway, Sweden and Great Britain more than 80 % of Internet users make purchases online. At the same time, there are more than two dozen countries in the world with a low or lower than average income level, where less than 10 % of Internet users make online purchases.

The UNCTAD B2C E-commerce Index is aimed at the estimation of the readiness of an economy to support online shopping. The ranks of the analyzed countries in the rating is presented in Fig. 2.11. The higher the Index is, the higher is the level of e-commerce development in the country.

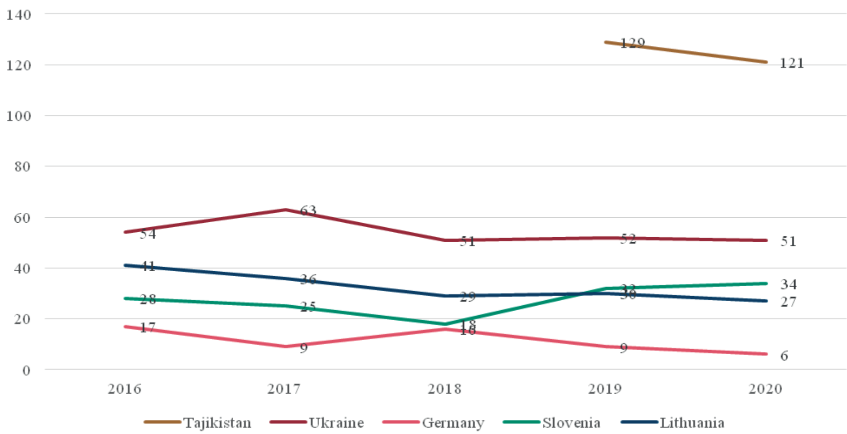


Fig. 2.11 – UNCTAD B2C E-commerce index, 2020 [44]

According to the estimations, the value of e-commerce market of Lithuania is worth US$ 1526 million [44]. The forecasts show that the expected growth rate of revenue is estimated as 18,59 %, which will result in a forecasted market volume of US$ 2,545,00 m by 2025 [15]. Currently, there are 1,41 million of online buyers in Lithuania, and this number is expected to grow up to 1,85 million in 2022. According to the estimations, about 18 % of Lithuanian small businesses sell their products and services online and almost 10 % use e-commerce platforms to sell abroad. On the other hand, e-commerce also increases competition. In particular, the share of foreign online stores in the Lithuania market is assessed as 36 % [34].

If to consider payment methods, Lithuanians mostly use online bank transfers for online shopping (48 % of online purchases). Other options used by Lithuanians include using a payment card (23 %), cash payments (14 %), e-wallet (7 %), and other payment methods (7 %) [21].

Revenue of e-commerce reached US$ 504 million in 2021 in Slovenia and according to the expectations will grow up to US$ 1,738,00 million by 2025, as the forecasted annual growth is 14,53 % [16]. Currently, there are 1,1 million users of e-commerce in Slovenia, so the estimated user penetration will be 50,8 % by the end of this year, and it is expected to reach 56,9 % by 2025.

The largest segment of e-commerce market in Slovenia is fashion. It accounts for almost 30 % of the total revenue from e-commerce in Slovenia. Toys, Hobby & DIY sector has a second place and generates about 26 % of the revenue. It is followed by Electronics & Media, which accounts for a 23 % share in the revenue. The last two sectors are Furniture & Appliances (11 %) and Food & Personal Care (10 % of the revenue).

Most of the transactions for online purchases are provided with the use of prepaid cards – about 63 %. The second place belongs to mobiles – 17 %, as the share of this payment method is much lower. Credit cards occupy third place with the share of 10 %, and e-wallets account up to 9 % [23].

The e-commerce market in Ukraine is one of the most dynamic, the market volume in 2020 increased by 41 % and reached US$ 4 billion, which accounts for 8,8 % of the total retail trade volume. The e-commerce market has grown almost 3 times over the past 5 years and is predicted to grow 2 times over the next 5 years.

The volume of e-exports in 2020 amounted to about US$ 450 million. At the same time, the USA is the largest importer of Ukrainian goods – 33 % of the total Ukrainian e-exports falls on the USA. Electronics and clothing are the largest and most developed e-commerce sectors in Ukraine. The volume of e-commerce in clothing in Ukraine has grown by an average of 26 % since 2016 and reached US$ 291 million in 2020. The share of e-commerce in the retail trade of clothing in 2020 was 6,8 %. And the average check was US$ 24–31 [41].

The estimated e-commerce market volume in Germany is US$ 121,8 billion and has grown by 15,8 % in 2022 compared to 2021 [26]. 20 % of retail purchases in Germany is made online and 41 % of purchases is completed on mobile devices [29].

If to consider payment methods in Germany, the most popular is bank transfer, which is used for 34 % of online payments. Germans use e-wallets in 29 % of online payments, a range of local and minor payment methods in a further 19 % and cash in just 4 % [26].

Germans use debit cards and credit cards, the standard payment method in markets such as the US, in just 14 % of online transactions. In the card market, Visa has a 13 % share, MasterCard 11 %, and American Express 1 % but other, local schemes hold a massive 75 % share [26].

The issue of e-commerce development in the EU and especially involvement of small and medium business in this sphere remains one of the key priorities of European policy at the modern stage. Its development has started from the time of “Electronic Europe” project launch in December 1999. The purpose of this program was the e-commerce development, which primarily consisted in providing buyers and sellers with appropriate guarantees for participating in it, increasing user confidence, and providing appropriate technical solutions [22].

The e-commerce development is also a central element of the EU Digital Single Market strategy, which is aimed at strengthening this sector in the world economic space. The Digital Single Market strategy consists of a range of initiatives, focused on e-commerce and digital economy promotion by harmonization of national laws and development of single technical standards for facilitating of interaction. The joint efforts of European countries in the sphere of supporting the development and regulation of the market partly explains the rapid growth of e-commerce.

Despite the progress reached due to the effective cooperation between the EU countries in the sphere of single digital market harmonization, European enterprises continue to face obstacles to growth, especially beyond their national borders. One of the biggest challenges for online sellers remains the lack of a level playing field both within the EU and globally, as players based outside of Europe have the ability to exert serious pressure on the European single market. As a result, e-commerce businesses need the support to grow in a more competitive global market. It is also necessary to harmonize the main laws and standards so that European companies can rely on a single set of rules when conducting cross-border operations. Another important thing is that the rules created at the European level were enforceable in relation to companies from non-EU countries that operate on the EU market.

Questions for self-control:

1. What are the main advantages of e-commerce?
2. What are the characteristic features of e-commerce development in the partner-countries?
3. What are the main problems of e-commerce?

2.6. Digitalization policy by countries

Germany. At the beginning of the XXI century Germany has started an active process of information society creation: the country quickly realized the potential of communication technologies and systematically supported their development. The state program “Internet fuer alle” can be an example. This program is aimed at people with disabilities, children and adolescents or people with special social difficulties. The state program is aimed at helping people with special needs in order to give them the opportunity to fully use the Internet independently.

Germany belongs to the countries in which digitization has been actively popularized in everyday life. The formation of the digitalization policy have started in 2010 after the IKT-Strategie der Bundesregierung “Deutschland Digital 2015” publication [29]. The main purpose of digitalization of economy and society is digital transformation.

“Deutschland Digital 2015”, developed by the Federal Ministry of economy and energetics, have proposed the new purpose – transfer to “gigabyte society” emphasizing creation of a network infrastructure.

In January 2022 in Germany there were 78,02 million Internet users. The level of Internet penetration in Germany accounted up to 93 % of the general population number at the beginning of 2022 [8].

In 2019 the government presented GAIA-X program [25]. This program is focused on representatives of business, science, and policy. The purpose of the program is to create data infrastructure of a new generation: open, transparent, and safe digital ecosystem, where data and services can be accessible, comparable, and shareable in the environment of trust.

In addition to the GAIA-X integrated data infrastructure, the following programs were adopted by the German government:

– Umweltpolitische Digital agenda – ecological agenda on digitalization [12];

– Bundesregierung verabschiedet Blockchain-Strategie – the strategy on development and implementation of blockchain technology [3];

– Digitale Wirtschaft und Gesellschaft – digital strategy of Ministry of Education and Science [13].

All programs are aimed at improving the quality of digitization processes and the availability of the benefits of the digital economy for all citizens. It is important to mention the separate education program. The government sets a goal to ensure digital transformation in five key elements of the education sector: to strengthen digital education and professional training, to generate knowledge and innovation, to ensure technological sovereignty and scientific leadership, to increase security and trust, and to create conditions to live and work better and more sustainably.

In addition to the mentioned government projects, there is a range of other initiatives in Germany regarding economy digitalization. In particular, such initiatives are aimed at the development of the artificial intelligence systems, 5G connection implementation, cybersecurity strategy development.

Business, academic society, trade unions and politicians have joined their forces on the "Plattform Industrie 4.0" [38] platform to promote digital transformation of production in Germany. The platform participants are working to strengthen Germany's competitiveness. For them, digitalization is a process of society as a whole, which can only be successful in dialogue.

The "Industrie 4.0" platform promotes the development of Industry 4.0 in Germany by:

– development of pre-competitive concepts and solutions and their implementation in practice;

– supporting companies with recommendations on actions, information and cases for practical application (e.g., on the Industrie 4.0 map with more than 350 use cases and participation in the SME Transfer Network);

– introduction of own ideas into the international discourse of Industrie 4.0 and participation in international standardization processes (through more than ten international collaborations) [38].

Slovenia. Republic of Slovenia develops its system of economy digitalization according to the Strategy for the digital transformation of the economy for 2021–2030 within the framework of the Recovery and Resilience Plan. The existing strategy is formed according to the processes of digitalization, informatization, and single digital market of the EU. Stimulation of the development of technologies such as artificial intelligence, the Internet of Things, and big data processing is expected. Implementation of this strategy will not only contribute to sustainable economic growth and competitiveness but will also enable the country to enter the top five countries in the Digital Economy and Society Index (DESI).

The Strategy for the digital transformation of the economy is one of the three key strategies of the state. A synergistic effect is expected from the interaction of the Strategy for the digital transformation of the economy, RISS – Research and Innovation Strategy of Slovenia and SIP – Slovenian Industrial Policy. The main expected result is a formation of an innovative society, based on knowledge. These strategies are united within the S4 framework – the Strategy of smart specialization, which is a platform for targeted investments in priority spheres.

The Strategy for the digital transformation of the economy implementation should provide solving of the following tasks:

a) implementation of advanced digital technologies, which are direct drivers of digital transformation;

b) building an effective ecosystem of a competitive economy;

c) development of an open and sustainable society as a basis for the growth of the digital economy.

In order to support business Digital Innovation Hub (DIH) [47] is operating in Slovenia. The Hub functioning is aimed at providing support for companies in their digital transformation, especially for micro, small and medium enterprises, and governmental sector. The European Commission data shows that there are ten digital innovative centers in Slovenia. DIH in Slovenia was created as a response for diverse needs and opportunities and that is because is aimed at those sectors where the requirements of the external environment were the highest.

To operate effectively DIH has created a network of strategic partners, which include those from the specialization platform S4 Smart Factory Cluster, ICT Horizontal Network (SRIP PMiS), industry representatives (members of the smart factories, TECOS), academic institutions (University of Ljubljana, University of Maribor) as universities are the largest Slovenia's research organizations, support environment for SMEs (Association for Informatics and Telecommunications, Chamber of Commerce and Industry of Slovenia), Technology Park Ljubljana (connecting SMEs and several research institutes for innovation), Smart Factory Cluster, Wood Cluster, IIBA Slovenia and others.

In addition to that since 2021 Slovenian Digital Center has operated to implement and develop advanced technologies. Slovenian Digital Center is a central economic event of Slovenia's presidency of the Council of the EU. Slovenian Digital Center allows business to present innovative and technically advanced solutions, products and / or services. Some of the spheres presented in the Slovenian Digital Center include the following: digitalization, AI, Society 5.0, robotics, cybersecurity, innovative technologies, advanced mobile services, energetics solutions, smart cities and communities, sustainable development, etc.

Lithuania. The development of the digital economy system in Lithuania is implemented according to "Lithuanian Industry Digitisation Roadmap 2019–2030" [30]. In the Roadmap the initiatives that will allow to implement the most modern technologies have been developed. The digital economy transformation is designed to make local production more effective and competitive. It is assumed that the Industry Digitization Roadmap will work in sync with the adopted Smart Specialization Strategy, as well as the Science, Technology, and Innovation

Strategy.

Lithuania has created The State Information Resources Interoperability Platform [17]. This platform allows individuals and enterprises to get access to all available state and administrative e-services: “Birth of a child”, “Losing and finding a job”, “Starting a business”, “Taxes”, etc. The e-signature system is used for identification. Everyone benefits from the check of the signed with e-signature document (ADOC), as well as from the creation and signing of e-documents.

In general, the digital economy development policy of Lithuania is highly integrated in the system of the EU digital economy. Lithuania is an active participant of all EU programs in economy digitalization, in particular in the sphere of digital skills popularization among the population. The analysis of the state services market in 2019 shows that the Smart-ID application which is used for identification and signing state documents has become the most popular tool for signing documents. In 2019, Smart-ID occupied 56 % of the market among electronic signature qualification certificates. At the same time, the 2019–2030 Strategy provides for an increase in the share of users of state digital services.

Business is an active participant of economy digitalization. Several projects are launched in Lithuania for state and business interaction within state digital services providing. Digital industry also has opportunities to receive various grants and subsidies from both the state and the EU. “Digital-Lithuania. A Hub for Innovation” [11] is one of the examples. “Digital-Lithuania” exists as a cluster of Lithuanian IT-companies. Different IT-companies are the participants of the cluster, which work jointly on the popularization of the ICT sector of Lithuania. At the same time one of the cluster tasks is to provide support and assistance in formation of digital government and digital business for Lithuanian and international companies.

Universities and R&D centers are actively involved to the implementation of state and business initiatives in the sphere of digital economy development.

The existing system of economy digitalization has allowed Lithuania to reach progress in the transformation of the country and transition to the post-industrial level. At the same time, some spheres (access to connection, Internet services use) still are below the EU average level. The development strategy has an ambitious goal – Lithuania's achievement of 7th place according to the DESI index in 2030 already.

Ukraine. In 2016 Ukraine adopted "Digital Agenda of Ukraine" [5] until 2020. It outlined the conceptual foundations of digital development, proposed development initiatives, and defined key goals to be implemented by 2020. Thus, it was expected to improve Ukraine's positions in three ratings based on global development indices, in the Networked Readiness Index rating, the Global Innovation Index rating, and the Global Competitiveness Index rating. However, despite the beginning of the transformation of economic sectors, the digitization of public services, and an increase in the level of access to the Internet, the changes were not enough for real qualitative growth of the country's digitalization. In 2020, the Ukrainian Institute for the Future developed a strategy for the development of the digital economy "Ukraine – 2030E". The strategy foresees several development scenarios and defines an algorithm of actions to achieve the set goals. Key KPI until 2030 are:

– 65,0 % – the share of the digital economy in Ukraine's GDP in 2030;

– 99,9 % of Ukrainian households have broadband Internet access;

– 100,0 % – 4G–5G coverage of the territory of Ukraine;

– 99,0 % of all highways and railways and 95 % of rural areas are covered by mobile Internet technologies;

– 99,9 % of citizens have digital identification (citizen-card, Mobile ID) and technical capabilities to use trust services, etc. [45].

It should be mentioned that Ukraine in 2020 on the national level has launched the project "Diya City" to create favorable conditions for innovative and technological business development. The project involves such spheres as AgroTech, Fintech та Blockchain, AI and cloud computing technologies, medical neural networks and biotechnologies, IoT, Publishing and marketplaces, aviation and space technologies, drones, advertising, marketing and promotion, animation, graphics and audio, cybersports and business process outsourcing [14].

"Diya" [7] project is another step in technical evolution, which allows a person to receive any document with a single click using a smartphone or laptop, where a person has a personal electronic signature. "Digital State" (another name of the project) is part of the development of the country e-governance. All services provided by various government bodies should become available to citizens online. Information about a person, his / her health, level of income, place of residence, skills, etc. are combined into big data, part of which remains open, and the rest is securely stored and limited by access rights. The well-protected platform is located in a proven data center and meets global standards for protection against cyber threats, so a person can be sure of the safety of personal data. In this way, Ukrainians join the global information community.

Government plans to implement four levels of e-services:

1) information about the state;

2) communication with the state;

3) transactions with the state;

4) involvement in state administration.

Among the already implemented e-services in Ukraine, a number of quite useful services can be noted that have made life easier for citizens and businesses. Already now, Ukrainians have the opportunity to register a business online, get certificates and extracts from registers, apply for childbirth assistance, etc. Currently, there are a number of solutions that facilitate the process of conducting business.

One of the most wide-spread and popular applications is mobile application "Diya" [49], which is a part of the "State in smartphone" project of the Ministry of Digital Transformation of Ukraine. "Diya" is needed to provide Ukrainians an opportunity to receive state services in the online mode instead of waiting for hours in the queues to the cabinets. We are talking about obtaining certificates, extracts and data from various state agencies and registers, submitting packages of documents for the initiation of various processes: starting or closing a business, applying for unemployment payments, etc. The task of “Diya” is to make the process of providing these services fast, transparent and save people from unnecessary bureaucracy.

Digitization of data reduces the workload of call centers and local administrations, which allows to reduce the costs of their maintenance. But the challenge on the way to the successful implementation of the project is insufficient Internet coverage and computer literacy. Only 5 % of people use online services. And among the age group of 60+ people, only 30 % use the Internet. However, this is not an obstacle for developers, they have already created educational courses. Elderly people in the villages, understanding the advantages of smartphones and the Internet, quickly learned to use them [7]. Life is impossible without progress, whether we like it or not.

According to the developers’ opinion, “Digital State” must become a service which will allow to get services quickly and to do job honestly. Therefore, the Ukrainian government launched the “Digital State” project, which will eventually unite all departments into a single convenient and effective online system.

By 2024 the Ukrainian government aims to transfer 100 % of all public services to online mode, reducing by three times the number of interactions between citizens and businesses with the government and achieving a zero level of corruption in this sphere.

So, in today’s world, the information sphere plays a big role. As a result, the adaptation of state processes to modern society becomes extremely important for the implementation of effective state policy. “State in smartphone” is not a fairy tale from the distant future and not another empty promise, the project is already on the way to its implementation.

Tajikistan. Tajikistan as a full subject of the world’s economy is involved in formation of information economy segments, particularly digital economy.

Tajikistan government has been working on transition to e-governance (information state) for more than 15 years. During this time conceptual and program documents on economy digitalization in the country have been adopted. Such documents first of all include Concept of formation of electronic government in the Republic of Tajikistan (2012–2020) and Decree of the President of the Republic of Tajikistan “On the state strategy of information and communication technology for the development of the Republic of Tajikistan”.

In the UN E-Government Development Index Tajikistan is positioned on the 129th place [46]. The E-Government Development Index of the UN is one of the key indicators of the information society development level.

Tajikistan gradually works on the formation of electronic databases. Such databases should become basis for implementing electronic customs, digital documents for business and population. As an example of electronic digital systems formation Tajikistan uses experience of high-developed countries which have reached results in the sphere of e-governance: South Korea, Japan, Germany, Lithuania.

Implementation of plans on country’s digital economy transformation requires adaptation of legislation to new needs. It is also important to ensure the development of communications, to create universal access to fiber optic infrastructure. That’s why the issue of IT-sphere development must be under special control of government.

Telecommunications sector in Tajikistan is continuously improving, but the access to high-speed internet is still limited and expensive if to compare with other countries. In Tajikistan 40,1 % [9] of people use Internet on any devices. Kepios [32] analysis reflects that the quantity of internet users in Tajikistan has increased by 605 ths (18,1 %) between 2021 and 2022. Permanent access to internet in Tajikistan remains to be limited by large city regions, where residents pay one of the highest in the world price for internet services. The cost of the basic subscription package is equivalent to 16 % of the average monthly income.

Due to the poorly developed access to the Internet and high prices only 60 % of the companies in Tajikistan use email for communication with their clients and less than 50 % of the companies have their own websites. Tajikistan needs more investments and government support to use fully the potential of digital technologies and the Internet for increasing business productivity and economy competitiveness as a whole.

Opportunities for e-commerce development in Tajikistan grow from year to year. Its development will allow national producers to discover new markets and to find new clients. Digital Tajikistan can become an important source of innovations, growth and employment in the region if the country will invest more in people's skills, entrepreneurial environment and will continue to enhance digital infrastructure.

Thus, the digitization of the economy is one of the important and complex civilizational challenges. The prospects for functioning and development, the country's competitiveness depend significantly on the effectiveness of its solution. Each of the studied partner countries has its own characteristics, its achievements, and obstacles, which provides an opportunity to determine the optimal ways of achieving results in the field of digitalization using the experience of other countries.

Questions for self-control:

1. What are the main tendencies of digitalization in the partner-countries?
2. What methods can be useful in the development of the digital economy?
3. What country is the most "digitalized" in your opinion? Why do you think so?

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UDC 339.92:004

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Chapter 3
THE NEW MODEL OF DIGITAL SINGLE MARKET: THE EUROPEAN APPROACH

Content

3.1. European digital single market model: concepts, principles, and components

Nowadays, digital technology is an integral part of human life. The Internet, big data, e-commerce, artificial intelligence transform modern economies in the direction of innovative development and economic progress. European economy and society are characterized by a high level of digital transformation, although in general the region ranks second in the world, behind the United States.

Switzerland, Sweden, Denmark, the Netherlands and Finland are the leaders in the level of digitalization on the European continent. According to the Digital Competitiveness Index in 2021, high positions in the top ten countries were occupied by Sweden (3^{rd} position), Denmark (4), Switzerland (6), the Netherlands (7), Norway (9). According to the Global Connectivity Index (2020), again, the most rated are Switzerland (3rd place after the United States and Singapore), Sweden (4), Denmark (5), Finland (6), the Netherlands (7), the United Kingdom (8), and Norway (10).

Each European country has a national digitalization strategy, which involves the deep penetration of digital processes into all socio-economic processes and includes the development of "smart cities", improving e-government and e-medicine, as well as social services, enhancing digital literacy of Europeans, harmonization "Green transition", etc. [1, p. 39]. At the same time, for more than a decade, the European Commission, as the EU's governing body, has been working to develop and implement a joint digital development strategy for the member states of the regional union, which aims to create an integrated digital single market. The EU's digitalization strategy aims to maximize the benefits of this process for people and businesses, ensure the digital sovereignty of countries, create a basis for systematic and sustainable economic growth of economies based on artificial intelligence, big data, innovative technologies and more. Until recently, both individuals and businesses in the EU were affected by a number of barriers to online tools and services usage: consumers had limited access to certain goods and services, businesses could not take full advantage of digitalization in business interaction, the regulation of this process was stopped by the government [2]. That is why the formation of the digital single market aims to open new opportunities by eliminating key differences between online and offline worlds, removing barriers to online cross-border activities.

According to one interpretation, the EU's digital single market is a policy document of the European Single Market, which includes such components as e-commerce, digital marketing, electronic communications system [3]. According to another approach, the interpretation of the EU digital single market is much broader and considers this concept as a holistic economic concept of creating an open market environment where buying and selling goods and services, business communication and interaction are carried out using digital tools. The central category of this concept is information, as the typical online consumer is nothing more than a set of data used by various economic entities (government, enterprises) to improve their own efficiency. At the same time, the digital single market as a platform for business cooperation is based on such principles as:

– economic freedom;

– fair competition;

– high level of consumer protection;

– maintaining the personal data confidentiality.

Digital single market is one of the EU's greatest achievements. This program destroys the borders between countries, allowing free access to goods, services, capital [4, p. 50]. This, in turn, promotes economic growth and increases economic efficiency, improves the standard and quality of an average European's life. The construction of the EU digital single market model was carried out in stages:

1. In 2010 enaction of the socio-economic development strategy of Europe untill 2020 "Europe 2020", which provided for the implementation of several major initiatives, including the "Digital Agenda for Europe". It already contained the foundations for the formation of a digital single market, ensuring the compatibility of IT equipment and programs, strengthening the security of Internet users, increasing digital literacy, introduction of high-speed Internet, conducting joint research in IT and innovation [5, p. 183–184].

2. In 2015 approval and start of the EU Digital Single Market Strategy implementation under the leadership of the President of the European Commission Jean-Claude Juncker. A package of legislative initiatives was

formed, aimed at building of the digital economy capacity, scaling up digital communication, and facilitating access to the Internet.

3. In 2019 enaction of an expanded strategy for the development of the digital single market (until 2024) under the leadership of the new European Commission President Ursula von der Leyen. The priorities of this stage were the development of artificial intelligence systems, improvement of innovative technologies, environmental protection, deepening the level of digital integration of EU countries.

According to the plan of European countries digitalization [6], the creation of a digital single market involves achieving the following main goals:

– expansion of network and information communication, as well as cooperation between countries;

– creation of a single European digital zone and strengthening of the EU's digital sovereignty, which provides for a common and "smart" policy in the field of innovation, research, technology and big data;

– harmonization of institutional and legal bases for the creation of an integrated secure Internet environment and strengthening cyber resilience;

– increasing the level of computing power of digital technologies and equipment;

– development of a single European database (integrated cloud service);

– transforming the EU into a global center of digital added value;

– encouraging the wider use of artificial intelligence based on innovative (limited) regulation;

– further development and deepening of the new technologies usage in the economy and society.

The digital single market model is one of the European Commission's political priorities and covers three component "pillars":

1. "Access": increases the reach of the goods and services market for consumers and businesses by expanding cross-border e-commerce, breaking

down geographical borders and facilitating access to online content while strengthening consumer protection.

2. “Environment”: provides for the creation of appropriate conditions for the digital platforms expansion, intensification of online trade in services (e-education, e-medicine, e-government), development of high-speed, secure and reliable digital infrastructure while strengthening cybersecurity, confidentiality and protection personal data, the fight against Internet fraud and abuse, etc.

3. “Economics and Society”: maximizes the benefits of digital change to ensure macroeconomic growth, strengthen the competitiveness of countries in the international arena, the formation of the data economy, business intensification, increasement of the employment level, ensuring human development and social progress.

Each of these “pillars” of the EU digital single market model includes a wide range of goals and directions (Table 3.1).

***Table 3.1* – EU digital single market model**

No	Model’s ‘pillars’	Directions of implementation	Goals and future achievements
1	*2*	*3*	*4*
1.	Access	– openness of online markets for goods and services; – development of telecommunications; – scaling of e-commerce; – introduction of the “One Stop Shop” service; – cessation of unjustified geoblocking; – regulation of e-commerce; – efficiency and availability of goods delivery system; – start of the antitrust e-commerce competition; – modernization of the copyright system; – reassessment of the Satellite and Cable Directives	– simplification of product distribution and cross-border movement of goods; – reduction of administrative burden on business; – expanding access to information; – prosperity of cross-border economic cooperation; – ensuring the transparency of electronic business agreements and communications; – improvement of pricing policy, optimization of sales processes; – development of a fair and competitive consumer market; – reduction of violations in the field of creativity and culture, restriction of plagiarism; – improving access to cross-border distribution of TV and radio programs

Continuation of Table 3.1

1	*2*	*3*	*4*
2.	Environment	– development of the European Code of Electronic Communications; – development of 5th generation wireless technologies; – restructuring of audiovisual media; – expansion of digital platforms	– deepening the integration of the average European into digital systems; – increasing the intensity and speed of Internet connection; – expanding borders and penetrating European media; – increasing the level of transparency of online communications, reducing the illegal Internet content
3.	Economics and society	– address barriers in the European data economy; – improving the standards and compatibility of digital interaction; – creation of a digital society	– increasing confidence in the network economy and the data economy; – ensuring the free movement of non-personal data; – minimization of legal uncertainties of the data economy; – high standards and compatibility of digital markets in the field of education, medicine, and transport; – bridging the digital division and the problem of digital inclusion

Source: complied by the author.

Some positive changes are already visible today. For example, in the last 2–3 years, the share of mobile users in Europe has grown to 97–98 %, more than 80 % of the population has access to the Internet, and the same proportion of users make purchases online. In 2021, almost 88 % of the corporate sector and 78 % of EU households are actively using digital technologies [7, p. 13]. If we talk about the business sphere, then medium and large corporations are more "digitalized", among micro and small businesses the share of "figures" users is 40–45 % [8, p. 11].

At the same time, the implementation of the digital single market strategy is complicated by the need for significant investment. In particular, in the medium term, up to 50 billion € needs to be raised for the digitalization of industry alone, including 37 billion € for the development of digital innovation; 5,5 billion € for national and regional investments in digital innovation hubs; 6,3 billion € to launch production of next-generation electronic components; 6,7 billion € for the implementation of the European initiative on cloud technologies [5, p. 187]. On the other hand, the full implementation of the EU's digital single market strategy, according to the European Commission, will ensure an annual GDP growth of 415 billion € and will create a number of new job places [3]. First of all, digitalization will lead to a number of positive structural and dynamic changes in high-tech areas.

In view of this, today the further implementation of the digital single market strategy can be seen as an important determinant of strengthening the competitiveness of the European Union in the geopolitical space, development of various spheres of both traditional and neoeconomics, intensification of international trade and economic cooperation, improving the standard and quality of life of the European population.

Questions for self-control:

1. Define the concept of a digital single market.
2. Indicate the principles which the EU digital single market is based on.
3. Identify the stages of building a digital single market in the EU.
4. Justify the main objectives of building a model of the digital single market, based on the European market.
5. What elements does the EU digital single market model include?
6. What does such an element of the digital single market model as "Access" provide?
7. Describe the block "Environment" by areas of implementation, goals and future achievements.
8. Explain the features of the EU digital single market model element "Economy and Society".

3.2. E-commerce in the EU digital single market system

One of the main trends in the development of information and network economy is e-commerce. In the narrow sense, these are any trade or financial transactions that are conducted through the Internet. However, in a broad sense, this concept should be understood not only online buying/selling, but also a number of other business transactions, including marketing and advertising (digital marketing), information exchange, business negotiations, internal management of companies and more. Today, e-commerce creates a number of benefits for both manufacturers and consumers (Table 3.2).

***Table 3.2* – Advantages of e-commerce for market participants**

No.	Manufacturer/seller	Consumer/buyer
1.	Reduction of transaction costs due to remote interaction and delivery of products [9, p. 77].	Expanding consumer choice: facilitating access to diversified product and service markets.
2.	Improving productivity and efficiency.	Reducing the cost of buying and selling.
3.	Leveling borders and the possibility of entering new markets.	Open access to information about prices, reviews, product characteristics.
4.	Ensuring gender equality in entrepreneurship.	Convenience and comfort of the operation of purchasing and receiving products.
5.	Facilitating the management of production processes [9, p. 78].	Openness of interaction with the manufacturer / seller.
6.	Ability to avoid trade intermediation and establish direct contacts with the consumer.	Transparency of the purchase / sale transaction.
7.	Favorable competitive conditions and convenience of marketing research [10]	Possibility of confidentiality of purchase.

Source: complied by the author.

At the same time, it is worth pointing out certain shortcomings of e-commerce for both manufacturers and consumers. In particular, entering international markets creates more risks for the buyer of losing competitiveness, significant costs of ensuring proper IT infrastructure, increasing the likelihood of infringement of intellectual property rights, uncertainty and complexity of financial reporting and more. As for the buyer, the negative aspects of e-commerce are the high probability of fraud, the risk of obtaining substandard products, the possibility of losing the confidentiality of personal data, the difficulty of returning or exchanging products and more. However, today almost all developed countries are trying to actively integrate into the online business world and expand e-commerce. Today, the European Union is the leader in the level of e-commerce development.

The implementation of the EU's digital single market strategy involves the creation of a consolidated e-commerce environment. The main objectives of this initiative are:

– facilitating access of all participants in market relations to online business communication, online buying/selling processes of goods and services;

– intensification and scaling up of virtual trade activities both within the EU and abroad, including the promotion of further integration of the region into the global electronic business system;

– simplification and reduction of the cost of the e-commerce process, in particular with regard to the procedure of cross-border supply of products, payment of VAT for online sales;

– cessation of unjustified geoblocking;

– facilitating access to audiovisual services;

– updating legislation and strengthening the protection of the rights of online consumers;

– improving the system of legal regulation of e-commerce, in particular, the adoption of the law on digital services.

Over the last decade, EU countries have tried to create favorable conditions for the development of e-commerce (non-discrimination, technological neutrality, the right to sign virtual agreements, electronic functional equivalents). At the same time, one of the main problems today is the lack of trust of both individuals and businesses in this area. The solution to this aspect is facilitated by the continuous improvement of the system of state and supranational regulation of online trade on the basis of international norms and the development of purely European standards. The EU's e-commerce guide is guided by the UNCITRAL

Model Law on Electronic Commerce, the UNCITRAL Model Law on Electronic Signatures, and various European directives, including e-commerce, electronic signature, consumer protection, personal data protection, payment services, e-invoicing, etc.

For example, the e-Commerce Directive (Directive 2000/31/EU of the European Parliament and of the Council dated June 8, 2000 on certain legal aspects of information services, including e-commerce, in the internal market) regulates a number of basic aspects, including: freedom and non-discrimination in the provision of information services, protection of data exchange and prevention of the spread of "garbage" information, the correctness of electronic contracts, liability for Internet fraud, dispute resolution, etc. [11, p. 20]. An act of e-commerce is the sale of goods or the provision of services or other interference in the circulation of goods for profit. The operation is carried out not only with the participation of the seller or buyer, but also other parties, including government agencies, NGOs, transport and logistics companies, post offices, banks, marketing and advertising agencies, IT companies, outsourcing companies. In general, the main subjects of directive regulation of e-commerce are the consumer and the seller, and the objects – the product itself, commercial transactions, payment and transport transactions (Table 3.3).

***Table 3.3* – The E-commerce components**

No.	Components	Definition in terms of e-commerce
1.	Product/service	Tangible/intangible good or service that the consumer orders from the merchant.
2.	Consumer	This is, whether we are talking about a natural or legal person, a person behind the screen of a computer, tablet or phone who checks the existence of the desired product or service on the merchant's website and places the order to the merchant.
3.	Merchant	This is, whether we are talking about an individual or a legal entity, a person or a group of people behind a computer screen, who manage the internal systems of the trader in order to deliver the good or service to the consumer.
4.	Payment systems	These are the systems used by the consumer to pay the merchant the value of the good or service purchased.
5.	Delivery	Service performed by the delivery service provider, which ensures the transport and delivery of goods purchased by consumers.

Source: [12].

One way to increase consumer confidence in online commerce and reduce potential risks is to enter into appropriate legal agreements. European law distinguishes between two types of such agreements: electronic agreement and remote contract. An electronic agreement is defined as an agreement to buy/sell online or provide online services through a website or other electronic means [12]. A distance contract is a broader concept and includes, in addition to an electronic contract, agreements concluded by means of distance communication.

To make an agreement in a proper way market participants should provide relevant information, namely: the full name and location of the seller's party; contacts; license information (if any); terms of operation (cost of goods and delivery, volume/quantity, terms of delivery, etc.) [13]. In addition, the electronic agreement must be supported by an electronic signature. The EU Directive on Electronic Signatures (Regulation 910/2014 of the European Parliament and of the Council from July 23, 2014 on electronic identification and authentication services for electronic transactions in the internal market) sets out the procedure for verifying the authenticity of concluded agreements. In particular, the EU has such types of signatures as electronic, advanced electronic and qualified electronic. And at the same time, only the latter has the same legal force as the handwritten signature [11, p. 20].

As mentioned above, one of the restraining factors in the development of e-commerce in the EU is the lack of public confidence. And this is not surprising, because today 50–60 % of European sites to a greater or lesser extent violate consumer rights. Major violations include false discounts, the difference between the bid and the final price, the lack of proper information on additional fees for delivery, payment, booking, lack of reference to the online dispute resolution platform (ODR), which is mandatory according to the EU law. In order to increase public confidence in e-commerce, the EU leadership is improving consumer protection mechanisms by improving information provision, consultation, consumer advocacy, cooperation between authorities and organizations responsible for consumer law enforcement, information, education and conflict resolution related to consumer complaints, systemic market surveillance, policy regulation of purchase/sale transactions. In particular, in the field of consumer protection, European legislation includes directives on consumer protection when concluding contracts outside retail premises and offices, on unfair terms in contracts with consumers, on consumer protection in distance contracts, on consumer protection when establishing prices for goods offered to consumers (for setting prices), on some aspects of the sale of consumer goods and related guarantees.

European rules make it easier for member states to protect consumers online. For example, these policies allow you to delete sites or social media accounts where fraud has been detected; allow you to request information from Internet service providers or banks to track the identity of fraudulent online traders; determine the concept of the promotional price or sale and the procedure for its application (notification one month before the sale at the promotional price, limitation of the sale period from one day to one month); oblige Internet markets to inform consumers about their legal status (legal entity or sole proprietor); disclose the terms of concluding, terminating commercial contracts and resolving disputes, payment for purchase, return or exchange. From a legal point of view, the same goods are sold and bought online as through traditional channels (except for digital products), and therefore all aspects of such transactions fall under the relevant national and supranational consumer legislation.

The EU countries are cooperating to promote e-commerce in the following areas:

1. Simplification of the VAT payment system: currently cross-border sellers who fall into the category of payers have to pay VAT in the country of residence of the buyer, and they are obliged to register their company for VAT payment either in the customer's country or in the system "single window".

2. Cheaper cross-border delivery of orders: in the EU countries, prices for

delivery of products abroad are on average 3–5 times higher than prices for delivery within the country. In order to solve this problem, restrictions on delivery prices have been lifted, but companies must clearly indicate the price of the product so that the consumer can compare its full cost (with delivery). Consumers can find prices for parcel delivery on a special website on the European Commission's website [14]. At the same time, in the EU there are special bodies to monitor the cost of delivery of certain companies.

3. Unification of legislation on digital services: aimed at adopting a single Law on Digital Services, which will increase the security of digital space, provide equal access for business, more effectively protect consumers on the Internet, create a strong system of transparency and accountability for online platforms, will stimulate innovation and the expansion of the single market.

As in other regions of the world, in the European countries, e-commerce is implemented by various business models, namely: Business to Customer, Business to Business, Customer to Customer, Customer to Business, Business to Administration, Customer to Administration (Table 3.4).

Table 3.4 **– Models of e-commerce implementation**

No.	Model type	Main features	Examples
1	*2*	*3*	*4*
1.	Business to Customer (B2C)	– transactions between a business and a consumer; – selling the products by the use of online marketplaces and stores; – two types: direct sellers and online-intermediaries	Etsy, IKEA, Carrefour
2.	Business to Business (B2B)	– sales between businesses, such as a manufacturer and a wholesaler or retailer; – is not consumer-facing and happens only between business entities; – focus on raw materials or products that are repackaged or combined before being sold to customers	BigCommerce Enterprise, Shopify, OroCommerce
3.	Customer to Customer (C2C)	– customers sell goods or services to each other by means of some sites; – allow customers to trade, buy, and sell items in exchange for a small commission paid to the site	Ebay, Olx, Zibbet

Continuation of Table 3.4

1	*2*	*3*	*4*
4.	Customer to Business (C2B)	– consumers sell goods or services to businesses; – business pays for the right to use customers' products	Google AdSense, Shutterstock, Upwork
5.	Business to Administration (B2A)	– a business provides an online service for the government, generally through a website	Accela, OpenGov, TurboTax
6.	Customer to Administration (C2A)	– a consumer is providing something for the government	Electronic taxes, distance learning, e-health, online surveys

Source: complied by the author.

Over the last few years, the development of e-commerce in Europe has undergone significant dynamic changes, which has contributed to the introduction of a common digital policy. The COVID pandemic also had a positive impact on this area. For example, in the United States, the share of e-commerce in total trade in the "pre-COVID" period was 11 %, at the peak of the pandemic – 22 %, and today – 17 %; in the UK, the figure was 22 %, 31 % and 24 % respectively; in Germany – 9 %, 14% and 10%, in France – 9 %, 18 % and 11 % [15].

The most positive changes are observed in the EU countries. In particular, as of 2020, the largest share in the structure of European e-turnover fell on Western Europe, this region shows leadership in other indicators (Table 3.5).

Table 3.5 **– The share of e-commerce in the economy of the European region (data from 2020), %**

Region	The percent of e-commerce in trade	The percent of online GDP in general GDP	The percent of Internet users to the population	The percent of e-shoppers to the number of e-users
Western Europe	64,0	5,2	95,0	86,0
Northern Europe	6,0	3,5	96,0	82,0
Central Europe	8,0	3,0	88,0	75,0
Southern Europe	16,0	3,7	85,0	60,0
Eastern Europe	6,0	2,5	77,0	41,0

Source: complied by the author based on [16].

The growth rates of e-commerce in the B2C segment were dominated by EU countries, namely Greece (77 %), Switzerland (37 %), Sweden (36 %), Hungary

(35 %), Poland (34 %). In terms of the share of online GDP, in terms of countries, the highest rates were shown by the United Kingdom (9,9 %), Denmark (7,3 %), Estonia (6,8 %), Greece (6,6 %), the Czech Republic (5,7 %), Spain (5,6 %). Among some European countries, the share of online shoppers to the total number of Internet users in 2020 was led by the United Kingdom (92 %), the Netherlands (91 %), Denmark and Switzerland (90 % each), Germany and Norway (87 % each) [16]. At the same time, it is mainly dominated by users who make online purchases 1–2 times a month (Table 3.6).

***Table 3.6* – Frequency of e-purchases in the EU and the UK for three months in 2020, %**

Country	1–2 times	3–5 times	6 times and more
Austria	15	23	23
Belgium	28	24	8
Bulgaria	13	7	2
Greece	19	15	15
Dania	22	27	26
Estonia	19	22	22
Ireland	18	17	26
Spain	24	17	16
Italy	16	11	6
Cyprus	7	13	14
Latvia	21	13	9
Lithuania	20	18	11
Luxembourg	19	24	27
Malta	15	21	27
Netherlands	25	28	29
Germany	19	28	32
Poland	18	21	16
Portugal	14	16	14
Romania	14	10	2
Slovakia	22	18	12
Slovenia	30	18	11
Hungary	25	19	13
Finland	20	25	16
France	18	25	22
Croatia	14	19	19
Czech Republic	20	26	20
Sweden	20	29	25
UK	13	25	47

Source: [16].

Generally, in the EU the frequency of online purchases 1–2 times was 20 %, 3–5 times – 21 %, 6 or more times – 18 %. Regarding the geographical structure of online shopping, in the EU 90 % were purchases in national online stores, 30 % – in stores in other EU countries, 21 % – on the websites of sellers from other countries (outside the EU). Analysis of the product structure of online shopping shows that, mainly, Internet users in the EU for three months of 2020 ordered clothing (63 %), film products (31 %), furniture, household goods and gardening (29 %), restaurant food and catering (28 %), printed books, magazines, newspapers (27 %), computers, telephones and accessories (26 %), cosmetics, beauty products (26 %), music (25 %), medical and medicines (23 %), sports goods (21 %) [16]. In 2020–2021, mostly European e-shoppers bought products through Internet sites, less often – mobile applications. The use of social media in e-commerce is also active, among which Facebook, Instagram, Twitter, and Pinterest are in the greatest demand. For means of remote communication, online purchases using a mobile phone (90 % of orders), e-mail (74 %), company contact form (66 %), chat (47 %), fax (8 %) [16].

Credit and debit cards, bank transfer, and e-wallet dominate among the payment mechanisms used by the average EU citizen, an active user of online commerce (Table 3.7).

***Table 3.7* – Payment methods in selected European countries (2021), %**

Country	Credit card	Debit card	Bank transfer	E-wallet	Cash-on-Delivery	Prepaid card	Prepay	Other	E-invoices	Invoice
Ireland	87	–	–	8	–	–	–	4	–	–
Italy	33	9	9	18	11	12	5	2	–	–
Belgium	31	24	17	17	6	2	2	1	–	–
Finland	31	31	30	12	–	–	–	4	–	23
Spain	23	24	9	21	12	7	3	2	–	–
France	18	30	13	23	4	4	6	2	–	–
The UK	16	41	4	22	9	2	3	3	–	–
Germany	15	6	40	19	6	3	–	7	3	–
Sweden	14	41	16	7	5	1	–	2	15	–
Denmark	8	25	25	22	10	2	–	3	4	–
Netherlands	7	5	69	6	6	2	3	3	–	–

Source: [14].

Along with citizens, European business is actively integrating into the field of e-commerce. Enterprises create their own websites and mobile applications for the sale of products, actively use artificial intelligence systems and IT technologies for internal management, production and commercial activities (Table 3.8).

***Table 3.8* – European business activity in the field of e-commerce (according to 2020), %**

Type of integration into the field of e-commerce	Companies with up to 249 employees	Companies with more than 250 employees
Online sales companies through their own websites	20	43
Companies selling through mobile applications, e-platforms	17	28
Companies that use IT for data processing	2	11
Robotic companies	2	11
Companies with chat services	2	6
Companies with elements of artificial intelligence	6	17

Source: [16].

Thus, one of the main directions of the digital single market in Europe is to increase the intensity and concentration of e-commerce. Today, a comprehensive regulatory, legal, institutional, economic foundation has been formed for the digital integration of EU countries, active involvement in the field of e-commerce, both citizens and businesses. The single European digital policy is aimed at facilitating access to the e-commerce environment, intensifying cross-border supply, improving the system of consumer and personal data protection, improving information security, further innovation and IT development. Prospects for the development of e-commerce in Europe include strengthening the role of commerce through mobile applications, expanding the online payment system, expanding purchases on social networks, hyper-personalization of e-commerce and more. The importance of e-commerce as well as the digitalization process in general is due to the positive impact on the economy and the creation of conditions for sustainable development.

Questions for self-control:

1. What is e-commerce?
2. Indicate the advantages and disadvantages of e-commerce for market participants.
3. What are the main goals of e-commerce in building a model of the EU digital single market?
4. What are the components of e-commerce?
5. Identify the main regulations governing e-commerce in the EU.
6. What are the most common violations in the field of e-commerce?
7. Justify the directions of cooperation between EU countries to improve the mechanism of e-commerce.
8. What are the e-commerce business models? Describe them and give examples.
9. Analyze the trends of e-commerce in the EU on the basis of the statistics above.
10. Justify the promising areas of e-commerce in the EU.

3.3. Digital transformation of the economy and the European labor market

The world is undergoing great changes that radically change the functioning of the economy, and along with it many areas of human life. Continuous technological development is an important condition for companies to maintain their competitive advantage. Throughout history, representatives of various industries have always sought to meet the changing needs of consumers, which made inevitable continuous technological development. However, the most significant breakthrough in technology and the labor market occurred during the third and fourth industrial revolutions, when computer-controlled automation was replaced by digital transformation, when devices communicate autonomously along the value chain [17–19].

The digitalization process has created opportunities for new products, technologies and processes, taking the form of new challenges for employers and employees. Digital technologies and services are changing the rules of employment and the requirements of competencies and knowledge. Job transformation requires different skills requirements, leading to widening skills gaps and labor market mismatches. Under the influence of digitalization and globalization, the labor market expands the scope of employment, requires constant updating of knowledge and competences, high willingness to adapt to new conditions and the formation of new regulatory mechanisms of a new type of social and labor relations.

Studies show that continuous progress in digital and robotic technologies will eventually lead to the death of non-automated labor [18–19]. An analysis by the McKinsey Global Institute estimates that by 2030, at least one-third of occupations can be automated in 60 % of jobs. In addition, predictions for job places automation by 2040 are as follows: half of existing jobs in the United States and the United Kingdom, two-thirds of jobs in India and three-quarters of jobs in China may disappear.

Despite this dangerous perspective, automation and digitalization processes are accompanied by some specific qualities, such as relieving people of repetitive tasks, providing 24/7 accessibility, convenient and useful, eliminating risky work in dangerous situations, eliminating workflow inefficiencies and saving resources and increase productivity. At present, all this is the basis for further economic growth.

The current political agenda of the EU is based on the paradigm of the Fourth Industrial Revolution (national programs “Industry 4.0”, “Employment 4.0”, etc.), digitalization, the knowledge society and social inclusion. At the same time, EU policy is clearly focused on “human-centered” approaches developed by the

Global Commission on the Future of Labor, which provide for increased investment in the development of human skills and labor institutions, in decent and stable employment [21].

The meaning of the Fourth Industrial Revolution is complex automation and robotization of production, cyberphysical systems, biotechnology, 3D printing, alternative energy, artificial intelligence, network economy, augmented reality, circular economy, Internet of Things, blockchain technology, cloud computing, quantum technology. The use of such technologies has led to the digitalization of the real sector of the economy, changes in traditional business models, and increased employment on platforms. As a result, social and labor relations are being modernized in global and national societies, remote employment is spreading, “digital jobs” are being created, and a new category of labor market actors is emerging: the so-called “smart workers”.

The peculiarity of labor usage is flexibility, mobility, rapid updating of knowledge, change of subject-object relations of management, the development of creative self-realization in labor processes. According to some estimates, the share of the global information economy, including digital skills and digital capital, is 22,5 % of the global economy [23]. This poses serious challenges for all countries in the world without exception and is likely to lead to the degradation of inefficient, non-innovative economies that will not be able to meet these challenges. Therefore, national economies are faced with the need to ensure their own competitiveness and innovation, the ability to respond to the latest challenges of digitalization, to identify opportunities for transition to new technological systems.

The tendency to use the latest technologies in most sectors of the economy creates a transformation of all activities, including in the field of labor [24–26]. Automation, artificial intelligence and digitalization have far-reaching implications for the labor market [27]. All these processes lead to the creation of more goods and services with fewer jobs and higher productivity. However, the same processes can lead to the risk of technological unemployment or lower wages. At the same time, new technologies create "new employment opportunities in various industries and in emerging markets" [28].

Some researchers point out that in addition to the positive, well-known effects, new technologies and digitalization can increase inequality, increase job insecurity and threaten the availability of adequate employment opportunities [29].

Recent researches suggest that digital technology will reduce labor activity in the future [30]. However, the generally accepted view of the impact of digitalization on the labor market has not yet been reached. Thus, researches suggest that even with the automation of routine activities, it would be possible to maintain a long-term balance in the market, creating a large number of new jobs. In recent years, there has been a trend where more than 60 % of jobs in developing countries are being automated [31]. Therefore, understanding the relationship between digitalization, job loss and unemployment is becoming more important, as digitalization is positively correlated with the level of economic development.

The impact of digitalization on the labor market can also be considered in terms of recruitment. Researches show that recruitment and selection methods will be much more sophisticated, as sophisticated digital tools already exist for selecting and testing candidates, for team building, and for feedback [32]. Such a platform, used in a virtual environment, can significantly reduce the cost for small businesses that need specialized assistance, such as accounting or marketing assistance when launching a product. Moreover, digitalization is changing personnel strategies. Instead of the traditional training and development of staff within the company's organization, qualified specialists are now being recruited. Such a change in strategy does not require organizations to pay attention to the training of professional skills, which involves saving time and direct employment of those who already have the necessary skills and competencies [33]. In addition, new technologies and digitalization will affect the autonomy and redistribution of powers between professional groups [32], with implications for privacy and the ability to counter electronic monitoring and intrusive surveillance systems.

Digitalization has also changed the trajectory of job evolution in the public sector. In recent decades, developed countries have used digital technology as an advantage to provide public services and to restructure the public sector [34]. Digitalization also has a significant impact on all activities: education, tourism and services, the automotive industry, the transport system, which promotes innovation and productivity. Thus, the way of performing tasks specific to various works in the system of transport services in other areas has changed, as the use of the Internet involves increasing the speed and volume of information processing, facilitates statistical accounting (e.g., online taxis). In addition, the ability to collect data in real time allows you to analyze information quickly and facilitates management decisions.

Digitalization affects the demand for various Soft Skills, such as teamwork, communication skills and problem-solving skills [35]. According to a report by the World Economic Forum, a serious problem arises in this context: who will pay for retraining and how flexible skills for critical thinking and analysis, active learning, resilience, stress and flexibility will be developed [36].

The COVID-19 pandemic has significantly accelerated online work in many areas, and this fact itself has significantly changed the parameters of the labor market. The current context shows that any major changes quickly lead to a systematic rethinking of the entire labor market.

In the current pandemic crisis, digital knowledge has become important for both workers and businesses. Companies and organizations had to quickly create e-commerce websites, develop programs and platforms, transfer saturate document storage on cloud storage servers and make it faster and more accessible. However, the success of these operations largely depended on the level of digital skills of their employees.

At present, the functioning of the global and national economies must achieve balance and coherence based on the paradigms of digital, sustainable security. And in the context of the COVID-19 pandemic, this request is of particular importance and requires appropriate research in the methodological, strategic and tactical areas. The key principle of counteracting the negative consequences of the COVID-19 pandemic, in particular in the field of labor and employment, is the principle of "Build Back Better", without returning to the level they were before the COVID-19 crisis [37]. It has been established that digitalization processes directly affect the change of forms of employment and the range of professions in the labor market, for example, the spread of employment through online platforms, on demand through mobile applications and more.

The French Conseil d'Orientation pour l'Emploi (COE) states that at least 10 % of jobs in France are at risk due to digitalization, while half of the existing jobs are likely to change in terms of content and organization [38]. It has been widely demonstrated that manufacturers more often sell services in addition to their products to compete in increasingly tough global markets.

At the same time, the spread of digital technologies is displacing workers in some tasks or creating completely new jobs, transforming existing professions and industries. There is a wider use of networking and freelance platforms, as well as remote applications: Etsy allows millions of handmade manufacturers to sell their products to a global customer base, Uber allows individuals to provide transportation services and Airbnb – to provide accommodation services to homeowners. More advanced services also support digital technology: the Upwork online marketplace, for example, brings together about nine million freelancers in areas such as mobile development and software, with more than 3,6 million companies to perform individual tasks or assignments. Undoubtedly, the digital economy gives employees the opportunity to either completely switch to new ways of performing their professional duties, or to supplement the income from more traditional activities.

Technological progress also leads to the creation of new jobs (Table 3.9).

Table 3.9 – **Examples of new professions and new skills in the 21st century**

Profession	Description	Needed skills
Robotics engineers	Research, design, development or testing of robotic programs.	Critical thinking. Comprehensive problem solving. Quality control analysis.
Biostatistics	Development and application of bio statistical theory and methods for the study of life sciences.	Inductive thinking. Oral statement. Mathematical thinking.
Chief specialists in sustainable development	Communication and coordination with management, shareholders, customers and employees to address sustainability issues. Implementation or control of the corporate sustainability strategy.	Comprehensive problem solving. HR. Service orientation.
Engineers with nanosystems	Design, development or control of production of materials, devices or systems of unique molecular or macromolecular composition, applying the principles of nanoscale physics and electrical, chemical or biological engineering	Critical thinking. Science.
Videogames designers	The main features of video game design. Innovative game and role mechanics, storylines and biographies of characters. Creating and maintaining project documentation. Collaboration with production staff to create games by design.	Programming. Critical thinking. Comprehensive problem solving.
Wind energy engineers	Design of systems of underground or aboveground collectors of wind power plants. Preparation and development of site specifications.	Active learning. Comprehensive problem solving. System analysis.

Source: [38].

Table 3.9 provides examples of new occupations in the Professional Information Network (O*NET), which maintains an updated database of new jobs emerging in fast-growing sectors of the economy. Importantly, many of these professions are directly related to the emergence of new technologies, including distance learning coordinators, nanosystem engineers, and wind energy engineers.

Also, digitalization causes a change of place of work, i.e. the performance of duties by individual employees does not require a permanent stay at work, creating opportunities for permanent stay of the employee online, for a flexible work schedule. The concept of the workplace is changing. So, digital workplaces can be email, instant messaging, corporate social networking, virtual meeting tools, and more. At the same time, the requirements for technical equipment of workplaces are growing.

The digital workplace needs access devices (smartphones, tablets), communication, telecommunications in the workplace, including audio, video and web conferencing.

Fig. 3.1 highlights the flexibility that digitalization brings in terms of where, how and what activities are performed. This can have benefits for both employers and employees in terms of increased autonomy and productivity, improved work-life balance, and reduced costs. Flexibility also requires and can lead to new types of management and skills.

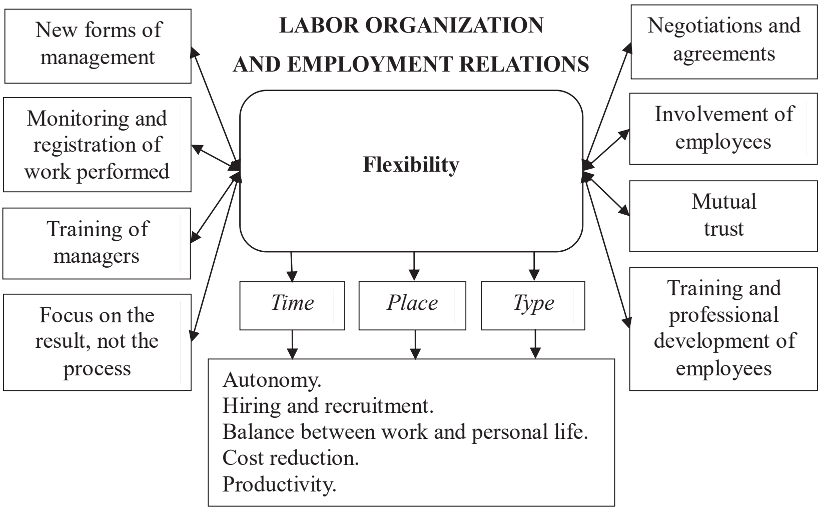

Fig. 3.1 – The structure of the impact of digitalization on work [26]

The introduction of digital technologies has created a new demand for digital skills, covering a wide range of abilities and competencies – from access to interfaces and basic manipulation of spreadsheets to advanced analytics and programming.

The last decade has advanced digital technology and digitalization to more sectors of the economy, not only in Europe but around the world. Competency and job surveys in Europe show that 43 % of EU workers have been involved in changing and/or replacing the technologies they have used in the workplace over the last five years. At the same time, 47 % of EU workers mentioned changes in current work patterns and processes, and more than half of workers in Ireland, Malta, Slovenia, Finland, Sweden and the UK said they were affected by digital changes in the work environment [39]. These changes have occurred, for example, in how products and services (product/service innovations) are made and how they interact with customers.

However, most of the changes in digitalization have taken place in the information and communication technology sector (in particular, 57 % of jobs have been affected by digital technologies). About a quarter of EU workers believe that their skills and use at work are unlikely to be relevant in the next five years. In addition, the share of workers in this situation varies depending on the sector of the economy in which they work: 29 % in the information and communication technology sector, 24 % in the financial and insurance sectors and 23 % in the professional, scientific and technical services sector. According to the same study, about 10 % of jobs in the EU are at very high risk of becoming obsolete due to digital skills of workers. The most affected EU countries are Estonia (23 %), Slovenia (21 %) and the Czech Republic (19 %) [39].

According to experts, structural changes in the labor market in Europe are closely linked to the very high demand for advanced digital skills in the coming years. There is a strong correlation between the projected number of jobs that will increase over the next ten years and the need for advanced digital skills to be applied. For example, 71 % of EU staff say they need basic and intermediate digital skills to do their job, and 14 % say they need advanced digital skills in the workplace. It has been found that more than 80 % of the EU workforce, including Denmark, Ireland and Sweden, requires basic digital skills to work, while in Greece, Cyprus and Romania this percentage is 60 % [39].

It is investigated that there are still differences in digital skills between EU member states. Thus, in 2017, the share of the population with digital skills above the base level was in Luxembourg (55 %), the Netherlands (48 %), Denmark (47 %), Sweden and the United Kingdom (46 % each) and Finland (45 %). Most EU citizens are positive about digital technologies and their impact on the economy (75 %), quality of life (67 %) and society (65 %). Countries that believe that digital technologies have a very positive impact on the economy are Malta (40 %), Lithuania (30 %), Germany, the Czech Republic, Slovenia, Cyprus (29 % in each country) and Bulgaria (28 %). It is noted that citizens with a higher level of education are more positive about the impact of digital technologies [40].

It is clear that digital skills are at the top of European politicians' agendas. In the "New Skills Agenda for Europe", the European Commission highlighted the steps that need to be taken to develop digital skills in Europe. Another important recent proposal is the Digital Skills and Jobs Coalition initiative, which aims to support people in career choices and training, improve skills forecasting, analyze skills needs and implement digital skills at all levels of education (in collaboration with a number of stakeholders, including national governments, social partners and educational institutions).

Over the last 10 years, the EU has launched a series of programs and policy initiatives aimed at stimulating the digitalization of economic, only to realize that the labor market lacks digital skills and competences. According to the European Commission, 44 % of Europeans do not have basic digital skills, 37 % of the workforce – farmers, bankers and factory workers – also do not have enough digital skills, despite the growing need for such skills in all jobs [39]. Accordingly, the European Commission has issued a number of policy documents, programs and actions aimed at improving the digital skills of the workforce.

In 2018, the Coalition of Digital Skills and Jobs launched the following initiatives:

1. The Digital Opportunity Internship Scheme is a pilot project under Horizon 2020 and Erasmus+ that provides students and recent graduates with

practical training in digital areas such as cybersecurity, artificial intelligence, coding or digital marketing.

2. The European Digital Skills Awards will celebrate initiatives that have improved the digital skills of Europeans at school, at work, for ICT professionals, for vulnerable groups and society at large. Thus, in the last decade, the digitalization of the economy has become a global trend, and even more significant over the past five years. Digitalization has changed the structure of the labor market, affecting employment and income distribution. In the coming years, digital literacy will become more widespread as information and communication technologies continue to transform the activities of European firms. Therefore, over the last decade, the European Union has launched many programs and initiatives to encourage people to acquire the digital skills needed for both social and professional life.

Questions for self-control:

1. How has digitalization changed the structure of the labor market?
2. Indicate the positive and negative effects of the digital revolution on European labor market.
3. Name the new forms of non-standard work, formed in the XXI century under the impact of active development of innovation processes and transformation economy.
4. How digital technologies and services are changing employment rules and competency and knowledge requirements?
5. List examples of new professions and new skills in the 21st century.
6. Give examples of the formation of a new demand for digital skills employees as a result of the digital technologies introduction.
7. What are the differences in digital skills between EU Member States still exist?

3.4. Integration of Ukraine into the European digital single market

In the conditions of formation and development of the post-industrial economic system, the issues of digitalization and a number of other information and digital processes acquire new significance for the national policy of economic development of Ukraine. The development of digital technologies is a fairly broad process and concerns many areas of modern life – from education and jobs to the social security system and the impact on public administration. Digital tools ensure transparency of power and reduce the impact of the human factor, promote economic growth, production and exports, by increasing the productivity of existing industries and creating fundamentally new areas of the digital economy with increased added value. Digitization also simplifies the conditions for business development, attracts investment and provides greater opportunities to meet the interests and protect the rights of consumers.

The EU Digital Single Market Strategy was proposed by the European Commission in 2015 in order to achieve synergies between EU countries in the field of new technologies, cross-border trade and the provision of services within the Digital Single Market. The strategy aims to enable Europe's economy, industry and society to reap the full benefits of the new digital age.

In autumn 2018, the Government of Ukraine prepared a Strategy for Ukraine's integration into the EU ECR ("road map") and an action plan for its implementation during 2018–2023, taking into account new EU acts. On October 4, 2019, the Verkhovna Rada of Ukraine approved the Program of Activities of the Cabinet of Ministers of Ukraine, the goals of which are to join the EU digital space and meet the criteria for membership in the European Union. At the level of the state apparatus, total digitalization of management and information exchange processes is planned. On October 6, 2020, the Ukrainian government identified a key sectoral vector of EU integration, noting the digital market as the most important and of high priority.

Ukraine's digital market is relatively new and requires a clear state regulatory policy on the activities of entities and facilities. The synthesis of the formation of a new digital market with an integration process allows Ukraine to implement the latest EU standards in the field of electronic communications immediately, which will provide many benefits when entering international markets, as it comprehensively provides mutual access to online markets and digital services, including Ukraine's accession to common rules, standards and procedures with the EU in the digital sphere.

It should be noted that this integration creates a complex effect, as it is also an essential tool for deepening the overall economic integration into the EU market.

Due to the standardization of the Ukrainian digital market to EU requirements and the creation of the Digital Single Market (DSM) we will get a ban on unjustified geoblocking practices, abolition of roaming charges, guarantees of net neutrality, cross-border parcel delivery, electronic identification and electronic trust services for electronic transactions, data and cybersecurity rules, copyright and related rights protection on the DSM, online consumer protection, requirements for contracts for the supply of digital content and digital services, measures to deploy high-speed electronic communications networks and a number of other benefits [41].

The economic benefits of the EU DSM are related to two main areas:

1) the benefits of the single market – regulatory harmonization and the removal of barriers between Member States in the digital sphere, the promotion of cross-border digital trade in the EU;

2) advantages of digitalization – further promotion of digitalization of EU countries, increasing the use of digital technologies in the EU, the development of public digital services and e-government [42].

Removing barriers for digital cross-border trade increases the overall efficiency of the EU's internal market for goods and services. The creation of the

DSM simplifies and reduces the cost of cross-border electronic transactions between Member States, improves cross-border access to online markets and new digital products and services for businesses and consumers. As a result, the benefits of the single market include lower prices, more choice of goods and services and improved convenience for consumers and businesses, and economies of scale.

In addition, the benefits of digitalization include increasing the productivity of the EU economy, optimizing business processes and reducing transaction costs for business, developing innovative products, services and processes, and increasing the EU's competitiveness [42].

The importance and prospects of the DSM for Ukraine is obvious, but the process of adaptation and accession to the union has its difficulties:

– convergence of regulatory and legal regulation;

– creation of market regulators that correspond to the best practices of EU member states;

– clear division of powers between Ukrainian regulators, if there are several in the field of electronic communications;

– identical and technically understandable regulation and standardization of the sphere.

Ukraine's integration into the EU digital market is possible provided that all these components are brought closer to European norms, rules and standards. Reform of the EU regulatory framework for electronic communications networks and services is a key step towards achieving a single European digital space and inclusive information society. Provisions describing the protection of the rights of end-users with disabilities have been significantly strengthened.

The process of Ukraine's integration into the DSM imposes a number of commitments to enhance the existing level of e-government, digital competition and network readiness. Today, according to the EGDI (e-Government Development Index) for 2020, Ukraine ranks 69th out of 193 countries (total score

0,7119) and is one of the countries with a high level of e-government development. Ukraine received the lowest scores for Telecommunications Infrastructure (0,5942), Public Online Services (0,6824), and the highest for Human Capital (0,8591) [43].

Examining the components of EGDI, it can be noted that this index is a weighted average normalized assessment of the three most important indicators of e-government, namely:

– human capital, expressed as a human capital index – Human Capital Index;

– quality and volume of online services – Online Service Index;

– Telecommunication Infrastructure Index [44].

Compared to the previous EGDI rating in 2018, Ukraine improved its position in 2020 (from 82nd to 69th place). Nevertheless, Ukraine is behind its neighboring EU member states, which belong to the group of countries with a very high level of e-government development (Poland, Hungary, Slovakia, Romania, Bulgaria, Latvia, Lithuania, etc.). In addition, many other neighboring countries are also ahead of Ukraine in the overall EGDI rankings: Turkey – 53rd, Georgia – 65th.

Analyzing the above data, it can be argued that in Ukraine a large part of the population can not fully enjoy all the opportunities and benefits of digitalization of the country due to insufficient development of the electronic services market. This, in turn, can be a brake on Ukraine's integration into the EU DSM, as the pace of innovation in the EU is quite high, so to achieve this level it is necessary to attract huge investments and revolutionize the development of Ukraine's digital market.

The Networked Readiness Index (NRI) assesses the development of countries' information and communication technologies based on 62 indicators [45].

The index includes 4 components: Technology (access, content, future technologies), People (citizen participation, business, government), Public administration (trust, regulatory conditions, inclusiveness) and Impact (economic, social and humanitarian impact of digital transformation).

In the NRI ranking in 2019, Ukraine ranked 67th out of 121 countries. Ukraine lags the most behind Future Technologies (82nd out of 121), Government ICT Use and Government Online Services (87th) and Regulatory Environment (72nd). And the highest positions were related to Content and Use of ICT by business. In the NRI ranking, EU countries occupy high positions (Poland – 37, Latvia – 39, Czech Republic – 30, Croatia – 44) [45].

Other neighboring countries are ahead of Ukraine (Turkey – 51) or occupy positions similar to the Ukrainian (Moldova – 66, Georgia – 68). The World Digital Competitiveness Ranking (WDCR) consists of three main components: Knowledge (measures the ability to understand and study new technologies) (digital skills, abilities, scientific developments), Technology (assesses the economic conditions for developing new digital innovations, including regulatory), (environment, access to capital, technological base) and Readiness for the future (assesses the readiness of business, citizens, the state for digital transformation, digital adaptability, mobility and e-participation).

In 2019, Ukraine ranked 60th out of 63 countries included in the WDCR ranking (lost 2 positions compared to 2018 – 58 position) [46].

Ukraine is behind the EU and other neighboring countries. In particular, Ukraine received the highest result in the Knowledge component (40th place out of 63 countries), while in terms of Technology and Readiness for the future it was at the end of the ranking (61st and 62nd place respectively). A review of international digital development rankings shows that Ukraine lags behind EU countries, including from the new EU member states, most of which have a lower level of digital development than the EU average.

In general, the new EU member states have shown more dynamic digital development in recent years compared to Ukraine. Accordingly, for the successful integration into the DSM it is necessary to involve as many institutions and investments as possible, as the effect will be complex and quite tangible from the economic point of view.

According to a study by the Center for International Trade Analysis Trade+ at the Kyiv School of Economics and the NGO "Ukrainian Center for European Policy" commissioned by the Ministry of Digital Transformation of Ukraine, the economic effect of integration into the EU DSM is quite significant.

Thus, according to the study, the gradual approximation of the regulatory environment and digital development of Ukraine to the EU level in the framework of integration into the EU Digital Single Market will affect bilateral trade between Ukraine and the EU: growth of exports from Ukraine to the EU – 11,8–17,0 % (2,4–3,4 billion USD), services – by 7,6–12,2 % (302,5–485,5 million USD).

It will also affect the productivity and economic growth of Ukraine: Ukraine's GDP growth – by 2,4–12,1 % (3,1–15,8 billion US dollars), welfare of citizens – by 3,6–7,8 % [47].

According to the calculations of the Trade+ Center for International Trade Analysis at the Kyiv School of Economics in partnership with the Ukrainian Center for European Policy commissioned by the Ministry of Digital Transformation of Ukraine and supported by the International Renaissance Foundation within the project "Calculation of Benefits from Ukraine's Integration into the EU DSM for Ukraine and the EU" it is noted that an increase in the digitalization of the Ukrainian economy and society by 1 % may lead to an increase in Ukraine's GDP by 0,42 %.

Accordingly, depending on the level of digitalization that Ukraine will gradually approach, the positive cumulative impact on Ukraine's GDP may amount to 2,4 to 12,1 % of additional growth throughout the approaching period.

That is, there is significant potential for economic growth in Ukraine in the case of increasing digitalization and productivity in various areas of the Ukrainian economy and society – including development of digital infrastructure and improvement of access to it, integration of digital technologies into business activities in all areas of economic activity, development of digital skills and competencies of citizens, e-government.

Bringing the regulatory environment and digital development of Ukraine closer to the EU level due to Ukraine's integration into the EU DSM can increase exports of services from Ukraine to EU countries by 7,6–12,2 %, and exports of goods – by 11,8–17,0 %. At the same time, exports of services from the EU to Ukraine may increase by 5,7–9,1 %, exports of goods from the EU to Ukraine – by 17,7–21,7 %. This is the potential for a cumulative increase in bilateral trade between Ukraine and the EU throughout the period of reforms to bring Ukraine's regulatory and digital rapprochement closer to the EU. It includes the effect of reducing the overall level of non-tariff restrictions and barriers in trade between Ukraine and the EU as a result of the digitalization of trade transactions and regulatory convergence with the EU in the digital sphere.

Ukraine will benefit from reduced trade costs in bilateral trade with the EU due to the reduction of digital regulatory barriers – the well-being of citizens may improve by 3,6–7,8 %. The impact on the well-being of EU citizens is much smaller than for Ukraine and is mostly positive [48].

Given all the features and prospects of Ukraine's integration into the EU DSM, it should be noted that the process of "merger" is methodologically and technically quite complex.

At the first stage, Ukraine needs to build the Data Economy, which is registered in the EU DSM. That is, you need to remove restrictions, such as location, that force service providers to build expensive local infrastructures (data centers) in each region or country. In addition to regulating the movement and protection of personal data, the DSM also regulates the free movement of non-personal data [49].

Free cross-border access to public and private sector data, scientific information, is seen as a catalyst for economic growth, innovation and digitalization in all sectors of the economy, especially for small and medium-sized businesses and startups, and for society as a whole.

The European Cloud Initiative covers 3 main areas of development: the European Open Science Cloud, High Performance Computing and the European Data Infrastructure. Big data, cloud services and the Internet of Things are key aspects for developing the EU's competitiveness.

In December 2018, in pursuance of the European Artificial Intelligence Strategy, the EC presented a coordinated plan to promote the development and use of AI in Europe, offering joint actions for closer and more effective cooperation in four key areas: increasing investment, accessing more data, empowering talent and ensuring trust.

The integration into the DSM of the EU envisages the formation of an inclusive electronic society and interoperability, standardization.

That is, there is a common understanding between Member States of the basic requirements for interoperability and compatibility, based on the European Interoperability Framework, according to which Ukraine should standardize with a focus on technologies and areas considered critical to the digital single market standards in such areas as health care (telemedicine, e-health), transport (travel planning, e-freight), former environment and energy.

An inclusive digital single market in which citizens and businesses have the necessary skills and can use interconnected and multilingual e-services: e-government, e-justice, e-health, "smart" energy supply or transport in Ukraine is gaining ground and practical use, special activation began in 2019–2021, developed a number of new multifunctional applications for citizens and businesses, creating a single portal of services, development of modern electronic methods of personal identification (such as Smart ID).

Ukraine also has significant achievements in the development of e-government, e-democracy and open data. In December 2018, an Administrative Arrangement was signed with the EU on cooperation in the field of e-government development. In particular, Ukraine has gained access to the EU's ISA² program, which oversees the development of common standards for the provision of electronic services. A number of new public digital initiatives and coalitions have been established, such as the E-Government Coalition, the E-Democracy Coalition and the Digital Transformation Coalition.

Questions for self-control:

1. What does the Strategy for Ukraine's Integration into the EU Digital Single Market envisage?
2. Indicate the main advantages of forming a digital single market for Ukraine.
3. Describe the directions of Ukraine's integration into the EU digital single market.
4. Describe the essence and components of the main indices of digital development of the country.
5. What does the development of the data economy consist in?
6. What is the European Cloud Initiative and what are the main directions of its development?
7. Explain the concept of an inclusive digital single market.
8. Identify trends in the formation of an inclusive electronic society in Ukraine.

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UDC 338.2

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Chapter 4
BLOCKCHAIN, INNOVATION MANAGEMENT AND DISRUPTIVE TECHNOLOGY

Content

4.1. Technologies that draw attention to blockchain

Digitalization and the introduction of modern technologies are radically transforming the existing principles and tools in the financial markets of the economies of most countries of the world. thanks to innovations, many operations that previously required personal presence and took a lot of time can now be available "in one click" and can be performed in a few minutes. And it is no secret that the most popular of these technologies is currently blockchain.

Let's start by recalling what blockchain is and why it has so many supporters among startups and investors. Blockchain is a distributed data registry (or database, if it is clearer), which are formed into blocks and recorded sequentially one after another using cryptographic encoding. This registry is distributed across multiple computers, and each copy is updated each time the blockchain changes.

Due to its distributed nature, blockchain has become interesting to specialists from the following areas of the traditional IT industry.

1. Rendering. You can render special effects for a new advertisement or movie on a processor or video card. The process requires a significant amount of time and power and can last for weeks. It is also well parallelized, because the video is made frame by frame, so each frame can be calculated by a separate machine.

2. Machine learning. Everyone has heard about neural networks. They help Google to find exactly what the user is looking for, and Tesla autopilots to arrive exactly where the owner wants. But these networks need to be trained. The process is long, by trial and error. Everything is calculated most quickly on video cards, because a video card has 2–3 thousand cores we need, and a regular processor usually has from 2 to 30 cores. That is, there are more cores in video cards, but they are small, but for machine learning just right.

3. Website hosting and data delivery networks. When you go to YouTube and watch a video in 99 % of cases, the video is downloaded for you not from distant America, but from a server in your city or from your provider. YouTube and similar sites keep copies of data (videos, movies) closer to viewers. This is called Content Delivery Network (CDN). And the equipment on the ground (people and miners) is perfect for this purpose.

4. Scientific computing. Scientific computing has traditionally been done on distributed systems (long before the advent of blockchain). Supercomputers used to do this work, but such centralized resources are few and expensive, and blockchain users' computers are often idle.

There are already several projects that bring these bold ideas to life, for example:

1. **Golem** *(https://www.golem.network)* – a platform, that is, a system that connects many computers into a network on an old insecure paradigm. Payment for power – for each calculation. Rendered one picture – paid one coin. That is, the cost does not depend on the speed of calculations – even an hour, even a minute, the main thing is that you do one unit of work – you get one coin. If you want to earn more – take more powerful hardware. Among the advantages: relatively simple architecture of task parallelization (for users). It is easy to check the integrity of hardware suppliers: if a node claims to have solved a task, it can be given to another node and the results can be compared.

2. **SONM** *(https://sonm.com)* – is IaaS (Infrastructure as a Service) – infrastructure as a service, a platform for cloud computing. The principle here is different: exclusive equipment rental. If you need to render something, you rent a powerful machine and can render or run a website there – anything. You pay an hourly or daily fixed price for the rented configuration. The system is suitable for running any programs without modification. But users need to parallelize the calculations themselves. Checking suppliers is more difficult because not everything can be simply repeated on another node and compared.

Also, the blockchain is a decentralized environment (at least to some extent), that is, there is no one node that would make decisions, all operations must be done with the consent of the majority of blockchain participants. But with a large number of participants, it can take a lot of time to make a decision. Therefore, to perform any action with the registry, in most modern blockchains, a certain condition is required – this is called consensus. There are many types of consensus, for example, it can be a complex mathematical calculation (Proof of Work – PoW). Without this consensus, no new blocks are created and no changes are made.

And one more feature of the blockchain. It is designed in such a way that the data in the block cannot be changed, and interference with the blocks is almost impossible. Even if information is recorded with an error, you will need to make another record, but with corrected data.

All this means that with the help of blockchain, companies can build trust in the veracity and security of information even in cases where there is little or no trust between the parties. Trust is the most important criterion that attracts investors to blockchain-related projects.

Of course, as a carrier of such features as distributed and decentralized, blockchain has attracted the attention of specialists from many industries. However, in the work of modern companies, in addition to storage (even if it is very reliable), there is a need to automate the processing of information received both from devices and by staff input.

To understand what exactly needs to be automated, consider the simplest example from real life – buying or selling goods.

In this diagram, we see that in order to simply record information about the purchase into the blockchain, several operations must first be performed:

1) accept the terms of the transaction (price, quantity of goods);

2) make inquiries on the Internet to find out whether the terms of the transaction are fulfilled (payment, delivery of goods);

3) process the results of the request (convert to another currency, etc.);

4) and finally, make a record in the blockchain.

Therefore, in the second generation of the blockchain, the ability to automatically perform some actions was implemented. For this purpose, support for so-called "smart contracts" was added to the blockchain. In the diagram, we can see that it is the smart contract that accepts the terms of the transaction, processes the results of the request and writes to the blockchain, but for security reasons, it does not have access to the outside world (to prevent attacks from the outside and reduce network downtime). Therefore, secure interaction of the blockchain with systems outside the network requires an additional piece of infrastructure, known as an "oracle", to connect the two environments. And the request to the internet is actually divided into two parts – from the smart contract to the oracle (2a) and from the oracle to the internet (2b).

Fig. 4.1 shows an example where a blockchain-based smart contract is used to monitor and execute a buy/sell transaction.

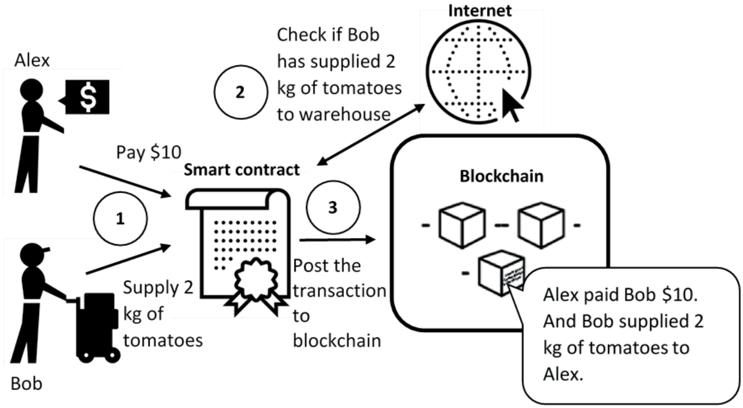

Fig. 4.1 – Scheme of how a smart contract works on the example of a simple purchase and sale transaction

Source: created by the authors.

When the buyer and supplier agree on a deal, they note that the money can only be transferred when the goods arrive at the warehouse. This condition is encoded into a smart contract, which is then embedded into the blockchain. Once all conditions are met, the transaction information will be added to the blockchain.

Now let's take a closer look at what a smart contract is and how it is used in blockchains. A smart contract is a computer algorithm designed to conclude and maintain contracts executed in a software environment. The main function of smart contracts is that they provide an opportunity to perform reliable and confidential transactions without the participation of external intermediaries represented by banks or government agencies. In addition, such transactions are traceable, transparent and irreversible. Smart contracts not only contain information about the obligations of the parties and sanctions for their violation, but also automatically ensure the fulfillment of all the terms of the contract.

The first ideas of smart contracts were proposed in 1994 by Nick Sabo. He described a smart contract as a computer protocol that, based on mathematical algorithms, independently conducts transactions with full control over their implementation. For the first time, Sabo's ideas were put into practice with the emergence of the first cryptocurrency Bitcoin and the underlying blockchain technology. However, most modern blockchains, including bitcoin, do not have the so-called "Turing completeness" (i.e. they do not have the ability to implement any computable function), so their "contracts" are relatively simple constructions, such as multi-signature or deferred execution transactions. Smart contracts became widely used with the emergence and development of the Ethereum project. The main network of which was launched by Vitalik Buterin in the summer of 2015. Ethereum includes Ethereum Virtual Machine (EVM) – a virtual computing environment that is responsible for the execution of smart contracts written using the Solidity programming language.

According to the degree of automation, smart contracts can be divided into three categories:

1) fully automated;

2) with a copy on paper;

3) contracts, most of which are on paper, and a small part in the form of program code.

Blockchain solutions are only at an early stage of development. The technologies are being tested and refined, so in practice, really complex smart contracts have hardly been used yet. To date, the vast majority of smart contracts belong to the third type, where only certain aspects of transactions are automated, in particular, the exchange of funds for property rights.

But supporters of smart contracts are convinced that many types of contractual relations can be partially or fully self-executing. And their main argument is that the cryptography underlying smart contracts provides a higher level of security than traditional contracts based on law. Smart contracts can also reduce transaction costs and eliminate the risks of ambiguous interpretations of terms or unfair court decisions. Thus, the main advantages of smart contracts include:

1) *autonomy* (there is no need to look for an intermediary, for example, a broker or a bank or a notary, to conclude and confirm the transaction);

2) *reliability* (the contract is stored in an encrypted form in the blockchain) and security, which is guaranteed by mathematical laws and makes hacker attacks and retroactive replacement of information unlikely;

3) *economy and speed* – thanks to the blockchain, many intermediaries are eliminated and processes are automated;

4) *accuracy* – due to automation and minimization of manual work, the likelihood of errors that often appear when filling out forms in the approval process and when manually conducting various operations under the contract is reduced.

But smart contracts are still far from ideal. Among their shortcomings is the imperfection of the blockchain infrastructure, in the code of which there are critical errors. In addition, there are many gaps in the legal regulation of smart contracts, and in some industries it does not exist at all. Also, the underdevelopment of blockchain oracles – programs that are designed to link the digital world to the real one and provide contracts with input data for their execution – has a negative impact. All this creates certain obstacles to the integration of smart contracts into the daily activities of organizations and individuals. In addition, smart contracts are often less flexible than conventional contracts. Also relevant are the problems of scaling and speed of execution of commands in smart contracts. Therefore, the efforts of many developers are aimed at solving these problems and limitations, and they are solved differently within different platforms.

For example, in September 2022, Ethereum made an update to switch from Proof-of-Work (PoW) consensus to Proof-of-Stake (PoS). The purpose of this upgrade is to make the blockchain platform more scalable, secure, and decentralized. This can be achieved due to the fact that after the transition of Ethereum to Proof-of-Stake, validators will replace miners in the network. To become an Ethereum validator, you need to make the so-called "staking" – that is, to deposit at least 32 ether (ETH) on the deposit contract (in other words, to block this amount on your wallet). And the system will start requesting confirmation of new transactions and accrue rewards for this. At the same time, the Proof-of-Stake algorithm assumes that the "weight" of the validator's vote depends on the number of coins deposited in the staking. As for the staking yield, as of September 2022, it is 4,0–4,5 %. It should be noted here that for supporters of the old principles of work, Ethereum has created a separate blockchain Ethereum Classic (ETC), which works on the Proof-of-Work consensus.

However, the use of Proof-of-Stake is not the only update in Ethereum. They are also introducing the ability to create subnets (this is called sharding) and the transition to a new virtual machine with support for multiple languages for smart contracts.

Previously, we have already mentioned the so-called blockchain oracles several times. Now it's time to take a closer look at it. We already know that most operations in decentralized applications are performed using smart contracts. But to work, they may need various data from external sources. For example, when exchanging one cryptocurrency for another, you need the exact rate of these cryptocurrencies. Therefore, only data from external sources (in particular, from platforms that aggregate trading data and prices from many exchanges) allow calculating the most "fair" price, as close to the market as possible. However, a smart contract is unable to receive information outside the blockchain in which it is deployed. This is where the oracles come to the rescue, which perform an intermediary function between the contract and the desired data source. Blockchain oracles are algorithms that usually run on the nodes of a particular blockchain.

Oracles are divided according to different criteria: the principle of operation, the sources of data received and their direction, as well as the form of organization. Let's look at the most popular types:

Software and hardware – the first take data from digital sources: databases, servers, cloud storages and broadcast it to the addressee in real time. Hardware collects data using physical devices: "smart" sensors, chips, barcode scanners, etc.

Input and output – oracles can have a specific specialization – either to transmit information or to receive from external sources. This may be necessary to increase reliability and solve the problem of single point of failure.

Centralized and decentralized. A centralized oracle is managed by a single operator who usually uses it in his application. This type of oracle was the first to appear, but due to problems with the vulnerability of such a system, the crypto industry gradually switched to the standard of decentralized blockchain oracles. These are systems that combine many oracles. A group of nodes is selected from it, each oracle of which performs its own part of the request. The first project that implemented the principle of decentralized blockchain oracles was Chainlink.

Today, oracles in the crypto industry are mainly used to transfer data flows, in particular price feeds, which are a table with a list of price values for different dates and their source. Feeds allow smart contracts to receive cryptocurrency quotes from centralized trading platforms and trading aggregators.

The recognized leader in the decentralized oracle market is Chainlink. Its ecosystem includes more than 1300 projects in the financial (DeFi), gaming (Game-Fi) and NFT sectors (more on NFT later). Chainlink does not have its own network: the project deploys nodes in different blockchains, applications in which it serves. Chainlink oracles work in Solana, Ethereum and EVM-compatible networks, including BNB Chain, Arbitrum, Optimism, Polygon, Avalanche and Fantom. We can also highlight Band Protocol, which has about 80 integrations. Unlike Chainlink, the project runs on its own BandChain blockchain, created using the Cosmos SDK. Band also develops tools for WebAssembly developers that allow creating oracles. BandChain is managed by a network of validators and works with applications on the Celo, Oasis and Cronos networks. The project's native coin is BAND.

Other major oracle providers are: Berry Data, Kylin Protocol and DIA.

Questions for self-control:

1. Basic concepts of blockchain
2. What is a smart contract?
3. How is a smart contract used in blockchains?
4. What are the disadvantages of smart contracts?

4.2. The main industries where blockchain is used related to smart contracts

Of course, the most common area of blockchain application is cryptocurrencies. We have a separate lecture dedicated to this topic, so now we will consider the use of smart contracts in cryptocurrencies. Earlier we have already noted that only simple smart contracts, such as multisignature or deferred execution transactions, are used in the cryptocurrency industry.

Multisignature is the simplest classic example of a smart contract. Access to money stored on a multi-signature wallet is possible only when two or more signatures are provided simultaneously. A simple analogy is a bank cell or safe with two locks and two keys. One key is kept by one customer and the other by the other. They can open the cell only if they present both keys at the same time. Separately, they cannot open the cell without the approval of the other. Multisignature is a type of signature implemented as a check of the conditions specified by the basic scripting language of the cryptocurrency. That is, it is supported by most cryptocurrencies.

The main types of multisignatures:

1-for-2: a joint account of two business partners – the signature of either party is enough to spend money.

2-of-2: a joint savings account of two business partners – both signatures are required to spend funds, which does not allow one of the account holders to spend funds without the approval of the other.

2-of-2: a wallet with two-factor authentication: one is stored in the computer, the other in the smartphone. Funds cannot be spent without the signature of both devices.

3-5: low trust donation address – each of the five trusted project participants keeps a private key. Three persons can spend funds, but anyone can transfer donations to the project address. This scheme reduces the risk of embezzlement, hacking, virus infection and loss of funds due to the fact that one participant loses interest in the project. The blockchain displays which private key was used in the final signature, which improves the possibility of accounting.

2-to-3: buyer-seller with escrow account that does not require trust – the buyer transfers money to a 2-to-3 address, the seller acts as a third arbitrator. If the transaction is successful, the buyer and seller both sign the transaction, returning the funds to the seller. If there is a failure, they can sign a transaction to refund the buyer. If they can't agree, both go to a third party who acts as an arbitrator and provides a second signature to whichever party they feel deserves it. The arbitrator cannot steal the funds as he has only one key.

2-of-3: a board of three trustees holds the funds of the company or organization – these funds cannot be spent without the consent of any two of the three trustees. For larger organizations, larger multi-signature transactions are possible – 3-5, 5-9, etc.

2-3: hot storage wallet for business. Bitcoin exchange stores one private key online, another private key as a paper backup. A separate cybersecurity company stores the third key online and signs transactions only after checking a number of factors (absence/presence in black and white lists, not exceeding the limit of the number of withdrawals for a certain period, two-factor authentication, compliance with regulatory standards, etc.) If an exchange or company's hot wallet is hacked, bitcoins cannot be stolen. If a cybersecurity company goes out of business, the exchange can access the funds in the form of a paper reserve.

2-of-3: decentralized cold storage unit – one of the keys is kept by the user in a safe at home, the second in a bank cell, and a copy of the third key is kept by a close friend of the user and his relative in his office. The home is protected from robbers, as spending money requires a visit to a friend, bank or office.

1 or 3 out of 4: distributed backup – the primary user can use the wallet at will, but if that owner loses their private keys, they can be recovered by three out of four other trusted friends/organizations. One key is stored in the bank cell, the other three are stored with friends. In case of death of the owner, the cell with the funds, according to his will, can be transferred to one of the trusted friends or to someone who can benefit from the help of trusted friends.

Next, we will talk about industries that are closely related to the concept of "token". So now let's look at what it is and how it is used in blockchain. A token is a unit of account used to represent the digital balance in a certain asset. Tokens are kept in a database based on blockchain technology, and access to them is carried out through special programs using electronic signature schemes.

As of now, there is no clear classification of tokens in the world, but usually tokens are divided into the following main types:

1. **Equity tokens, tokens-shares** – are needed to finance new startups and further build the network. They do not provide access to services, but offer to participate in the life and development of the platform.

2. **Utility tokens, appcoins** – reflect a certain value within the business model of the online platform. It can be reputation, points for certain actions, game currency, etc.

3. **Asset-backed tokens** – digital obligations for real goods or services (for

example, kilograms of carrots, an hour of work of a builder, etc.

But it should be understood that these are only basic types and each of them can contain dozens of other subtypes. For example, a “governance token” or a havernance token is a digital asset whose owners can participate in decision-making on the development of a blockchain project. What kind of token is it a variation of? Yes, that’s right – utilitarian.

And a few more words about tokens, or rather about tokenization. Tokenization is a process of transforming asset accounting and management, in which each asset is represented as a digital token. The essence of tokenization is to create digital analogues for real values in order to work with them quickly and safely. For example, the owner of a bakery creates an electronic accounting system in which he issues digital obligations for buns – tokens. Having a good enough reputation, the owner of the bakery can pre-sell buns by selling tokens on trading platforms on the Internet. In this case, any token holder can come to the bakery and exchange one token for one bun. By the way, what do you think this token belongs to? Yes, that’s right – this is an Asset-backed token.

If we talk about the degree of popularity, then the second place after the cryptocurrency should definitely be the so-called “Initial Coin Offering” or Initial Coin Offering (ICO). Also, instead of ICO, the term “crowdsale” is often used. What is it? ICO is a process during which the project team sells its digital tokens (coins) for cryptocurrencies or fiat money among investors. Later, these coins can be used on the project platform as an internal currency or traded on exchanges. By issuing its own tokens and exchanging them for popular cryptocurrencies (e.g. Bitcoin or Ethereum) or for fiat currencies (dollars or euros), the project raises the funding it needs to launch or develop. As a rule, ICOs are held in the early stages of the projects’ existence, before the creation of their full-fledged infrastructure. The funds raised go to finance the final stage of development, marketing or are directed to special development funds to support projects in the long term.

But it should be understood that currently ICO cannot be called both legal and illegal way to attract investments. Its legal status, procedure and requirements for companies that are going to raise funds in this way are currently not defined in any country in the world. In addition, it is difficult to determine the legal nature of the relations arising during the ICO. Since it is difficult to call such relations financial relations in their classical sense. At the same time, it is safe to say that this process is based on the reputation of the people behind the cryptocurrency startup and the trust of users (potential investors).

And what, in fact, attracts investors to ICOs? Firstly, it is the fact that by buying the tokens offered at the ICO, investors primarily expect to benefit from their sale at a higher price in the future. A classic example is Ethereum, whose tokens during the ICO in the summer of 2014 cost less than one cent, and at the end of September 2022 their price rose to almost $ 1270. In addition, investors have the opportunity to use tokens for their intended purpose, receiving services at a lower price.

But there are also risks – first of all, this is a common fraud, when the creators of the project have only one goal: to collect money from users. In addition, since there are currently no laws regulating cryptocurrency crowdsales, from the investor's point of view, this transaction is always based on trust. It cannot be ruled out that the project may not survive to the product stage or disappoint the investor with its implementation. In addition, in fact, many ICOs are fraudulent. A 2018 study based on public information and sources claims that almost 80 % of initial coin offerings (ICOs) are frauds, and only 8 % of ICOs can reach the trading stage on the various cryptocurrency exchanges.

Decentralized finance (DeFi) is a publicly available ecosystem of financial applications/services based on public blockchains, mainly Ethereum. The DeFi ecosystem covers all aspects of financial services and transactions, including lending, borrowing and trading within decentralized structures. Any Internet user can interact with the ecosystem and manage assets through peer-to-peer (P2P) networks, i.e. those that provide and decentralized applications (dApps).

decentralized finance can provide anyone with access to traditional financial services, eliminating the need for intermediaries and reducing entry barriers.

What are the key features and benefits of DeFi? First, it is of course decentralization and self-governance. There are no centralized management structures in DeFi: the rules of business operations are written in the smart contract. Once the smart contract is launched, the DeFi application can work independently with minimal or no human intervention.

Transparency. The source code of DeFi applications is open for audit, which allows any user to understand the functionality of the contract or detect errors in the code. All transaction activity is public – transactions are pseudo-anonymous by default. That is, a one-time violation of security measures (for example, buying cryptocurrency through a regular bank transfer) leads to the disclosure of the owner's identity.

Cross-border. Most DeFi applications are available to any Internet user. In addition, they are potentially useful both for residents of countries with unstable economies and in developed countries, especially in the field of lending, investing and developing new income models.

Inclusivity The DeFi ecosystem is inclusive – anyone can create an app and use it. Unlike the traditional financial sector, there are no controllers and accounts that require complex forms to be filled out. With the help of wallets, users interact directly with smart contracts.

Flexibility of user experience. If the user does not like the application interface, he can use a third-party interface or create his own. Because smart contracts have an open architecture, and therefore anyone can create applications for them.

Interoperability. New applications can be created by combining other DeFi products (stablecoins, decentralized exchanges, prediction markets, etc.). This feature of DeFi resembles a model within which a certain structure can be assembled in various combinations.

And one more point about – during 2021, the so-called DeFi 2.0 services began to appear. DeFi 2.0 is the second generation of decentralized finance, whose projects are aimed at solving the problems of the first version. This includes more efficient use of capital, liquidity stabilization mechanisms and long-term incentives for users.

And now let's discuss the use of blockchain in the field of accounting. It should be noted that as of now, this issue is still under study. And large organizations are just beginning to delve into how best to implement blockchain technology into their accounting infrastructure. In general, the use of blockchain in accounting comes down to its application within the so-called triple-entry method. The main content of this method is that when performing a monetary transaction, each of the two parties makes one record (two in total), as well as another record (the third) in an independent data storage. And blockchain has become such an independent (and, as we know, centralized and securely protected) storage.

At the moment, there are at least 4 blockchain projects related to triple-entry accounting: Abendum, Balanc3, Pacio and Request Network.

The sale and purchase of real estate is always associated with the need to involve intermediaries, lawyers, the state, banks, etc. A large number of participants in the process increases the risk of inefficiency and human error. And correcting each mistake in such cases requires not only time, but also financial losses. In some cases, it may happen that, for example, due to martial law or a natural disaster, the owner will not even be able to confirm his ownership. The use of blockchain technology can eliminate most of these shortcomings. Using smart contract technology, the seller and the buyer can agree on all the necessary conditions, and the contract is activated automatically. As soon as the buyer pays the agreed price, the blockchain will fix the property, and the subject of the contract will change the owner, which will become generally recognized. Smart contracts can contain elements of security deposits, which are automatically activated in case one party deviates from the contract. At the same time, all this can happen with incomparably lower costs than the costs associated with the classic processes of buying and selling.

And then some of the most successful examples of blockchain implementation in real estate. Let's start with a joint project of iNation and the International Blockchain Real Estate Association (IBREA), which teamed up in 2015 to create a global blockchain-based database of real estate owners and transactions.

In 2016, the Swedish cadastral chamber began to create a system that registers land ownership rights and records them in the public distribution register.

Something similar was planned to be done in Ukraine and on June 21, 2017, at a meeting of the Cabinet of Ministers of Ukraine, Resolution No. 688 was adopted on the transfer of the State Land Cadastre to the blockchain. However, in practice, only the procedure for checking the extract from the land cadastre was transferred to the blockchain. Cadastre administrators continue to store all data on land plots and transactions in the old electronic registry.

There are also ATLANT and Propy projects focused on creating blockchain platforms for buying and selling real estate using smart contracts. With their help, individuals and legal entities conclude transactions without intermediaries and guarantors.

In Ukraine, on September 25, 2017, for the first time in the world, an electronic transatlantic transaction was conducted under a real estate exchange agreement using a smart contract on the Ethereum blockchain. The American company purchased an apartment in Kyiv with the help of the startup Propy. At the same time, the seller, Kyiv and New York real estate magnate Mark Ginsburg, was in New York at the time of the transaction, and the representatives of the buyer's company and the seller (by power of attorney) were in Kyiv.

But in addition to simplifying the process of buying and selling real estate, blockchain can simplify the process of investing in real estate. We know that now such investments are available only to those who have a lot of free money – from $ 50 thousand. For particularly promising projects, the entry threshold is $ 200–500 thousand. But blockchain services are already being developed today, thanks to which developers can launch a separate ICO with their tokens for each new construction and sell them on financial markets. An investor will simply buy a token of an object located in another part of the world for $ 100 or $ 1000, and after the growth of the rate – sell it, as traders do with stocks, gold or currency in the financial markets.

You can already invest a small amount in real estate on platforms such as BRent, NEST, Slice, ATLANT and Propy. Their functionality is generally similar, the only difference is in the popularity and listing of objects available for investment.

NFT (an abbreviation of the English “non-fungible token”) are so-called irreplaceable tokens, which are certificates of ownership of various digital objects: texts, images, audio recordings, game items or characters, etc.

If cryptocurrencies are conditionally interchangeable – for example, one bitcoin in one user’s wallet is equal and identical to one bitcoin in another user’s wallet – then one NFT token representing a painting is not equal to another NFT token with the same painting by the same author, since they are objects of art and each of them may have a different value. Therefore, each NFT token is unique and exists in singular. Non-fungible tokens are unique – they cannot be copied. Each contains identifying information recorded in smart contracts.

Experiments with NFT began in 2013 with the emergence of solutions that made it possible to tokenize assets on the Bitcoin blockchain. Currently, the number of projects related to NFT is already more than 20. Most of them are art marketplaces. Such services are a kind of combination of auctions, galleries and release protocols. Some of them, for example, Nifty Gateway and SuperRare, invite creators with a high reputation to the platform themselves. Others, such as OpenSea and Rarible, are more versatile and allow creators to submit their works themselves.

Recently, a new type of indispensable tokens has appeared – **PFP** (Picture for Proof, literally "Picture for Proof") – images used as an "avatar". One of the first NFT/PFP projects was Bored Apes Yacht Club (BAYC), which was launched in April 2021 by Yuga Labs. This is a collection of 10,000 high-quality images of "bored monkeys" with an arbitrary combination of accessories – smoking pipes, necklaces, glasses, hats.

Among the characters are both ordinary primates and exotic ones – with golden skin, crowns, etc. (Fig. 4.2.).

Fig. 4.2 – Example NFT images from Yuga Labs

Initially, the company sold images for 0,08 ETH. In September 2021, the cheapest monkey already cost about 40 ETH. (Please calculate how much it is now in dollars.) In the same month, Sotheby's auction house sold a set of 107 monkey images for $ 24,4 million.

Questions for self-control:

1. How is blockchain technology used in accounting?
2. How is blockchain technology used in real estate transactions?
3. How is blockchain technology used in NFT?

4.3. Internet of things

Internet of things (IoT) is a concept of data transmission between physical objects ("things") equipped with built-in means (usually sensors for data collection) and technologies for interaction with each other or with the external environment. It is assumed that the organization of such networks can exclude the need for human participation from some actions and operations. There are already quite a few examples of the Internet of Things applications: from a smart home that automatically regulates heating and lighting to a smart factory that monitors industrial machines to find problems and then automatically adjusts to avoid failures.

The term "Internet of Things" was coined by entrepreneur Kevin Ashton, one of the founders of the Auto-ID center at MIT – Massachusetts Institute of Technology. Ashton was part of the team that discovered how to link objects to the Internet using RFID tags (those familiar metal labyrinth tags found on books and other goods that trigger an alarm if you take the item out without paying). He first used the phrase "Internet of Things" in a presentation in 1999, and since then it has become popular.

Now it is difficult to overestimate the importance of this technology, but another confirmation of this is that in the 2008 report of the US National Intelligence Council, the Internet of Things appears as one of the six disruptive technologies, that is, it refers to innovations that lead to the fact that old products become competitive. But, as always, despite the fact that the Internet of Things provides a number of benefits, it also has an important set of problems. Below are some of them:

1. **Security** – all IoT devices use the Internet to communicate or interact. The system provides little control despite any security measures and can be controlled by various types of network attacks.

2. **Privacy** – even without active user participation, the Internet of Things

system provides significant personal data with maximum detail.

3. **Centralized data** – all data is stored in a central data storage. If this server fails, the entire device will be impossible to control.

As we can see, all of these disadvantages can be leveled with the help of blockchain. But it is most widespread where the end user directly interacts with IoT devices. We remember that the blockchain, among other things, allows you to formalize agreements between counterparties directly, without intermediaries, right? Therefore, it is here that it came in handy as a means of formalizing relations through the conclusion of an agreement between the customer of the service and its supplier. These industries include: firstly, everything related to home automation (or as we call it – smart home), in addition to retail, medicine, transport, logistics, agriculture and the so-called sharing economy. And now let's talk about some of these industries in more detail.

"Smart house" or "home automation" is a system of home devices capable of performing actions and solving certain everyday tasks without human intervention. The most common examples of automatic actions in a "smart home" are automatic switching on and off of lights, automatic correction of the heating system or air conditioner, and automatic notification of home intrusion, as well as fire or water leakage.

Sensors used to implement smart home scenarios are divided into several main groups:

1. **Motion sensors** – most often used to automatically turn on the lights or trigger an alarm.

2. **Door and window opening sensors** – there are two parts, when opened, an alarm signal is sent to the hub (or in some cases directly to the central monitoring station of the security company).

3. **Leakage sensors** – they are located in places of probable leaks – in the bathroom, near sinks, washing machines, dishwashers, etc. When water gets on their contacts, an alarm signal is sent.

4. **Smoke detectors** – in new buildings of recent years, their use is mandatory for developers, so in a new apartment building such sensors will be superfluous.

Temperature, lighting, humidity sensors. Together with heating and humidifying devices, they allow maintaining a comfortable microclimate in the house or, for example, automatically watering flowers.

But sensors only record some change, and other devices react to it. The most common among them are:

– *smart sockets* – electrical sockets that are able to turn on or off the devices connected to it – fans, heaters, etc. at the user's command (or a signal from the sensor). They also allow you to measure electricity consumption.

– *electronic locks* – for locking and unlocking doors.

– *electric taps* – for closing and opening water in pipes.

– *electric drives* – for closing and opening gates, blinds, curtains, etc.

– *smart devices* – vacuum cleaners, air conditioners, washing machines, etc.

The popularity of this technology is growing every year. For example, the UK government has set a goal to replace all conventional sensors that measure electricity consumption with smart ones. And in 2022, this has already been achieved by 47 %. The Indian government wants to turn the country into one of the largest centers of smart homes and plans to build 500 smart cities. And in the United States in 2022, the number of households using home automation reaches 2 % of all households.

But as popularity grows, so does the risk of security breaches in these systems. Therefore, many companies have turned their attention to blockchain. So last year, Walmart (the world's largest wholesale and retail chain) published a patent describing the use of blockchain for secure smart home management. According to Walmart's concept, homeowners will be able to store information from connected devices in a blockchain-enabled database, where each device will be given a digital identifier. With the help of encrypted private keys, owners will be able to configure certain settings for devices and perform transactions in a secure network. Moreover, users will be able to dynamically change access levels and parameters for connected devices through a special management portal. By integrating their smart devices with the portal, they will control access from a distance via the Internet of Things. At the same time, this solution will store configuration information and change logs in a permanent, immutable blockchain database.

Next, and actually very close to the Internet of Things in the context of its practical use is the so-called “sharing economy”. In fact, this is just a familiar rental of premises, vehicles, etc., but there is also such a wording – it is an economic model defined as a peer-to-peer activity of providing shared access to goods and services, which is often facilitated by an online platform.

Why is blockchain very promising in the sharing economy? Firstly because blockchain-based smart home technologies are already being widely adopted by owners of rental properties. Secondly, the decentralized nature of blockchain networks allows sharing providers to connect more directly to users in a true peer-to-peer mode, i.e. without intermediaries at all. As a result, blockchain can make it cheaper to create and manage an online platform. For example, transactions can be performed automatically using smart contracts. Currently, those who use sharing platforms such as AirBnb, Uber and others have to pay a transaction fee to these platforms. By eliminating intermediaries from the sharing economy, blockchain will allow users to avoid the aforementioned fees.

In addition, given the still decentralized nature of the technology, blockchain solutions for the sharing economy can also be more secure. Traditional centralized solutions are more accessible to hackers and many of them have had cases of serious data breaches. For example, in 2017 Uber reported that in 2016 hackers accessed the personal information of 57 million passengers and drivers from its platform and the company paid $ 100,000 as ransom. Airbnb also faced several cases of data leakage. In such an incident, hackers hijacked the accounts of top-rated users and used them to book hosts' homes, which they then had to rob. In a blockchain-based exchange solution, hackers will never be able to access user accounts, let alone manipulate them to provide a false identity.

Blockchains also seek to eliminate fragmentation. Traditionally, users must register and download an app for each of the many sharing economy solutions they want. If there are five sharing economy companies in your area, for example, you would need to register with each company to access all of their services.

However, with blockchain-based solutions such as the ShareRing project, all services can be available on one platform and payments can be made through the same platform. This means that you don't need to register multiple times and even when traveling abroad, you don't have to worry about finding local sharing apps as the blockchain-driven approach will connect you to local sharing economy solutions. In addition, this application will allow users to pay for goods and services using tokens, effectively eliminating the need to carry cash or debit cards.

One of the most promising areas for the implementation of the Internet of Things is medicine. According to a study conducted by analysts from the Hewlett Packard Network Products Department, six out of ten global healthcare organizations are already using IoT devices. Due to this, several positive trends are observed at once:

– medical staff is becoming more mobile;

– the process of collecting, transmitting, analyzing patient data and making a diagnosis is accelerated;

– the efficiency of medical care is increasing.

The most common sensors of the Internet of Things used in medicine include the following:

1. Continuous glucose monitor (CGM) is a device that helps diabetics continuously monitor their blood glucose levels for several days by taking regular readings.

2. The Automated Device for Asthma Monitoring and Management

(ADAMM) is an intelligent asthma monitor worn on the patient's body and designed to detect the symptoms of an asthma attack before it starts. It vibrates to notify the wearer of an impending asthma attack and can also send a text message to a designated caregiver at the same time. This device can also detect and track inhaler use if the patient is unable to remember if they have used it.

3. Swallowable sensors. Proteus has created pills that dissolve in the stomach and produce a weak signal that is picked up by a sensor worn on the body. The data is then transmitted to a smartphone app, confirming that the patient has taken the medication as directed.

4. Intelligent contact lenses. In 2014, Google Life Sciences (now known as Verily, a subsidiary of Google's parent company Alphabet) announced that it would develop contact lenses that could measure glucose levels in tears and provide an early warning system for diabetics.

5. Coagulation sensors. In 2016, Roche launched a system that allows patients to check how fast clots are forming in their blood.

Blood pressure and heart rate monitors and blood oxygen saturation monitors. In addition to devices specially designed for this purpose, sports bracelets and smart watches with advanced sensors have recently become widespread. They allow not only to monitor the vital signs of the body, but also to diagnose some nervous diseases. For example, there is an Apple Watch app that tracks depression, and another one that allows you to monitor the symptoms of Parkinson's disease.

But a study published in March 2022 found that 75 % of medical infusomats contain one or more of 40 known software vulnerabilities or at least one of 70 known security flaws in IoT devices. Therefore, it is not surprising that many companies related to the Internet of Things and medicine have also turned their attention to blockchain. Thus, according to some estimates, in 2028, the total value of the global market for blockchain applications in the field of healthcare will reach 9,5 billion US dollars. Here are some of the leading companies that have successfully earned the best blockchain applications in healthcare.

Blockpharma is developing an anti-counterfeit drug application that helps control pharmaceuticals throughout the supply chain, from the production stage to the end customers.

Pokitdok – helps to collect information from IoT devices and other sources for users registered in the Dokchain service and uses blockchain technology to provide secure and decentralized access to patient information.

Blockpill monitors the active ingredients of medicines offered by different specialists so that their actions are not repeated. And when necessary, it offers alternatives.

As for agriculture, blockchain technology is being implemented in several areas, but the most massive of them are:

– smart agriculture;

– optimization of the food supply chain;

– electronic trade in agricultural products;

– crop insurance.

Smart agriculture. The Internet of Things has acquired a special role in agriculture in the context of the so-called “smart agriculture”. Smart agriculture is a concept that allows a plant or livestock to receive exactly the amount of fertilizer, water or medicine or feed that they need right now. The short scheme of this technology is as follows:

1. First, data on soil moisture or the content of microelements in the soil is collected using various sensors.

2. Then, based on the collected data, a field map is formed, which indicates in which part of the field how much fertilizer or insecticide should be applied.

3. And according to the resulting map, with the help of modern devices, the required amount of substances is applied exactly where it is needed.

Thus, the farmer will receive cost savings and more environmentally friendly products (which can also be earned now). But, although smart technologies have been available for agriculture for some time, the main challenge in applying this technology is related to the creation of a reliable and comprehensive security system for the proper management and use of the collected data. In the traditional smart technology management system, all mechanisms are usually centralized, which leads to various inaccuracies and distortions in data collection. Blockchain, on the other hand, helps to maintain data transparency and ensures that all figures are preserved. The decentralization offered by blockchain is definitely its biggest advantage when it comes to smart agriculture. Therefore, companies are now emerging that offer their customers to connect smart agriculture and blockchain. An example of this is Filament, a brand that offers devices that can connect various networks to physical objects using smart agriculture technology. The company has developed coin-sized hardware to help people perform secure transactions on the blockchain.

Optimization of the food supply chain. Providing information about the origin of food products is essential to ensure customer loyalty and trust. Blockchain can essentially make any fruit or vegetable as safe to buy as the one grown on a local farm nearby. With traditional supply chains, food retailers have no effective way to ensure that all products are grown under the conditions specified by a given supplier. This is why retail giants such as Walmart, Unilever, and Carrefour are already using blockchain to trace the origin of food products. In addition, the time required to trace the origin of food is significantly reduced. For example, it took Walmart almost a week to track the origin of their mangoes. Thanks to blockchain, this time is reduced to only 2 seconds. If a product does not meet a retailer’s standards, limiting the time it takes to trace the source of a product is crucial as it allows retailers to isolate that product faster, minimizing the risk of harm to people. For example, Ripe is a startup developing a transparent blockchain-based digital food supply chain that stores data on product quality.

Electronic trade in agricultural products. Blockchain in agriculture is uniquely positioned to help not only simplify transaction processes, but also level the playing field for small farmers and large crop producers, especially those from poor regions. An estimated $ 940 billion worth of food is wasted globally each year. This is partly due to the fact that farmers and producers from less developed countries do not always have access to large markets, so they are unable to sell all of their produce. AgUnity is one of the blockchain startups that addresses this problem by giving small players access to their own blockchain-based platform to trade agricultural products and build trust between market participants. Their product allows individual market participants to create small cooperatives and work together.

Crop insurance. In agriculture, smart contracts have a unique application in the form of helping farmers insure their crops and claim damages from insurance companies. This is usually a very slow and cumbersome process for both the producer and the company that insures them. Due to unpredictable weather anomalies, it is difficult to correctly assess and quickly report the exact losses they cause. This leaves room for fraud and turns the process into an operational nightmare. By establishing individual blockchain smart contracts, a claim for damages can be triggered by changes in weather conditions that meet certain criteria, making the process easier for farmers and insurers. An example of such companies is Etherisc, a blockchain startup that offers crop insurance to farmers through its decentralized insurance programs.

To summarize the topic of blockchain in agriculture, it should be noted that in 2023, the size of blockchain innovations in the agricultural market is expected to grow to 430 million USD, which is an impressive 47,8 % annual growth rate compared to 41 million USD in 2017. Therefore, we can already conclude that blockchain is changing the way of doing business in the industry, reducing the risk of fraud, increasing the speed of transactions, helping farmers to monitor and analyze crops and much more.

Earlier we talked about the first transatlantic real estate transaction, but this is not the only example. In 2018, a voting system was tested in the NEM blockchain test environment (28 nodes) in Ukraine. According to the experiment, the estimated cost of posting election results in the context of each polling station in the public NEM blockchain will be 8765 XEM = $ 1227. It is believed that this is a small fee for lifelong storage of socially important data.

In June 2022, Ukraine received observer status within the European Blockchain Partnership (EBP). This status makes it possible to use blockchain technologies to provide cross-border public services.

According to the leading blockchain analytical company Chainalysis, Ukraine ranked third in the ranking of the global index of crypto assets use in 2022.

Questions for self-control:

1. How is blockchain technology used in smart home management?
2. What is the sharing economy?
3. Identify the pros and cons of using centralized and decentralized blockchain solutions.

4.4. Cryptocurrency exchanges

A cryptocurrency exchange is a place where you can exchange regular, fiat money (dollars, hryvnias and euros) for cryptocurrency and back. Or sell one cryptocurrency for another.

Here a question may arise: What is the difference between an exchange and an exchanger? First of all, when you buy cryptocurrency in an exchanger, you do it directly from the exchanger and get a fixed rate that the exchanger sets daily.

And on a cryptocurrency exchange you:

– buy cryptocurrency from other users, like on a marketplace;

– you see all the offers to buy/sell from other users (this, by the way, is called a “glass”);

– you can set the price for the purchase or sale of cryptocurrency yourself – your application will get into the “glass” and the transaction will take place when a counter offer is found.

If we draw an analogy with modern online trading, we can say that the exchanger is an online store, and the exchange is a marketplace.

Exchangers earn on the difference in rates plus commissions. They buy cryptocurrency on different platforms a little cheaper, then sell it a little more expensive.

The main income of the exchange is the commission from transactions. And the trades themselves and the inflow of cryptocurrencies are provided by traders. The exchange of currencies takes place between them, the exchange appears as an intermediary.

What else can you do on a crypto exchange besides currency exchange? Almost every self-respecting exchange has additional ways to earn money on cryptocurrency. For example, in a bank you can not only keep money and change currency, but also open a bank deposit.

The cryptocurrency world has its own earning tools, they are part of the world of DeFi – decentralized finance, that is, cryptocurrency.

On exchanges you can:

– keep fiat money and crypto on deposit and receive interest for it;

– lend money secured by cryptocurrency and receive interest for it.

Earn on arbitrage: trade on different exchanges and earn on the difference in rates. Deposit, transfer, withdraw to different wallets and bank accounts.

Exchanges mainly differ in one parameter – centralization. There are three types of crypto exchanges:

– traditional or centralized (CEX);

– decentralized (DEX);

– peer-to-peer (P2P).

How do centralized crypto exchanges differ from decentralized ones? The main difference is where users' cryptocurrency is stored. In a centralized exchange, all users' money is stored on the exchange. Such an exchange has access to your money – with all the risks and possible bonuses.

A centralized exchange is similar to a regular bank: if you want to buy dollars from a bank, you first deposit money into a bank account and only then convert them into dollars. Then you take them from the bank through the cash desk or ATM.

To start trading on a centralized exchange, you need to replenish your deposit, and then you can start trading. You can replenish your account on centralized exchanges by transferring from card to card, PayPal or in cash at the offices of the exchange.

The main advantage of a centralized exchange is that you can come there with fiat (real) money, for example, hryvnia, and buy cryptocurrency for it. In decentralized exchanges, only cryptocurrency can be exchanged.

You cannot trade anonymously on centralized exchanges. All centralized exchanges require KYC – passport verification, when you send them photos of the document and a selfie with it. This is how exchanges protect themselves from "dirty" cryptocurrencies that have been involved in the trade of illegal substances and even worse.

But KYC has its advantages – with a passport you can restore access to your wallet if you have lost your password. In any other wallets, the loss of the password and passphrase means that the money is gone forever.

Centralized exchanges are the easiest to use, so many beginners choose them. Examples of centralized exchanges:

– Binance (American);

– CoinBase (American);

– WhiteBit (Lithuanian with Ukrainian roots).

There are two types of commissions (and both are unavoidable):

1. *Network fee* – this is the commission of the blockchain network itself for executing a transaction. It always exists, for any cryptocurrency, for any wallet. All transactions in the blockchain are performed by miners (their devices literally record who transferred coins to whom) and this commission is your payment to the miner for burning electricity and performing your transaction.

2. *Service commission* – and this is the commission that each service (exchange, exchanger) bites off for itself and which you can influence by choosing an exchange with more favorable conditions.

What exchanges take money for:

– trading commissions – for cryptocurrency exchange;

– deposit replenishment fees;

– fees for withdrawing funds.

Advantages of a centralized cryptocurrency exchange:

– you can trade cryptocurrencies of different blockchains: for example, sell Bitcoin for USDT;

– you can work with fiat (hryvnia, dollars, euros);

– it is convenient to engage in arbitrage – a large spread of buy and sell offers at different prices;

– accrue interest on the storage of money in the accounts of the exchange;

– additional ways to earn money: for example, borrowing cryptocurrencies;

– there is technical support;

– you can restore the password by passport if you have lost the password.

Cons of a centralized cryptocurrency exchange:

1. If you store cryptocurrency on the exchange, then the exchange has access to your money. Exit – do not keep large amounts on the exchange wallet, use the exchange for trading.

2. Some exchanges have very high commissions. Way out – do not choose a greedy one.

3. Will have to upload your passport.

4. Brief description of the decentralized exchange.

5. Carries out crypto exchange between users without storing funds on their wallets. The exchange is managed by a smart contact – a special program in the blockchain that ensures the transaction and its reliability.

6. Works only for cryptocurrency, fiat funds (hryvnias, dollars, euros) are not suitable here.

7. A decentralized exchange does not require a deposit – you connect your crypto wallet and exchange with other users directly.

Continuing the analogy with a bank and buying foreign currency: if a centralized crypto exchange is a bank, then a decentralized one is an algorithm that combines a system of smart safes. Imagine that every home would have a smart safe that would store different currencies. And after pressing one button, part of your dollars would change to hryvnias – the exchange would take place directly between you and the owner of another safe. This is approximately how a decentralized crypto exchange works: using an algorithm, it instantly changes two cryptocurrencies in two user wallets.

The arrangement of smart contracts for the exchange of crypto between wallets allows you to change currency only within one blockchain network. This means that you can change Bitcoin to Ethereum because they operate on different blockchains. Most decentralized exchanges work on the Ethereum blockchain.

Conclusion: in order to start using a decentralized exchange, you will one way or another first have to go to either a centralized exchange or an exchanger to buy some cryptocurrency.

Pros of a decentralized cryptocurrency exchange:

1) your coins are stored with you: the exchange takes place directly between two wallets;

2) decentralized network is safer;

3) no human factor – everything is controlled by smart contracts;

4) you can trade anonymously.

Minsuis of a decentralized cryptocurrency exchange: on such an exchange, you cannot exchange cryptocurrencies from different blockchain networks – for example, you cannot exchange bitcoin for ether; if you forget your password and passphrase – no one will help you; the user interface may not be as intuitive as that of centralized exchanges; there is no technical support; there are only thematic communities where people in their free time can help you deal with the problem; you cannot enter with fiat money.

Separately, we can distinguish platforms for peer-to-peer (p2p) transactions. What distinguishes such platforms from a full-fledged crypto exchange is that there is no regulation on them – neither the company that provides the platform nor smart contracts guarantee the reliability of the transaction.

A bot for p2p crypto exchange is similar to the telegram chats that have recently emerged to sell dollars at the market price: it simply connects you with someone who is ready to sell or buy the specified cryptocurrency at a certain cost. And you make the deal yourself.

Trading is the purchase and sale of financial assets (instruments) on the stock exchange. Of course, any trade is impossible without analyzing the situation. As for trading on exchanges, such analysis is called Technical Analysis.

There are many indicators on the basis of which crypto traders develop their own strategies. Most of them are quite complex, but there are also effective strategies that have gained great popularity due to their simplicity. Further, we will talk about such strategies, which will be easy to understand for a beginner, but at the same time they will help in trading.

Technical indicators reflect real market indicators and help to determine key support/resistance levels, overbought/oversold, trend direction and much more. With the help of indicators, crypto traders can find optimal entry points into the market and receive signals to buy and sell cryptocurrency with a certain accuracy. Based on the indicators, traders create their own strategies. As a rule, the indicators used are combined for more accurate signals so that the trader can see a more comprehensive picture of what is happening in the market. This eliminates unnecessary noise and allows you to get the necessary information faster and better.

As a rule, crypto exchange terminals contain pre-configured basic indicators that a trader can use in his trading, such as SMA (Slippery Averages), MACD, Volume and others. For example, Binance charts have 3 moving averages with different periods and a Volume indicator. MA indicators smooth out price fluctuations and calculate average price values, allowing you to understand in which direction the trend is currently directed. And the Volume indicator reflects the current market activity: how much buyers (bulls) or sellers (bears) prevail.

Traders can add, remove and customize the indicators they need according to their individual trading preferences. But for beginners, the standard settings will be enough – they are recommended by the creators of these indicators and are often used by professional traders. As you gain experience, you will learn to adjust the parameters for yourself. Next, we will look at popular trading strategies and explain how to use them in crypto trading.

Scalping is not the easiest strategy for beginner crypto traders, but with proper risk management, it can bring good results. The essence of scalping is to make many transactions during the day to make a small profit of up to several percent. However, cryptocurrencies are highly volatile assets, and their price can change by 10–50 % or more during one day. But this carries increased risks for traders, especially beginners.

Therefore, it is important for a trader to determine at least two key parameters: support/resistance levels and trend direction. With the help of support and resistance levels, a trader can determine at what moments it is best to open/close positions. When the price bounces from the lower boundary, it is a buy signal, and a bounce from the upper boundary is a sell signal.

Special attention should be paid to moving averages. The MA crossing can indicate both local and global trend changes. The Volume indicator will additionally help to form a picture of the market and indicate bearish and bullish divergence. For example, if the indicator shows red, but it is green on the chart, it indicates that the strength of the bears is running out and the price is preparing for a breakout.

Since it is necessary to determine the direction of the trend and key support and resistance levels, trend indicators as well as volume indicators are suitable for trading: SMA, MACD, Parabolic SAR, RSI, Volume.

The trend can change at any moment and it is impossible to predict it. Therefore, it is important to make sure that trend indicators keep their direction.

Binance and many other popular platforms use charts of the popular tradingview.com service. To add an indicator to the chart, you need to click on it with the right mouse button and start entering the indicator name in the field. Then select the desired indicator in the list.

Another popular strategy among beginner traders is trend trading. In this case, you need to determine in which direction the price is moving at a given time. Trends can be local and global. Global trends are suitable for medium and long-term trading.

How to understand that the trend is uptrend? During an uptrend, the price moves in a staircase in a narrow channel and may slightly go beyond it. And, as a rule, each local minimum is higher than the previous one. The same is true for local highs.

So, when you have determined that the trend is directed upwards, it is necessary to identify key support and resistance levels – we will start from them. Accordingly, the support zone is suitable for opening long positions, and the resistance zone – for closing.

As you can see in the picture, the price of the cryptocurrency fluctuates in a narrow corridor. And local lows and highs are higher than the previous ones (in the screenshot, the lows are marked with white horizontal lines).

In a downtrend, a breakout of the resistance level will be a signal to start trading. However, sometimes the breakout can be false. If the price after the breakout quickly retraced and returned to the initial position, it may indicate a false breakout. At this time, it is better to wait until the trend is clearly revealed. We will talk more about the strategy based on the breakout of levels in the next paragraph of the article.

What indicators to use? Since the strategy under consideration involves trading on the trend, it is logical to use trend indicators:

– MA (SMA, EMA, etc.);

– Stochastic RSI;

– MACD.

This strategy is used when a new trend has not yet formed, but the breakout of a key level may indicate its change. For a certain period of time, the price may bounce from support and resistance levels for a long time.

But sooner or later, the market forces prevail in the other direction: the price cannot move only in one direction. When the rate grows significantly, the buyers weaken and the bears are actively involved in the game. The opposite is also true.

How to determine that the trend may change? When approaching this moment, the price amplitude begins to decrease, that is, the price is in sideways movement or flat. The beginning of an uptrend can be indicated by the breakdown of the resistance level. Before that, sellers "push" the price closer and closer to the resistance level.

One of the characteristic signs of a trend change can be observed when the resistance level practically does not change, and the support level approaches it, closing the chart in the form of a wedge. At some point, the resistance level is broken and the price starts to grow, indicating the emergence of a new uptrend. It is important that the price does not immediately roll back to the previous level – this phenomenon is called a false breakout.

How to trade? There is no need to hurry and open a position immediately after the price has broken above the resistance level. It is necessary that the condition is fulfilled: the newly formed support level must provide not lower than the previous resistance level. In this case, you can open a long and then trade the trend.

What indicators to use? Again, trend indicators are suitable here. But in addition to them, it is better to use momentum and volume indicators. The list of suitable indicators for the strategy for the breakout of key levels:

– MA (SMA, EMA, etc.);

– RSI;

– Parabolic SAR;

– Volume.

MACD (moving average convergence/divergence) is one of the most popular and simplest indicators in trading. It is the simplicity of its use that has caused such popularity of the indicator.

How to trade? The signal to buy cryptocurrency will be the crossing of the fast and slow MA lines below the zero level of the MACD. In this case, the fast moving average should cross the slow MA from the bottom up – this is what signals a price reversal to growth.

Accordingly, a sell signal will be the crossing of the slow MA from top to bottom. It is not necessary that this crossing is above the zero level of MACD.

What indicators to use? As we wrote earlier, two basic indicators with standard settings are enough for this strategy:

– MA (part of the MACD);

– MACD.

Not all trading strategies can be based on indicators, although they may imply their use as an additional tool. In periods of high volatility on the crypto market, there is often a difference between the quotes of different exchanges and in different trading pairs. The difference between quotes can reach 5 % or more.

Types of cryptocurrency arbitrage. There are two main types of crypto arbitration:

– inter-exchange;

– intra-exchange.

Inter-exchange arbitrage works like this:

1. Buy cryptocurrency on the first platform at a lower price.

2. Transfer coins to the second crypto exchange.

3. Sell at a higher price.

In this case, you need to calculate commissions when withdrawing cryptocurrency from the exchange and for the exchange. In addition, there are still risks that the cryptocurrency rate will change dramatically during a period of high volatility, and you will not only lose profits, but also suffer losses. This is especially true for cryptocurrencies such as Bitcoin and Ethereum: their blockchains have expensive and slow transactions that can take up to an hour or more. During this time, the rate can change a lot.

Intra-exchange arbitrage involves using an intermediate trading pair within the same exchange. The rate in different pairs can also vary greatly. An example of intra-exchange arbitrage:

1) exchanging BTC for ETH;

2) buying LTC for ETH;

3) selling LTC for BTC.

It turns out a kind of triangle. And here the profit is made with the help of the price spread. As a rule, the higher the liquidity, the lower the spread. But pairs such as LTC/ETH or BTC/LTC are less liquid, so the spread can be much higher, which opens up good opportunities for crypto arbitrage. But with lower liquidity, orders can take longer to execute – this is the main risk of intra-exchange arbitrage.

These are just some of the trading strategies used by beginners. There are many equally popular trading strategies based on Bollinger Band, Fibonacci levels, Parabolic SAR and other well-known indicators.

If you want to learn more about trading, trading strategies and new promising directions, then subscribe to the official resources of Top Traders Academy.

Cryptocurrency lending is a lending process involving digital money. Individuals (creditors) can give their crypto-savings to other persons (crypto-exchanges, other enterprises) who need them at the moment. The loan is made at a certain interest rate, and there is also the nature of debt amortization (mainly depends on how long it will take to return the money and how the interest payment is structured).

For the lender, such activity has only advantages – his cryptocurrency is not just in the wallet, but works and brings passive income. Cryptocurrency landing is usually associated with margin trading lending and investments in landing programs. In the first type of lending, the lender lends the borrower money for margin trading and receives a certain percentage for their use.

The borrower provides his funds as collateral at the moment when he believes that the price of the coin will definitely move in a certain direction; this will allow him to increase the efficiency of trading. He borrows additional funds through an exchange that supports margin trading and undertakes to return them with interest after a certain amount of time. Secondly, the lender subscribes to an available landing page and receives interest on the deposit. The annual interest rate depends on the cryptocurrency used.

There are five main types of cryptocurrency lending on the market now:

1. Margin lending on exchanges The most common type. This is secured lending, in which traders borrow money on the exchange from other traders, hoping that the price of cryptocurrency will rise or fall in the near future. The option is not suitable for beginner traders, as it also increases the level of risk. But experienced ones actively use it. Cryptocurrency is usually provided as collateral; interest and limits vary from platform to platform. Margin lending is available on many major exchanges.

2. Bitcoin loans for collateral. This is a type of lending where a person can get direct peer-to-peer loans in Bitcoin using other assets as collateral. This type

of service differs from margin lending in details; in particular, it has fixed interest rates. Individuals set up their own loan offers with the desired interest rates and collateral at their own discretion. Borrowers research the market, find a suitable offer and respond to it. An example of such a service is BTCPOP, which has been operating since 2014.

3. Hybrid loans based on fiat and Bitcoin. These are loans that you take in fiat and return to BTC. The borrower gives, for example, US dollars, receives Bitcoins; If the price of Bitcoin rises during the loan period, he will need to return less, since the debt is calculated in fiat. This type of landing is used to minimize risks and those who hold cryptocurrency, but temporarily want to transfer part of it to fiat. One of the well-known platforms offering such services is the German Bitbond, a regulated microcredit marketplace operating in USD and EUR-backed zones. Requires mandatory proof of identity.

4. Cryptocurrency loans based on reputation. These loans work on the principle that lenders issue loans based on the personal reputation of borrowers. You can build a reputation in different ways – having a large amount of collateral, or a positive repayment history (both on the platform used and on some other platform, for example, eBay. A similar method is used on the already mentioned BTCPOP.

5. Fiat loans with cryptocurrency as collateral Allow individuals to give their BTC as collateral to obtain a loan in fiat funds, perhaps the most popular service of this kind is SALT, it uses its own cryptocurrency, SALT tokens, they are purchased for one of five cryptocurrencies or two stablecoins, and then in return. you can get fiat.

Advantages and disadvantages of cryptocurrency landing pages:

1. Pros:

– the possibility of cryptocurrency earnings on free funds held as investments;

– many platforms allow you to choose an investment plan or customize the investment criteria to get the maximum benefit with your financial capabilities;

– for developers, landing pages can be a good way to promote little-known tokens;

– it is often more profitable than using traditional bank deposits. The average yield on landing per year can be about 10–12 %.

Landing is also popular because you can lend not only cryptocurrencies but also fiat funds.

2. Cons:

– a small selection of offers;

– there are limits on deposits;

– many fraudulent sites that simply close without returning funds to users.

In the case of landing, the guarantor for the lender is the exchange, which provides loan servicing, monitors the timely liquidation of traders' positions so that the lenders' funds remain safe. In the history of crypto trading, due to technical aspects, there have been cases of loss of funds used for margin collateral, but since the reputation of exchanges is extremely important, and a massive outflow of users will immediately affect the earnings of the exchange itself, such losses have always been reimbursed at least over time.

Yield farming is the process of obtaining additional profit (usually in the form of control tokens) by users of DeFi protocols for granting or receiving loans, as well as for providing liquidity to decentralized exchanges (DEX).

The first successful project in the field of farming is considered to be a decentralized derivatives platform. Synthetix, but the boom in profitable farming began after the launch of the Compound protocol control token (COMP). With the help of its distribution, the project attracted many liquidity providers and the price of the token increased significantly. Almost immediately, other projects followed Compound's example.

Types of earnings on profitable farming. Earnings on interest through borrowing funds. Both receiving and granting a loan involve placing the participant's funds in a liquidity pool either as collateral or as a deposit. The farmer registers with the project that issues loans and transfers the funds to another user who applies for a loan subject to further payment of interest. The farmer's income is the bonus tokens received along with the loan interest.

The liquidity pool is a smart contract on decentralized exchanges (DEX) based on automated market making (AMM) technology. During trading, the ratio of tokens in the pool changes, as well as the price of tokens. For example, a user purchases 100 ETH using the ETH/USDT pool. The volume of USDT in the pool increases, and the volume of ETH decreases. At the same time, the price of ETH increases.

The liquidity-providing participant receives two types of coins: lucrative LP tokens, which serve as a share and confirmation that liquidity has been provided to the pool and are "burned" in the blockchain when liquidity is withdrawn; and bonus tokens of DEX or DeFi protocols, which are rewards for activity.

The pool can incentivize participants to provide more liquidity on a particular asset through an increased reward in bonus tokens. The pool's profit commission is distributed in proportion to the funds that participants place.

The farmers sell the bonus tokens on the exchange in exchange for the underlying liquidity, which is again supplied to the specific pool and the participants are again awarded bonus tokens. Such manipulations take place as long as they remain profitable, overlapping trading commissions and fees of the Ethereum network.

How to calculate the profit from profitable farming? Profit from profitable farming is calculated in the form of annual interest, like in a bank. The most common metrics are the annual percentage rate (APR) and the annual percentage yield (APY). The difference between them is that APR does not take into account the accrual of compound interest. In this case, the accrual of compound interest means direct reinvestment of income in order to obtain greater profit.

What are the risks associated with profitable farming? Among the main risks associated with pharming are errors and vulnerabilities in smart contracts, fraud, token crash due to inflated profitability or economic insolvency of the project as a whole. Smart contracts. In the DeFi sector, many protocols are developed by small teams with a limited budget, which increases the risk of bugs and vulnerabilities in the code. High fees in Ethereum, which can make pharming operations unprofitable.

Withdrawal of funds from liquidity pools. Any user of the DeFi platform can withdraw their liquidity from the market, except for those scenarios when it is blocked by a third party mechanism. In addition, in most cases, developers manage large amounts of underlying assets and can dump these tokens on the market.

AMMs operate on the basis of constant token value functions in liquidity pools. Due to price changes in external markets, quotes in AMMs may diverge from them, which is used by arbitrageurs. At withdrawal, liquidity providers may receive fewer tokens due to the risk of volatile losses.

Questions for self-control:

1. Applications for medical use with blockchain technology.
2. The use of blockchain technologies in the concept of smart agriculture. Optimizing the food supply chain using blockchain technology.
3. Use of blockchain technologies in electronic trade of agricultural products and crop insurance.

4.5. Ecosystems of cryptocurrency exchanges

Binance is an ecosystem that includes a centralized cryptocurrency exchange with the world’s largest trading volume, the BNB Chain blockchain platform, a training center, investment and charitable funds, an NFT marketplace and other products.

The first and main product of Binance is the cryptocurrency exchange, which began operating in 2017. It offers various tools: spot trading in digital assets and leveraged transactions, derivatives, a section for P2P exchange. In addition, users have access to the possibility of passive earnings on cryptocurrencies through staking and farming, the function of issuing a debit card and other services.

According to the official website, as of April 2022, Binance supports more than 600 crypto assets and more than 40 fiat currencies. The platform has 90 million registered users.

Binance does not disclose financial data. However, according to various estimates, its revenue in 2021 ranged from $ 14,6 billion to $ 20 billion. According to media reports, in 2021, the company's own valuation was $ 200 billion. The exact number of Binance employees is also unknown, but at the beginning of 2022, the project's CEO Changpeng Zhao said that the remote staff of employees numbered about 4000 people.

The founder of Binance – Changpeng Zhao was born in the Chinese city of Jiangsu, then moved with his parents to Canada, where he graduated from McGill University. After graduation, he completed an internship at the Tokyo Stock Exchange, where he developed software for high-frequency trading. Then he worked for Bloomberg for several years. In 2005, Zhao founded his first company, which was engaged in the development of high-frequency trading algorithms. In 2017, Zhao founded Binance and since then has served as its CEO and is its largest shareholder. In 2022, Changpeng Zhao became the leader of the ranking of the richest representatives of the blockchain industry, compiled by Forbes. The publication estimated his fortune at $ 65 billion.

An interesting feature of Binance is that it guarantees users a refund in case of large-scale hacking of the exchange. For this purpose, in 2018, the company opened a special fund called Secure Asset Fund for Users (SAFU). In particular, the stolen cryptocurrencies worth $ 40 million were compensated from it in 2019.

SAFU receives a share of the commissions paid by users. According to official data, as of the end of January 2022, the size of the fund was $1 billion. The fund is kept in BNB, BUSD and BTC.

At the end of 2021, Binance launched a $ 1 billion fund to support BNB Chain. The developers intend to bring the total number of users of applications based on this blockchain to 1 billion people.

The main products of the Binance ecosystem are:

1. PancakeSwap is a decentralized exchange (DEX) that operates on the basis of an automatic market-making mechanism. Ranks third in terms of trading volume among DEX.

2. Venus is a protocol for creating decentralized markets and issuing tokens and algorithmic stablecoins.

3. Era7: Game of Truth – a tactical strategy using NFT cards.

4. Cream – a landing protocol with the ability to borrow tokens issued in the BNB Chain.

5. Biswap – a decentralized exchange.

6. BNB is a native coin of the Binance ecosystem. It is in the TOP-10 by capitalization. Works in the BNB Chain network.

The main ways to use BNB:

– discounts on trading fees for transactions in Binance;

– payment of commissions for transactions in BNB Chain;

– staking;

– payment for services and goods in some services and online stores;

– participation in tokensales on Binance Launchpad;

– payments with Binance Visa Card;

– using liquidity pools and decentralized protocols on the BNB Chain;

– donations to Binance Charity.

BNB Chain is an EVM-compatible blockchain launched by Binance in 2019. In February 2022, it became a single blockchain platform after the merger of BNB

Beacon Chain (formerly Binance Chain) and BNB Smart Chain (formerly Binance Smart Chain). BNB Chain works on the Proof-of-Staked_Authority consensus algorithm and is focused on the operation of decentralized applications with a large number of users. The main directions of the network development are decentralized finance (DeFi), non-fungible tokens (NFT), games on the blockchain (GameFi) and meta universes (MetaFi).

Binance USD (BUSD) is a stablecoin project founded by Binance and the American company Paxos. The asset price is pegged to the US dollar in a 1:1 percentage ratio. BUSD ranks fourth in terms of capitalization among stablecoins. It works in the BNB Chain and Ethereum network.

The stability of the BUSD price is provided by dollar reserves on the account of a special company operating in the United States. It is regulated by the New York State Department of Finance and is audited monthly. The amount of reserves corresponds to the number of Binance USD stablecoins in circulation.

In addition to the crypto exchange, the Binance ecosystem includes the following products:

1. Binance Labs is a business incubator designed to support entrepreneurs, projects and communities in developing blockchain startups using the BNB Chain. Currently, there are more than 120 projects in the Binance Labs portfolio.

2. Binance Academy is a training portal with a database of educational articles and videos about digital asset trading, blockchain technologies, projects and companies.

3. Binance Charity Foundation – a non-profit charitable organization that implements a number of charitable programs in the field of poverty alleviation.

4. Binance Launchpad – an exclusive platform for tokensales. Among the major projects that have been launched on Binance Launchpad are: Axie Infinity, The Sandbox and Celer Network.

5. Binance Research is a cryptocurrency market research and analysis department that releases research and provides professional data.

6. Binance NFT is a trading platform that features all kinds of digital artwork and collectibles.

7. Binance Card is a cryptocurrency debit card of Visa system.

8. Binance Pay is a cross-border cryptocurrency transfer service.

9. Binance has also acquired several crypto projects that continued to operate, while maintaining their brand and autonomy.

10. CoinMarketCap – the most visited aggregator of data on trading in digital assets.

11. Trust Wallet – a cryptocurrency wallet with support for a large number of digital assets.

12. WazirX is the largest crypto exchange in India.

Uniswap is a decentralized protocol for trading cryptocurrencies based on smart contracts, which operates on the Ethereum network and is one of the top five DeFi applications in terms of blocked funds. Uniswap was the first project to implement an automated market maker and liquidity pools.

The author of the Uniswap protocol is Hayden Adams. In the summer of 2017, he resigned from Siemens, where he worked as a mechanical engineer after graduating from college. On the advice of his friend Karl Flersch, who was then working at the Ethereum Foundation, Adams began to learn how to develop smart contracts.

A few months later, Carl suggested that Adams create an application for trading digital assets that would use the Automated Market Maker (AMM) mechanism.

The idea of AMM on Ethereum was first proposed by the developer of the Gnosis project Alan Liu. His colleague Martin Koppleman passed the concept on to Vitalik Buterin, who publicized it on Reddit in 2016 and on his personal blog.

In August 2018, Adams received a $ 100,000 grant from the Ethereum Foundation to implement the concept.

In the creation of Uniswap, Adams was assisted by Microsoft and Google developer Kallil Capuozzo, programmers Uchiel Wilchis, Philip Dayan, Dan Robinson, Andy Milenius and others.

By March 2018, the developers presented a demo version of Uniswap. On November 2, 2018, the full version of the protocol was launched. Presenting Uniswap, Adams listed its main characteristics: “There is no central token or platform fee. No special treatment for early investors, users or developers. The token listing is free. All smart contract features are open, they can be improved”.

Adams originally wanted to name the protocol Unipeg – a derivative of the words Unicorn and Pegasus. When Karl Flersch first told Vitalik Buterin about the project, he said: “Nipeg? Uniswap sounds better”. Adams agreed with the proposal.

How does Uniswap work? The Uniswap protocol includes a series of smart contracts that allow any user to trade directly with each other on the Ethereum blockchain. Technically, it is a decentralized exchange (DEX).

Uniswap is a publicly available tool that distributes rewards among liquidity providers. Providers support the exchange by locking tokens, which allows other users to trade in a decentralized system.

The platform does not require registration and KYC and AML procedures. To use it, you only need a browser wallet with support for the Ethereum network, such as MetaMask.

Since Uniswap is a decentralized project, it does not have an administration that selects new cryptocurrencies for listing, as on centralized exchanges. Anyone can add a new ERC-20 asset on Uniswap.

To do this, you need to open a liquidity pool – a separate market for a particular trading pair. To open a pool for a new token, you need several new tokens, as well as the base currency of the ERC-20 standard for the same amount.

Uniswap does not connect sellers and buyers to set the price of digital assets, but uses the equation: $x \times y = k$. In the equation, x and y represent the number of tokens available in the liquidity pool; k is a constant value.

Based on the balance between the tokens in the pair, as well as between supply and demand, the equation calculates the price of a particular token. This pricing and quoting mechanism is called an automated market maker (AMM).

Each token has its own smart contract and at least one liquidity pool. Any Uniswap user can trade this coin or deposit funds into the liquidity pool, receiving a reward from the fees.

Each time new tokens are added to the Uniswap liquidity pool, the user receives an ERC-20 pool token (LP). Pool tokens can be exchanged, moved and used in other decentralized applications.

When the funds become in demand, the pool tokens are burned. Each such token represents the user's share of the total pool assets. It also allows the holder to receive a proportional share of the exchange fees that the pool collects.

Uniswap v2. In April 2019, the project team raised more than $ 1 million in an investment round led by Paradigm Investment Company. These funds were used to create the second version of Uniswap (Uniswap v2) with a number of new features.

If in the first version of the protocol, a new asset could only be placed in a pair with ETH, then in Uniswap V2, any ERC-20 token can be placed in a pool with any other asset of this standard. In the main contracts, Wrapped Ether (WETH) is used instead of ETH, although end users can use ETH through ancillary contracts.

If two ERC-20 tokens do not form a direct pair and do not have a common pair with each other, their swap is possible as long as there is a path between them. Router Contracts are used to optimize direct and multi-step swaps.

Improved control of quotes.

Uniswap v2 provides improved control of quotes through the use of oracles. Instant swaps. Instant swaps provide the ability to withdraw any number of coins to make, for example, arbitrage and margin trading operations.

What is UNI token? UNI is a governance token designed to participate in the

Uniswap governance system, in particular for voting. The project authors suddenly announced its release in September 2020.

They decided to distribute tokens in an unusual way. Instead of a tokensale, the project team decided to conduct an airdrop: they credited a fixed amount of UNI to each user of the decentralized exchange who has ever performed any actions on it.

Immediately after the issue, the value of Uniswap (UNI) increased several times, and it entered the TOP 50 cryptocurrencies by capitalization. According to CoinMarketCap, in early May 2022, the total capitalization of this digital asset exceeds $ 7 billion, traded on all leading cryptocurrency exchanges.

Development of Uniswap.

As of the beginning of May 2022, Uniswap remains one of the main DeFi projects: it ranks fifth in the DeFi Pulse ranking in terms of blocked funds with an indicator of $ 7 billion.

In December 2020, Uniswap managed to gather a quorum to make the first decision. Community members approved a grant program for the development of the ecosystem using UNI tokens.

In May 2021, exactly a year after the presentation of the second version, the third version of the decentralized exchange – Uniswap v3 – was launched. It provides radically new features and components, including concentrated liquidity, limit range orders and multiple positions within one pool.

Shortly thereafter, Uniswap users supported the launch of the Ethereum network protocol of the second-tier Arbitrum solution. In July of the same year, the decentralized exchange launched an alpha version of the platform on the main network Optimistic Ethereum. At the end of the same year, Uniswap was deployed on the Polygon network.

Under pressure from regulators in the summer of 2021, Uniswap stopped trading 129 tokens in its interface due to the “evolving regulatory landscape”. Since April 2022, the exchange has been blocking users who are under sanctions.

In the spring of 2022, the project team launched Uniswap Labs Ventures, a venture capital arm to invest in Web3 products.

Uniswap v3. What distinguishes the new version of Uniswap from the previous one is the emphasis on capital efficiency made through the concept of concentrated liquidity. Liquidity providers (LPs) are now able to choose a specific price range for providing funds to the pool.

This will allow market participants to concentrate liquidity where most trading activity takes place. As a result, LPs can increase the return on capital by allocating free funds to other pools and investment instruments. This approach allows for better risk diversification.

Uniswap v3 also introduces the concept of active liquidity. If the price moves out of the LP's assigned range, liquidity is effectively removed from the pool, ceasing to generate commission income.

When this happens, the liquidity flows entirely into one of the assets in the pool. At this point, the LP can either wait for the price to return to a given range or change the price range to a more relevant one.

Uniswap has also introduced a new order type – Range Limit Orders. It allows LPs to allocate tokens of the same type to a certain range above or below the current market price. When the price enters the range specified by the user, one asset is sold for the other. When using this feature within a narrow range, you can achieve an effect similar to using a standard limit order.

Also with the new release, multiple positions have appeared in the protocol: LPs can provide liquidity to the same pool according to different price ranges, which may overlap with each other.

Uniswap v3 provides for a three-tier structure of liquidity provider fees with rates of 0,05 %, 0,3 % and 1 % per transaction. The company expects that commissions of 0,05% will be used mainly for pairs with stablecoins. The 0,3 % tariff will be used in pools like ETH/DAI, and 1 % – for trading much more volatile pairs with low-liquid assets.

Questions for self-control:

1. Do you know about examples of the application of blockchain technologies in your country?
2. Is there a regulatory basis for the use of blockchain technology in your country?
3. What are the prospects for using blockchain technology in 10 years?

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UDC 004.330.1

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Chapter 5
DIGITAL PERFORMANCE IN BUSINESS AND ECONOMICS

Content

5.1. Digital efficiency and its importance for business and economy

The development of information and computer technology (ICT) is characterized by rapid technical progress, which has rapidly reduced the prices of ICT products, ensuring that the technology can be applied in all sectors of the economy at a low level of costs. In many cases, falling prices caused by advances in technology and the demand for constant innovation have influenced many of the key technologies that have fuelled the growth of the digital economy.

The digital economy has given rise to several new business models. Although many of these models have parallels in traditional business, modern advances in ICT have allowed business to grow on a much larger scale and spread over greater distances than was previously possible. Some of these business models can complement each other, and in some cases combine with each other (for example, payment for services can be combined with e-commerce or cloud computing). While innovation in the digital economy is fuelling the rapid development of new business models, it can also rapidly render existing companies obsolete.

Business models of the digital economy

Electronic commerce. Electronic commerce or e-commerce in a broad sense is defined by the OECD Working Group as "the sale or purchase of goods or services carried out over computer networks by methods specially designed for the purpose of receiving or placing an order. <…> An e-commerce transaction can be between businesses, households, individuals, governments, and other public or private entities".

E-commerce can be used either to facilitate the ordering of goods or services, which are then delivered through conventional channels (indirect e-commerce), or to complete ordering and delivery electronically (direct e-commerce). Although e-commerce covers a wide range of businesses, in general, several types can be distinguished among them:

1. B2B (business-to-business) models. Most of the e-commerce consists of transactions in which a business sells goods or services to another business (the so-called business-to-business (B2B) model). This may include online versions of traditional operations in which a wholesaler buys lots of goods over the Internet and then sells to consumers from retail outlets. It may also include providing goods or services to support other businesses, among them:

– logistic services (transportation, storage and distribution);

– application services (deployment, placement and management of software from a central facility);

– outsourcing services (e-commerce support functions, web hosting, cyber security, supervision);

– services of performing auction operations in real time via the Internet;

– website content management services;

– services for providing online shopping opportunities.

2. B2C (business-to-consumer) models. Business-to-consumer (B2C) models are among the oldest forms of e-commerce. A business operating in a B2C business model sells goods or services to individuals. B2C models fall into several categories, including:

– "pureplay" providers on the Internet (without physical stores or offline presence);

– "clicks-and-mortar" businesses that have added online sales to their existing business, and manufacturers that use their online business to allow customers to order directly.

The goods or services sold by the B2C company can be tangible (for example, CDs with music) or intangible (that is, received by consumers in an electronic format). With the digitization of information, including text, sound and visual images, an increasing number of goods and services can be delivered digitally to customers who are increasingly distant from the seller. B2C e-commerce can dramatically shorten supply chains in many cases, eliminating the need for many wholesalers, distributors, retailers and other intermediaries to use traditional material flows. In this case, intermediation of B2C business usually involves large investments in advertising and customer service, as well as in logistics. B2C reduces operational costs (especially search costs) by increasing consumer access to information.

It also lowers barriers to entry, as the cost of maintaining a website is generally lower than running a traditional retail store.

3. C2C (consumer-to-consumer) models. Consumer-to-consumer (C2C) transactions are becoming more common. C2C e-commerce businesses act as intermediaries that help individual consumers sell or lease their assets (such as residential real estate, cars, motorcycles, etc.) by publishing their information on a website and facilitating transactions. These enterprises can charge the consumer of these services. This type of e-commerce exists in several forms, in particular:

– auctions organized on the portal, which allows for online bidding on items for sale;

– single-level systems that allow file exchange between users;

– ad portals that offer an interactive network on the Internet for negotiations between buyers and sellers.

The Internet facilitates operations such as ordering goods and services. This means that many operations that took place without the Internet can be carried out more efficiently and at lower costs. In addition, the Internet has expanded the scope of activities of small and medium-sized businesses, giving them the opportunity to enter markets where they would not have been able to enter without the Internet. As a result, the number of firms carrying out business operations has increased dramatically over the last decade.

Payment services. Payment for online transactions traditionally requires the transfer of certain funds, such as through a bank account or credit card. Accordingly, making a transaction requires information about the supplier and a high level of trust in him. This is not always possible in the case of an unknown supplier, especially in the case of C2C transactions. Online payment service providers help solve this problem by providing a secure way to make payments online without requiring the exchange of financial information between transaction parties.

A payment service provider acts as an intermediary (typically using a software-as-a-service model) between online buyers and sellers, accepting payments from buyers using various payment methods, including credit card payments or real-time bank payments, processing those payments, and depositing funds into an account seller.

Electronic payment systems have a number of advantages for users:

– protection against fraud, as the seller and the buyer do not exchange confidential information;

– faster payment delivery compared to traditional payment methods;

– in many cases, the ability to perform transactions in several currencies.

Payment service providers usually charge a fee for each completed transaction, which can be either a flat fee or a percentage of the transaction value, although some payment service providers also charge monthly fees or set-up fees for certain additional services.

However, several other alternative payment options are also used on the Internet, including:

1) ***solutions for cash settlements*** – the customer makes purchases online and pays in cash using a barcode or payment code at participating stores. Used when merchants offer a payment method that customers do not want to use online to make online purchases, but want to pay in a safe place and in a secure way;

2) ***electronic wallets or cyber wallets*** **–** is an alternative to using a credit card. They are often used for micropayments because it is not economically viable to use credit cards for frequent small payments;

3) ***solutions for mobile payments*** **–** cover all types of technologies that enable payment using a mobile phone or smartphone, in particular, mobile card data processing using connected smartphone card readers, in-app payment for virtual products and on-site, short-range wireless technologies for information exchange.

The digital economy has also spawned virtual currencies, discussed earlier, that can be used to buy goods and services from businesses that agree to accept them, as an alternative to paying for the service.

Application stores. The growth of Internet access via smartphones and tablets has increased and led to an increase in the use of online services and the development of app stores – digital distribution platforms for software that is often provided as a component of the operating system. Application stores typically take the form of centralized platforms accessible through a consumer's device through which the consumer can browse information and reviews about software products, purchase, automatically download, and install the application on their device.

The availability of software stores changes. Some app stores are only available to consumers with certain devices. These stores may represent the only way for users of this device to obtain applications. There are stores available to consumers of any device using a certain operating system. Others may be used by consumers with service contracts with a specific mobile network. Finally, some others are freely available and do not depend on the type of device, proprietary software or service provider.

Applications can be downloaded for free or for a fee. Free apps may be ad-supported. In addition, there are applications that move to the "freemium" model, in which the basic functionality is provided for free, but customers can pay for additional content or features. Typically, an app store hosts apps created by developers in multiple countries. Additionally, many app stores target customers in specific geographic markets. However, there is often a cross listing of apps in multiple stores targeting multiple geographies. The use of app stores continues to grow rapidly.

Advertising on the Internet. Online advertising uses the Internet as a means of targeting and delivering marketing messages to customers. Internet advertising offers a few advantages over traditional advertising. For example, many online advertisers have developed sophisticated consumer segmentation techniques that allow more precise targeting of ads. Many online advertisers have also developed ways for clients to track ad performance by observing how users interact with their brands and learning what current and potential customers are interested in. Advertising on the Internet comes in many forms, but mainly this:

– display ads, in which the advertiser pays to display ads related to certain content or user behaviour;

– search engine ads, in which the advertiser pays to appear in Internet search results.

Internet advertising covers a number of players including:

– web publishers who agree to integrate advertising into their online content in exchange for compensation;

– advertisers who produce advertisements for display on content and ad networks;

– web publisher intermediaries that connect web publishers with advertisers to reach online audiences.

Ad network intermediaries include a range of players, including search engines, media companies and technology providers. These networks are supported by exchanges of customer data collected through online tracking and content providers. This data can be analysed, combined and processed by specialized data analysers into a user profile.

In advertising business models, content publishers are often content publishers willing to offer free or subsidized services to consumers to ensure a large enough audience to attract advertisers. The most successful advertising comes from companies that combine a large user base with calibrated algorithms for collecting, analysing and processing data from these users, which allows for targeted advertising. While traditional advertising involved paying for ad exposure over a period, with little control over visibility or user response, online advertising has given rise to a number of new payment and billing methods, including:

– "cost per thousand" (CPM), in which advertisers pay for a thousand impressions of their message to users;

– "cost per click" (CPC), where advertisers pay only when users click on their ads;

– "cost per action" (CPA), in which advertisers pay only for a specific action (such as a purchase) performed by a user.

Internet advertising is growing rapidly both in terms of total revenue and in terms of share of the total advertising market.

Cloud computing. Cloud computing is the provision of standardized, on-demand computing services over the Internet that may include computing, data storage, software, and data management using shared physical and virtual resources (including networks, servers, and applications).

Since the service is provided online using the ISP's hardware, users can usually access the service using different types of devices wherever they are, provided they have a suitable internet connection.

The resources accessed by cloud computing clients are not stored on the same computer. Instead, they reside in networks of computers available to anyone with access to that "cloud" of computing resources (which, depending on the cloud, may be unique to an organization, a community of organizations, the general public, or a combination of these).

Cloud computing often provides customers with a cost-effective alternative to purchasing and maintaining their own IT infrastructure, as the cost of consumer resources is typically spread across a wide range of users. The benefits of cloud computing are largely due to economies of scale in infrastructure setup and maximizing server utilization by sharing space among clients (their space and computing power needs can vary greatly).

Network platforms for participation. A participatory online platform is an intermediary that enables users to collaborate and contribute to the development, enhancement, evaluation, commenting and distribution of user-generated content. User Generated Content (UGC) includes various forms of media and creative works (text, audio, visual and mixed) created by users. There are a few different distribution platforms, including blogs, online encyclopaedias, group aggregation sites, social networking sites, podcasting, and virtual worlds.

UGC is generally created with no expectation of profit, but may monetize content in a variety of ways, including through voluntary contributions, charging viewers for access to a particular product or subscription, advertising-based models, licensing content, selling goods and services, providing services with selling user data for market research to other firms.

The infrastructure of the digital economy

Digital (or online) markets are obviously different from brick-and-mortar markets. The main features of digital markets include:

– direct network effects;

– indirect network effects;

– economies of scale;

– “switching” costs and blocking effects;

– complementarity.

Direct network effects. In digital markets, the utility of consuming a particular good or service often depends on the number of other end users consuming the same goods or services. This effect in economics is called an externality. In this case, this is a positive externality, since the larger the network, the greater the benefit for the end user. An obvious example is social networks and Internet messengers. Both applications are virtually useless to the user if he or she were to use them alone. However, their value increases with the number of other users. The effect is also obvious, for example, in the case of online games.

Indirect network effects. In contrast to direct network effects, indirect network effects occur in the context of multilateral markets. They occur when a certain group of end users (such as users of a social network) benefit from interactions with another group of end users (such as advertisers on a social network). Digitization has enabled the emergence of online platforms and networks in many different sectors of activity, such as for example rental accommodation, transport or e-commerce.

Economies of scale. In many cases, the production of digital goods and services entails relatively higher fixed costs and lower variable costs. Software development, for example, requires significant investment in infrastructure and human labour; however, once the final program is developed, it can be maintained, sold, or distributed with very low marginal cost.

“Switching”costs and blocking effects. Digital transactions can be made on a variety of electronic devices; however, end-user devices often run on different operating systems. As a result, customers may be “stuck” on a specific operating system if they purchased a specific device. This effect is due to the psychological as well as monetary switching costs that end users must incur to move from one system to another. Again, social media or email services are good examples, as switching from one application to another involves the transfer of a wide range of personal data and contacts. Another example is the change of a specific smartphone (including the operating system) to another one, which involves the loss of access to previously accumulated applications and data.

Complementarity. Many goods and services traded in digital markets are add-ons; that is, customers benefit more from consuming two (or more) goods that complement each other. For example, the usefulness of using a laptop or smartphone is greatly increased when it is used together with appropriate software, such as operating systems, applications or games. Likewise, the utility of time spent on a social media platform increases when the user also has a smartphone with a variety of apps that allow him or her to share more content.

These features can be used to describe specific aspects of digital or non-digital markets; as such, they are not exclusive to the digital economy. Nevertheless, the constant shift towards digital products and transactions has significantly increased their relevance and has already led to a deeper structural transformation in the economy. In particular, the low marginal costs and global reach of the Internet allow digital companies to quickly scale up their operations. Direct and indirect network effects increase the value created by digital business.

Digital markets are often non-competitive in the sense that individual firms become large enough to influence market prices. On the one hand, this means that it may be more difficult for new firms to gain significant market share if a company already dominates the market. On the other hand, the low marginal costs and non-competitive nature of many digital goods also mean that new entrants can replace an incumbent firm in a relatively short time simply by offering a superior product. Once a critical mass of end users has switched to the new product, the former dominant firm may lose market share in a short period of time. This was the case, for example, with search engines, web browsers, and social media or networking platforms.

The impact of this digital transformation is further amplified by the fact that digitalization has also led to an acceleration of economic activity. In the digital space, agreements between end users in different jurisdictions can be concluded without loss of time, and digital content can be accessed directly from any device connected to the Internet. As a result, digital products and services spread faster, ideas spread faster, and it becomes much easier for companies to identify, attract and grow their customer base. This increased dynamism of economic activity means that businesses can gain significant competitive advantages by first entering and potentially dominating a new market.

In general, these structural changes led to the strengthening of digitalization of the economy, and, accordingly, to the emergence of new business models, as well as a significant transformation of old ones. In particular, the concepts of indirect network effects and multilateral markets are critical to understanding the success of several of the world's most innovative digital companies. Let's consider these concepts in more detail.

Digital multilateral markets

Digital or online markets, like offline markets, can be one-way or multi-way. In one-sided markets, sellers interact with only one specific set of customers, such as a reader buying a book in a bookstore. In multi-sided markets, there is more than one set of customers who buy different goods and services from a company. Multi-sided markets have existed before, for example in the form of television, where advertising is shown to a wide audience, and newspapers also present advertising to all readers. However, digitalization in the economy has contributed to the emergence of companies that are localized in multilateral markets.

Digitalization has significantly reduced communication costs, allowing businesses to quickly reach a global base of suppliers, users or customers and create networks of users in different jurisdictions through websites, online platforms and mobile applications. New digital enterprises often function as intermediaries, connecting different groups of users who would otherwise find it difficult to interact directly in a non-digital environment. By being able to create such a network and enable mutual exchange between different groups of end users, a company has enormous potential for value creation.

Multilateral markets can be defined by the simultaneous combination of two characteristics: indirect network externalities and neutral pricing strategies. ***Indirect network effects*** occur when an increase in end users on one side of the market increases the utility of end users on the other side of the market. Take for example an online platform that helps people rent housing by connecting hosts and guests. The online platform plays a crucial role in the exchange, connecting both sides of the market; without it, most deals wouldn't happen, and guests would likely book more traditional accommodations (which is Airbnb's business model). From this point of view, an internet platform basically provides intermediary services to different parties of the digital market and can vary depending on the degree of control over its users.

The economic success of digital business models based on intermediation between different groups of end-users is largely dependent on reaching a critical mass of end-users on both sides of the market. The Internet has enabled digitized companies to reach many participants. At the same time, a key feature allows online platforms to achieve significant scale by adapting their pricing structures by charging different fees to each market participant.

This leads to the second characteristic of the multilateral market – ***a neutral pricing structure***. A preponderance of positive indirect externalities means that a firm operates on a platform and can benefit beyond the marginal utility of end users, allowing it to increase the number of users (or transactions) by charging more to one side of the market and cutting the other side's price. As a result, pricing is not neutral in the sense that optimal prices may be below the marginal cost of providing a service to one side of the market, while being higher for the other side; the price for end users with less price elasticity will tend to be inflated, and vice versa. This result also implies that platform operators may, depending on the magnitude of indirect external network effects as well as price elasticity, provide goods or services to end users from one (or potentially more) sides of the market for free. As a result, so-called barter transactions may arise, which involve the effective trade of goods or services without monetary compensation in exchange for other valuable resources (such as user engagement, user data, or user-generated content). This strategy is, for example, adopted by many social media platforms, email services or media providers. In these cases, end users often enjoy "free" access to a particular service.

However, platform operators typically compensate for this by collecting user and transaction data, and by selling this information to the other side of the market. A prime example is selling customer-targeted advertising to advertisers on the other side of the market.

Emergence of new business models in digital markets

In the digital economy, businesses interact with users through many different types of online or web interfaces, platforms, including:

1. Platforms that allow end-users to exchange information and carry out transactions, while leaving mostly to the provider control rights and obligations to customers; end users join the platform and interact between market parties, so that indirect network effects have become crucial. Examples: Uber, Airbnb, BlaBlaCar, Amazon Marketplace, Facebook, Google, Deliveroo, Foodora, UberEATS.

2. Multi-sided platforms – enterprises that will purchase products (including control rights) from suppliers and resell them to buyers; resellers control prices and take responsibility for customers; they do not allow for end-user interaction and do not necessarily require customers to join an online platform. Example: e-commerce Amazon, Alibaba, Spotify, Netflix (purchasing content).

3. Resellers – enterprises that have acquired ownership of suppliers of individual goods and services and thus integrated the entire supply of goods and services within their business. Example: Amazon e-commerce (warehousing and logistics), Xiaomi (user devices and applications), Huawei (hardware and cloud computing), Netflix (film production and screening).

4. Vertically-integrated Firms – enterprises or individuals that supply resources necessary for the production process of goods or services to another firm. Unlike multilateral platforms, input suppliers are not intermediaries and interact only with other firms and not with end users (for example, Intel).

5. Input suppliers.

Although all of them can use websites, applications or similar interfaces to sell their products and interact with customers, only the first group of enterprises can fully be considered a multilateral platform.

The characteristics of the indicated digital business models according to the group of criteria are shown in the figure below (based on the OECD study) (Fig. 5.1).

Digitalization was necessary for the emergence of multilateral platforms and the involvement of suppliers, while intermediaries and vertically integrated companies were already standard organizational structures used long before the digitalization of the economy. Some of the big digital companies started with one business vector – a multi-sided platform, gradually growing into more integrated or hybrid structures with additional business vectors. In terms of market dynamics, traditional, vertically integrated firms have sometimes found themselves threatened by newly created multilateral platforms, suggesting that in some cases the latter may have a comparative advantage over the former.

	Multi-sided platforms	Resellers	Input suppliers	Vertically integrated firms
Indirect network effects	Yes	Yes	No	Yes
Agent	Yes	Yes	No	No
User ownership	High	Low	–	Low
Price control and responsibility	Consumer	Agent	Company	Company
Production of the final product	No	No	No	Yes

Fig. 5.1 – Characteristics of digital models according to OECD criteria

This has been the case, for example, in the transport and accommodation sectors, as traditional taxi and hotel businesses have been challenged by multi-party platforms such as Uber, Airbnb and Booking.com.

Concept of digital efficiency in business and economy

Digitalization decisions are a strategic business choice. As mentioned above, for economies of scale, many companies are digitizing their own operations, combining various elements from the four listed visa models or using different models for different areas of activity. For example, online stores Alibaba and Amazon operate as intermediaries for market segments where demand fluctuations are expected to be low, but AliExpress and Amazon Marketplace are multilateral platforms serving market segments with more volatile demand. Thus, the risk of low demand remains with the seller, and the multilateral platform carries no risks. Similarly, the music streaming service that Spotify or Deezer offer users is provided within two different business models: free or "Freemium" (a subscription service that is fully funded by advertising (a multi-party platform)) and a "premium" subscription service (financed by the membership fee (intermediary)). Netflix, on the other hand, started with a pure mediation model, but is now integrated with a content creation model.

The choice between different business models depends on the company's business development strategy, but it is also based on the following ***factors***:

– economies of scale and scope;

– strength of direct and indirect network effects;

– information asymmetry between suppliers, market operators and users;

– advantages of marginal costs in various organizational forms.

There is another approach to evaluating digital effectiveness – ***evaluating the effectiveness of the implementation of digital transformation of customer service*** based on several indicators:

– compliance with the planned deadlines for the implementation of the digital strategy and the introduction of digital tools;

– compliance of real revenue indicators after the implementation of digital transformation of customer service with forecast values;

– the ratio of the company's profit for the established period to the costs of implementing the digital transformation of the client service.

The disadvantage of these indicators is that their values are delayed and do not allow businesses to quickly assess the effectiveness of implementation. Monitoring of marketing metrics will help to promptly evaluate changes and, if necessary, adjust the strategy. Gartner analysts advise choosing from 5 to 9 indicators that most closely match the specifics of your business.

Let's list 10 key metrics, the positive change of which will allow us to draw a conclusion about the systematic improvement of key business indicators because of the digital transformation of customer service (Fig. 5.2). The method is suitable for any company that wants to receive applications via the Internet.

Conversion Rate (CR)	conversion factor
Customer Acquisition Cost	customer acquisition cost
Average order value (AOV)	average check
Lifetime Value (LTV)	the total profit that the company receives from one customer for the entire time of interaction with him
Customer Retention Rate	the share of regular consumers who make regular repeat purchases
Repeat Purchase Rate (RPR)	frequency of repeat purchases
Churn rate (ChR)	the ratio of customers who refused the services, unsubscribed from the newsletter, do not visit the site
Net Promoter Score (NPS)	consumer loyalty index or the percentage of users ready to recommend a brand, its goods or services to
Return on Advertising Spent	return on investment in advertising, considering each specific channel
Lead-close Rate (LCR)	lead closing rate

Fig. 5.2 – Key marketing metrics

Conversion Rate (CR) – conversion rate. This parameter helps to understand what percentage of people who went to the site later became customers of your business, i.e. bought a product, ordered a service, filled out a lead form. For an online retailer site, the CR value is usually between 1 % and 2 %.

The formation of an omnichannel environment, personalized communication with each user and increasing the relevance of offers due to the digital transformation of customer service allow to achieve an increase in conversion. If, because of the implementation of the digital transformation strategy of the client service intended for the user, the indicator has not changed, you should think about whether you did everything right.

Customer Acquisition Cost (CAC) is the cost of attracting a customer. When calculating the indicator, it is important to consider not only the direct costs of paid promotion channels, but also all additional taxes and fees, the costs of conducting marketing campaigns, the lost benefit of the company due to the provision of a discount, promotional offer, free trial period, etc. As the audience expands, the cost of attracting a customer increases. The task of any business is to achieve the optimization of CAC.

To recoup acquisition costs, it's important to establish regular sales and focus on retaining existing customers. Active repeat sales, cross sales and stable growth of the average check allow you to reduce CAC. To do this, it is necessary to constantly improve the quality of service, maintain continuous communication with current and potential customers in various channels, and increase their loyalty.

Average order value (AOV) is an average check. This indicator shows how much the company earns from one order. The size of the average check directly affects revenue and is calculated as the ratio of total revenue to the total number of orders for the specified period.

When calculating AOV, it is important to correlate its value with the total amount of spending on advertising and other channels of attracting buyers. For most B2C companies, the cost of first acquisition remains quite high. In certain segments, these costs can be significantly more than the amount of the first purchase. That's why it's so important for businesses to make sure the average check keeps growing.

It is useful to use AOV-based customer segmentation to evaluate marketing effectiveness. Depending on the amount of the average check, divide buyers into 3 groups: "high AOV", "medium AOV" and "low AOV". So you can understand how effective your marketing spend is and adjust your strategy in time. The implementation of digital transformation of customer service will allow the brand to recognize its customer in all communication channels, know about all appeals to the company, predict his behaviour and purchase intentions, and make the right offers. The business gets the opportunity to optimize the costs of attraction and increase the amount of the average check.

Lifetime Value (LTV) is the total profit that the company receives from one customer for the entire time of interaction with him. This indicator is especially popular in e-commerce, because the longer users stay with you and the more money they spend on purchases, the better for business. The LTV indicator allows you to assess how relevant your commercial offer is and how perfect the level of customer service is, as well as to adjust the user retention strategy in a timely manner if necessary.

Often, businesses focus only on making a sale, not caring about the user experience and completely ignoring the issue of customer support after the conversion. The result is disappointed consumers, negative reviews, missed repeat sales. The formation of a single digital profile allows the brand to consider the previous experience of communication with the user, track the purchase history, know about the benefits, make personalized offers, ensuring effective cross-selling and upselling.

Customer Retention Rate (CRR) – the share of regular consumers who regularly make repeated purchases. CRR is calculated as the ratio of the number of regular customers at the end of the reporting period to the number of new ones. How does the quality of customer service affect this indicator?

Evaluating the potential of a retail network, analysts pay attention to the percentage of regular customers. One of the main tasks of the digital transformation of customer service is the automated and complex management of relationships with consumers. Personalization of marketing campaigns, offers and loyalty programs enables businesses to significantly increase CRR. If, because of the digital transformation of customer service, the share of regular customers remained at the previous level, it makes sense to think about adjusting the digitalization strategy of your marketing.

Repeat Purchase Rate (RPR) is the frequency of repeat purchases. Unlike the previous indicator, this metric reflects not only overall satisfaction with customer service, but also the quality of goods or services offered by the company.

It is based on this indicator that marketers plan and launch loyalty programs. Implementation of a single Customer Data Platform and its integration at a single point with all company systems: CRM, ERP, CDP, chatbots, call center, customer support service – allows you to study the preferences of consumers in detail, offer them timely discounts on their favourite products, or select the appropriate replacement if the product is temporarily unavailable or the customer has stopped liking it. To find out if your customers are satisfied, it is enough to divide the number of users who purchased goods or ordered services more than once by the total number of buyers in the reporting period.

Churn rate is the ratio of customers who have abandoned your services, unsubscribed from newsletters and messages, no longer visit the site and mobile applications, who do not visit offline points. For business, this means only one thing: customers are categorically not satisfied with your offer or level of service, and they gradually go to competitors. The formation of segments and cohorts of consumers based on their behavior and purchase history, personalization of content on the website and in marketing communications, provision of convenient service and after-sales service will help to solve the problem.

Special attention should be paid to the analysis of the work of support service specialists. Operators may not be polite enough with customers or unable to solve their problems. The creation of intelligent chatbots and the launch of tools based on artificial intelligence and machine learning will help to minimize the human factor, improve the level of service and reduce the costs of maintaining a call center.

Net Promoter Score (NPS) is an index of consumer loyalty or the percentage of users who are ready to recommend a brand, its goods or services to others. To calculate NPS, brand representatives ask customers one question: “How likely are you to recommend our company/product/service to friends, acquaintances, relatives, and colleagues?” Depending on the answer, the audience is divided into “supporters” (or promoters), “neutrals” and “critics”. Next, the total number of “critics” is subtracted from the total number of “promoters”, the resulting value is divided by the total number of respondents and multiplied by 100 %. Foreign marketers recommend updating the index at least once a year. It is useful to recalculate NPS once a quarter. And even more so, as a result of the implementation of significant changes in customer service.

Return on Advertising Spent (ROAS) – the return on investment in advertising, considering each specific channel. Regular calculation of ROAS helps the business to evaluate how effectively the costs of advertising are paid off, to correctly allocate the budget and to refuse to invest in unprofitable campaigns. Digital transformation of customer service allows you to optimize advertising costs in each of the channels and significantly improve this metric. For example, custom data analytics integrated with all key channels of brand communication with consumers will help reduce retargeting costs. The advertisement of the product already purchased by the client will be automatically disabled. These budgets can be invested in advertising related products that can provide cross-selling.

Lead-close Rate (LCR) – lead closing rate. It is calculated as the ratio of the number of customers for the reporting period to the total number of leads for the same period. LCR helps to understand how many people were interested in a brand or offer, but ultimately did not decide on the operation. Regular calculation of the metric allows the business to draw conclusions about the effectiveness of advertising as incoming traffic, as well as how faithfully the sales department processes it.

If the strategy of digital transformation of customer service is implemented correctly, the rate of closing leads will begin to grow among the first. If this does not happen, there is a serious reason to think about whether you chose the right strategy, how competently you approached its implementation.

You should always start the process of digital transformation of customer service with an audit and an objective assessment of the degree of digitalization of a specific business. At the next stage, a target vision is formed and priority areas of digitization are chosen. It is better to focus on those channels and tools, the digital transformation of which will bring the company the maximum economic effect. An alternative option is to focus on "bottlenecks" and optimize them through the implementation of digital transformation of customer service.

Questions for self-control:

1. Define the term "digital efficiency"?
2. How did information and communication technologies change the use of information for business?
3. What is the "infrastructure of the digital economy"?
4. What is digital efficiency in business and economy?
5. What is the digital economy?
6. How did modern advances in ICT enable business development?
7. What business models are used by today's well-known companies?
8. What is e-commerce?
9. How is payment for goods or services made within electronic commerce?
10. What are the types of electronic commerce?

5.2. Value creation and digital business transformation solutions

The process of value creation in the digital economy

Digitization affected the structure of markets, which allowed not only enterprises to develop new products and services, but also brought structural economic changes.

The concept of value creation. A discussion of value creation usually begins with the value chain. Developed by Michael Porter in the mid-1980s, the value chain is a standard tool in academia and business used to analyse a firm's competitive advantage. Since its publication, M. Porter's "value chain" has undergone several major criticisms, all of which are very relevant in the context of digitalization:

1) *its limited ability to incorporate value created from information flows.* It is obvious that the key feature of the digital economy is the efficient and fast transfer of data and information, which is possible with the help of the Internet. Although Porter saw the Internet as an efficiency-enhancing mechanism, he did not see it as a change in business strategy. Others, however, saw a clear need to adapt M. Porter's value chain given the fact that information has long been considered central to value creation. In response, Rayport and Swiokla (1995) introduced the concept of the virtual value chain, which serves as a useful refinement of M. Porter's value chain;

2) *it was originally developed for use in domestic firms.* The concept of the value chain has been extended to accommodate the possibility that production processes may span multiple jurisdictions, introducing the concept of the global value chain (GVC). GVC describes the need to coordinate the company's activities in different regions. This is especially true in the digital economy, given the ease with which the production processes of a digital business, as well as its final goods or services, can cross borders. Indeed, when it comes to creating value, business is not confined to one geographic location or even to one firm;

3) *its limited application to services.* While value chains are well suited to describe the production processes of physical goods of traditional manufacturers, the concept is less able to describe the business model of service provision. The value chain concept models enterprises where value is created based on the production process, such as in traditional vertically integrated manufacturing enterprises. It also includes intermediaries as their main activity is consistent. Therefore, two concepts should be considered. The value network concept depicts

a business where value will be created by connecting users, suppliers or customers (i.e., forming a network of them) using intermediation. This category covers all types of multilateral platforms. The concept of store value describes a business where value is created by sorting resources, that is, hardware and software, as well as specialized knowledge that can solve customer problems and satisfy his requirements. This includes digital and non-digital services from providers.

Any *classification of value creation processes* will have limitations if applied to the activities of real companies and their areas. However, it helps systematize the large number of enterprises that are heavily dependent on digital technologies by organizing their value creation process along three approaches:

– value chains;

– value creation networks;

– stores of value.

These approaches provide a broader classification of value creation in the age of digitalization (Table 5.1).

***Table 5.1* – Three concepts of value creation**

	Value chain	*Value network*	*Value store*
1	*2*	*3*	*4*
General Description	Purpose: To transform inputs into outputs through discrete but sequential processes (each of which can be defined as a production function). Products can be manufactured by the company itself or purchased. In general, final goods will be standardized	The purpose of a value chain is to broker services to: 1) facilitate two-way interaction between it and its customers; 2) multi-way interaction between its customers (e.g. buyers/sellers, passengers/drivers, etc.). The value creation process can be shaped by direct connections between consumers (for example, phone calls or recommendations from friends) and indirect connections (for example, a commercial bank can determine the possibility of lending to a prominent buyer)	The purpose of the value store is to solve a problem, in particular, to transform an existing state in a more desirable state. The problem is characterized by information asymmetry (that is, the store has more information than its customers). The problem-solving process can be labor-intensive, involving professionals and specialists, or be standardized or highly customized
Primary technology	Continuously connected: a linear process that begins with inputs and receipts and moves to the delivery of the finished product to the end user	Intermediary: used by the company to connect users or customers interested in joining the operation	Intensive: forms of hardware use and knowledge to change specific objects

Continuation of Table 5.1

1	*2*	*3*	*4*
The logic of value creation	Value is created by transferring a product from a company to its customer	Value is created by organizing and facilitating exchanges between related customers	Value is created by solving a customer problem or satisfying a customer demand
Main types of activities	Activities organized sequentially: – inbound logistics; – operations; – outbound logistics; – marketing; – services	Types of activities organized simultaneously (in parallel): – network promotion and contract management; – provision of services; – operation of the infrastructure	Activities organized iteratively (repeatedly): – identification of problems; – choice of approach to finding a solution; – problem solving; – execution; – monitoring/evaluation
Examples of traditional business model	– assembly line for production; – wholesale	– employment agencies that connect employers and job seekers; – banks that unite investors and borrowers	– medical technologies used for diagnosis and treatment of diseases; – professional services (legal, consulting, financial)
Examples of the business model of the digital economy	**Production of goods (vertically integrated firms)** *Tangible goods:* – Unilever, Coca Cola, GE, Siemens, BMW, IKEA, Microsoft (PC, tablets, Xbox), Apple (PC, tablets, iPhone), Huawei (devices), Sony (devices, electronics), Intel, IBM, Cisco, Tsinghua Unigroup (microchips), Xiaomi *Intangible goods and digital content:* – creative content: Disney, Netflix, Sony; – software (one-time purchase of standard package): Microsoft, Adobe, SAP, Dassault Systems, Dropbox, Weiyun, Google Drive. **Trade intermediaries** *Tangible goods:* – Alibaba, Amazon retail, JD.com, Tencent, Walmart. *Intangible goods and digital content:* – creative content: Netflix, Sony (movies/music), Spotify, Deezer, Amazon Audible – software (one-time purchase from standard package): Amazon, Best Buy.	**Multilateral platforms** *E-commerce intermediary* – Material goods: AliExpress, Amazon Marketplace, eBay, Etsy – Intangible goods: Trivago, Booking.com, Hotels.com, Google Play, Apple iTunes store. *Intermediary services:* – Sharing economy: AirBnB; Blablacar, Drivy, Turo, Uber, Didi Chuxing, Ola; Deliveroo, Foodora, TaskRabbit, Upwork; – Social networks: Facebook, LinkedIn, Sina Weibo, Tencent Weibo, Twitter, Nice, Kuaishou, Qzone – Online games and gambling; – Search engines: Google, Bing, Yahoo, Baidu, NetEase; – Email: Gmail, Yahoo, Hotmail, NetEase; – Internet content: Dailymotion, SoundCloud, TripAdvisor reviews, Vimeo, YouTube; – Electronic payments: Transferwise, Alipay, Tenpay, Paypal, Worldpay	**Cloud computing providers / input of computing power to other companies** (X-as-a-Service, potentially fully vertically integrated) **IaaS:** – AWS, Alibaba, Microsoft, IBM, Huawei, Cisco, Intel **PaaS:** – AWS, Alibaba, Microsoft, IBM, SAP *Professional services (vertically integrated firms)* – internet consulting: GE, Siemens – data analysis

Continuation of Table 5.1

1	2	3	4
	Suppliers of materials: – companies that were created to sell reseller products: Intel, Tsinghua Unigroup; – companies that have created applications for supply to application stores		

Creating value in digital business models

Value Network Model: The social network is supported by advertising revenue.

Business model overview. The social network discussed here is a multifaceted platform that collects user data and provides advertising services. This type of business model serves two purposes. First, on one side of the market, it aims to provide a platform for users to connect with each other and share content. A user participates by referring to other users, where links are formed based on real-world relationships or topical interests that are not necessarily dependent on the relationship between users (such as Facebook, LinkedIn, Tencent Weibo, Twitter, and Qzone). From the user's point of view, social networks work by connecting users on the Internet, generating a news feed with frequently updated content. Users get access to news channels via the Internet or through applications, usually without payment. A traditional equivalent of this business model would be membership based on a social club.

Second, on the other side of the market, the purpose of social media is to allow customers to effectively advertise on the platform to reach their target audience (i.e. users on the other side of the market). Advertising space will be purchased by parties wishing to promote their ideas, brands, products and services, and strengthen their market presence and audience reach. The company's social networks have more diverse options for using advertising space on their platforms, including promoting content that appears from news channels, as well as promoting trends and some user accounts. Ad placement will be based on attributes such as geography, demographics, interests, keyword content, events, device type. The traditional equivalent of this business can be seen in the placement of more traditional forms of advertising such as television or radio advertising.

The two **goals** typical of operators in multilateral markets are to connect users and to provide advertising services: fulfilment of the first goal provides market research for the second. Users of the social network provide data in the form of geographic and demographic information, voluntary content, and behavioural data when interacting with the network. This data allows the company to learn about its user base. From the company's point of view, its user communities are valuable because they are a means of attracting major commercial customers – advertisers.

Social networks generally receive **revenue** from the sale of advertising space to third parties who want to promote their goods or services to users on the platform.

Social media companies typically protect their **intellectual property rights** through a combination of trademarks, trademarks, domain names, copyrights, trade secrets, and patents. They may also enter into confidentiality and non-disclosure agreements with employees, contractors and other third parties to limit access to, disclosure and use of confidential information and proprietary technology.

Social networks recognize the need to balance ad content with user-generated content so that ad content is well-targeted to maximize user engagement. **User data** and user-generated content form the basis of targeting strategies: the greater the amount of data and user-generated content, and the more sophisticated the data analysis, the greater the potential profit, because the information provided by users is usually contains keywords, which describe the user and his interests. Advertising content is then sent to users with profiles that companies want to reach.

As described, *the value network consists of three main activities*: network promotion and contract management, service provision and network infrastructure operation.

Network promotion and contract management is a category of activities related to inviting potential customers to the network, selecting customers who are allowed to join, and initiating, managing and terminating contracts governing the provision of services and the collection of fees. The business model of a social network company is to create a social network that then serves as an audience for clients who sell ads on the social network. To best serve their advertising clients, social networks strive to foster a broad and engaged community of users. To this end, they seek to attract influential people to the network, including world leaders, government officials, celebrities, athletes and journalists, as well as media and well-known client brands. Since the social network operates in a two-sided market, it can use price elasticity for different categories of users.

Users connected to users. User-to-user promotion is a key aspect of a social network company's business model: the more users and the more time they spend online (and the more they engage), the more content they create and the more available they are to target with ads. All of these factors are central to increasing the value of the platform's advertising business. In order to encourage users to join their network, social networks offer the use of their platforms to users without financial payments. Also, the barriers to engagement with a social networking website can be low. Although an account is usually required to post content, in some cases it can be opened without any personally identifiable information (such as Twitter), and in other cases users do not even need to have an account to view content on the network. By lowering such barriers, the company aims to encourage users to visit its website or mobile application as often and for as long as possible. However, some social networks require a real identity (for example, Facebook). In these cases, the social network also serves as a means of verifying the user’s identity on other platforms.

Advertisers connected to users. Since the social network’s users are spread across the globe, the companies it seeks to work with can also be global.

Operation of the network infrastructure. The functioning of the network infrastructure for the business model consists of:

1) collection of data about the potential target audience for advertising purposes;

2) formation of strategies that can be used to reach the target audience;

3) setting tariffs according to various characteristics of advertising.

Although the social network and traditional television companies are the fact of these measures in general, they go about each in different directions.

The social network company has the advantage of generating its own user data digitally thanks to the community it supports on its platform. The social network collects company-specific user content, as opposed to profile or demographic data, to learn more about user interests. Moreover, user data is available on the social media platform in real-time, as opposed to the reverse data collected through market research.

In terms of setting ad rates according to different ad characteristics, just as other digital firms can differentiate prices using data on product supply and demand, social media companies typically rely on an auction to set prices for their advertising products. This allows them to get the maximum price that businesses are willing to pay for advertising.

The platform is the result of a significant investment in technological resources: computer hardware and software, software engineers, website designers, algorithms, servers, etc. In particular, a social network company must ensure the stability and integrity of its platform, maintaining privacy and sufficient server space to handle large volumes of user traffic.

Digital transformation of the company and its advantages

Digital business transformation is not just another marketing term, but a new reality that requires businesses to radically revise their business processes and approaches to working with clients. The ability to quickly adapt to changes and optimize one's work, adapting to the client's expectations, are the main challenges brought about by the digitalization of business.

Customer expectations regarding the speed and quality of service provision are growing rapidly. This is especially true of the younger generation of consumers. A high level of service becomes a default requirement. Applying for a loan, activating a service, ordering goods, accessing information about expenses, receiving advice – customers want to perform all these operations here and now with the help of devices that are "at hand". Consumers value their time more and more, they need instant feedback, as well as a clear and convenient interface to meet their needs. Good design of information resources, availability of online chats, individual approach – this is a world to which customers have already gotten used to.

To meet the high expectations of customers, companies must accelerate the digitization of their business processes. To do this, it was enough to automate existing business processes. Companies need to reinvent them. The main goals of digital transformation are to increase the speed of decision-making, increase the variability of processes depending on the needs and characteristics of the client, and reduce the number of employees involved in the process.

Digitization of existing processes is an expensive and often quite futile activity, as all existing problems and shortcomings are automated. It is necessary to shift the center of gravity towards new opportunities that give the company a competitive advantage. For example, instead of automating the work of employees responsible for working with customers, you need to create self-service systems, minimizing the number of intermediaries between the customer and the final service or product.

The creation of digital business processes is associated with fundamental reengineering and revision of existing limitations. At the initial stage of restructuring, it is necessary to select those areas of the process that are related to the customer experience. For example, how to reduce the time for making a loan decision from several days to a few minutes, how to reduce the number of involved employees from X to zero, etc. Below are some examples:

1. The bank reduced costs by 70 % by implementing an automated mortgage pre-approval system. The duration of the procedure was reduced from several days to a few minutes.

2. The shoe chain implemented an inventory system in its stores, which made it possible to receive information about the availability of shoe sizes online, which reduced the waiting time of customers and the loading of sellers several times.

3. The insurance company has fully automated the decision-making process for simple operations that take most of the time of the customer service staff. As a result, the number of involved back-office employees was radically reduced.

Another advantage of digitalization of business processes is the possibility of collecting information about the customer experience and automatic adaptation of individual process scenarios in accordance with consumer expectations. The current level of technology development makes it possible to accurately predict customer needs and the most relevant methods and channels of communication.

The human factor, outdated IT systems, lack of knowledge, customer habits are the main obstacles on the way to digital transformation. It is possible to single out the factors of a less complicated, costly and risky transition of the company to new business processes (Fig. 5.3).

Management support. Digital transformation must be supported and promoted by the company's top management. This is a necessary condition for the successful implementation of the planned changes. The main task of management is to "sell" innovations to employees and show how they will affect each of them. New processes may cause job losses for some employees. This fact does not need to be hidden and announced in advance so that the planned changes do not become the subject of rumours and gossip.

Fig. 5.3 – Factors of transition to new business processes

Availability of a competence center. To implement changes at the operational level, it is necessary to create a cross-functional team consisting of employees of departments responsible for certain aspects of the process. Often, a separate competence center is formed for this purpose, consisting of employees of various profiles – client experience designers and designers, marketers, IT representatives, etc. It is important that the members of this team are open to new ideas, have the necessary skills and are not afraid to experiment. Such a center can function on a regular basis, broadcasting best practices within the company.

Organizational transformation. Traditionally, new business processes are implemented within the existing organizational structure by employees who have long been working within existing processes. There are big risks involved in this approach, and here's why:

– *any innovations require time for training and adaptation.* As mentioned above, this always causes some repulsion among employees. Fear for one's job, reluctance to change established practices, unwillingness to learn, fear of the new – these are traditional attributes of any internal corporate changes;

– *when switching to new processes*, more effort will be required from employees. It is necessary to maintain operational efficiency and simultaneously switch to new work rules. In essence, employees must “change shoes” on the go without changing the speed of movement. It can also create a negative background and cause hidden sabotage or open discontent.

Therefore, in some cases, it is more correct to create a new organizational unit or group within an existing unit to work on new digitalized processes. When transitioning to the updated processes, employees of the “old” organizational units will transfer to the new division. This approach allows you to go through the transformation faster and with less financial and energy effort.

Evolutionary integration with legacy systems. The digital transformation of business processes affects many legacy systems (inherited mechanisms of the company’s activity), which cannot be eliminated at once. Attempts to integrate old systems into new processes threaten long projects with vague payback periods. After a few years, it may become clear that what was done is no longer relevant. To reduce such risks, it is important to move in very small steps. The duration of individual initiatives should not exceed 6 months. Sometimes it makes sense to use simple temporary solutions to transition to “new rails”, in parallel creating integration interfaces between new services and old systems, or completely replacing the latter.

Attracting and stimulating customers. Customer habits change slowly, which slows down the introduction of new service technologies. For example, a significant proportion of passengers at railway stations stand in line at the ticket office, although there are terminals for self-purchase of tickets installed nearby. The development of new models of consumer behavior is an integral element of digital transformation. It is important to identify the key reasons that prevent consumers from using new services and develop measures to attract such customers. Training, demonstration of benefits along with stimulation allows to achieve results. It is important that the first experience of interaction with the new rules is successful and emotionally positive. Below are some examples of how this can work:

– bank employees help office visitors to make payments through the terminal;

– the client receives a bonus for completing the application online;

– the company offers special conditions for making a purchase through the mobile application.

Flexible model of business process management. The classical theory of optimization and reengineering of business processes in new realities is complemented by flexible approaches. The description of business processes, separated from the business processes themselves, is a thing of the past. Such a description quickly becomes outdated, maintaining its relevance requires serious labor costs.

The best way to have an up-to-date version of business processes is to use the company's business process management tools. Another characteristic feature of the new approach is the shortening of the process optimization cycle. The use of A/B testing, control groups and other tools to evaluate the changes made allow you to quickly check and implement changes in processes with minimal risks of obtaining negative results.

Types of digital business transformation and its stages

Digital business transformation can be represented by various digital business solutions.

CREATION OF A B2B PORTAL. A B2B portal is an online platform within which agreements between companies (for example, a manufacturer and a wholesaler, between a wholesaler and a retailer) are implemented. Partners from different levels of the distribution chain can be connected to the portal:

– distributors;

– dealers;

– independent wholesalers;

– retailers.

Wholesale sales, registration and preliminary processing of orders, exchange of documents and reference information are carried out on the portal. The supplier can reduce the time for interaction with the buyer, relieve the sales and support departments. The customer can find the necessary products and all information about them in an interactive catalogue with filters and sorting, instantly receive information without the need to call the supplier.

In turn, **creating a B2B site** will help you quickly find your own audience of regular customers and, thus, get a reliable source of permanent income (Fig. 5.4).

1. • **DESIGNING A PORTAL FOR A SPECIFIC BUSINESS.** Collection of data about the company and the industry. Development of an individual solution considering business processes and goals
2. • **INTEGRATION OF THE PORTAL WITH THE COMPANY'S ACCOUNTING SYSTEM.** Integration of the portal with accounting programs
3. • **CONNECTING CLIENTS TO A PERSONAL ACCOUNT.** Defining the circle of customers who will have access to the portal. Each partner is sent an individual login and password for logging in through a personal account
4. • **PROVIDING INFORMATION IMPORTANT TO THE CLIENT.** The client receives all information about the goods, current balances, terms of payment and delivery. Chat is provided for consultations
5. • **TRANSITION OF ALL ORDERS ONLINE.** Customers can choose products in the catalog. Prices are set individually for each customer. Ordering takes place without unnecessary calls
6. • **ORDER STATUSES ARE TRACKED IN THE OFFICE.** Partners can see the order fulfillment status and transaction history in their personal account. The system generates invoices and invoices for each order

Fig. 5.4 – The sequence of creating B2B digital portals

Usually, the development of a B2B portal takes into account the specifics of a specific business niche, to which the activities of its owner are directed. Therefore, it is necessary to consider the most popular types of such sites in order to draw up the most accurate **business plan for a B2B portal** (Fig. *5.5–5.6*)**:**

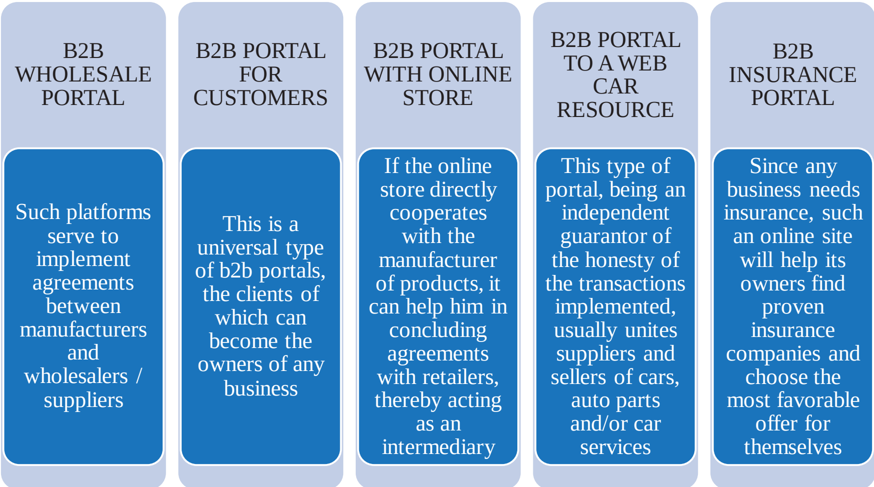

Fig. 5.5 – Types of B2B digital portals

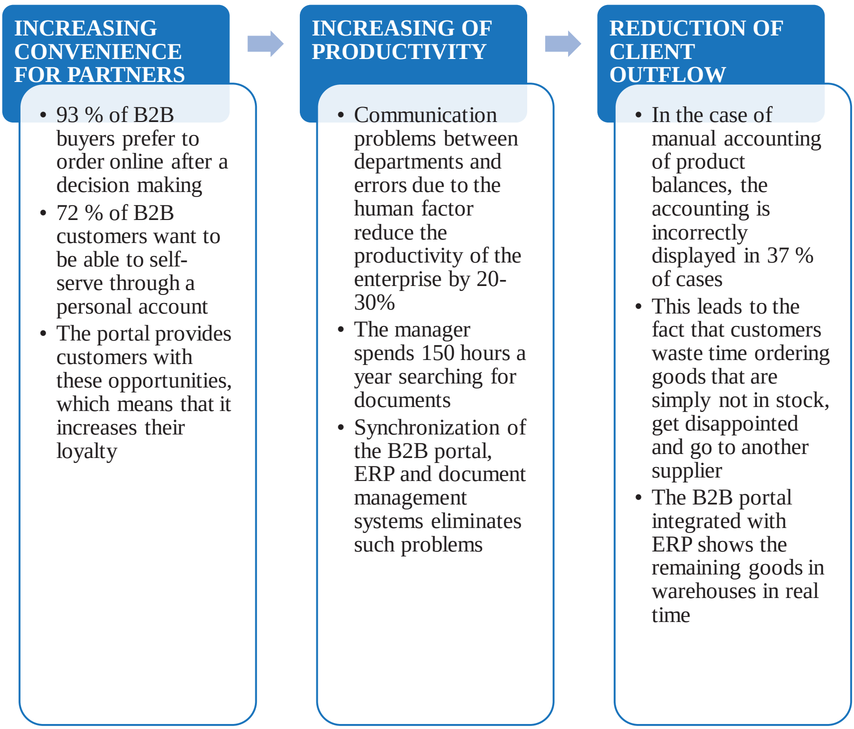

Fig. 5.6 – Advantages of creating a B2B portal

DEVELOPMENT OF CRM SYSTEM. The CRM system is a program for streamlining work with clients. CRM stores data about current and potential customers from various sources and optimizes processes in sales, marketing and customer service departments.

CRM stores the history of interactions with each customer and helps managers make timely offers and provide personalized service (*Fig. 5.7–5.8*).

Increasing loyalty

CRM stores the history of interactions with each customer and helps managers make timely offers and provide personalized service

Optimization of marketing

The system accumulates information about the target audience, helps to better understand the needs of customers and adjust the targeting of advertising campaigns based on accurate data

Cost reduction

The CRM system automates the processing of orders and the preparation of offers. Sales managers will sell, not fill out forms or search for documents

Improved coordination

Improves cross-departmental interaction and monitors employee performance against key metrics. The system will help transfer the team to remote work without loss of productivity

Increase in profit

Each module of the CRM system is aimed at increasing profits by attracting new customers, increasing conversion and check depth, increasing the retention rate and LTV – the lifetime value of the customer

Fig. 5.7 – Tasks solved by CRM

The choice of such a system depends on the specifics of the specific business – its turnover, security requirements and the need to implement unique functions. But the general rule is as follows: for small businesses, it is better to choose ready-made box solutions; for medium and large businesses – to develop their own system for automation.

01
- **Definition of goals**
- Setting strategic SMART goals for system implementation. Example: reduce customer churn by 15 % in 6 months

02
- **Synchronization with systems**
- Import of the client base, integration with other enterprise programs

03
- **Access settings**
- Creation of roles with different set of powers: administrator, department curator, user

04
- **Connection of communication channels**
- Connection of email, IP-telephony, social networks, messengers. Transformation of CRM into the core of omni communication with the client

05
- **Final setup of CRM**
- Customization of reports, dashboard, input fields and customer scoring parameters

06
- **Fixation of the person in charge**
- So that employees know who to go to with questions and suggestions for improvement

Fig. 5.8 – Stages of CRM system implementation

Such advice is due to the fact that with the development of business there are more and more complex processes that are difficult to translate into template solutions.

Standard CRM solutions cannot be fully adapted to all business processes. Often, after the implementation of the system, it is necessary to manually maintain Excel, coordinate actions or upload documents to the system. As a result, CRM only complicates the work (*Fig. 5.9*).

DEVELOPMENT OF E-COMMERCE PROJECTS. E-commerce covers a number of different types of businesses and corporations and is becoming one of the most important aspects of the Internet. Today, online trade accounts for more than 5 % of the world trade volume.

Templates

Standard CRM solutions cannot be fully adapted to all business processes. Often, after the implementation of the system, it is necessary to manually maintain Excel, coordinate actions or upload documents to the system. As a result, CRM only complicates the work

Redundancy

You pay for a standard set of tools whether you need them or not. The individual system will have only the necessary functions. So, they will be easier, faster and more convenient

The problematic of the developments

Big providers of SaaS systems will not specifically complete functional modules for you, whether it is automatic payroll calculation or the formation of sales plans

Dependence on the provider

You are completely dependent on the CRM provider and do not get full control over the software and accumulated databases

Integration

Ready-made solutions can be integrated with other programs. But for this service you have to pay separately and the list of applications for synchronization is limited

Security

It is easier for attackers to find and use vulnerabilities in standard CRM systems

Monthly payments

Most CRM providers provide their software on a subscription basis. You will have to pay for it every month. Moreover, the tariff increases with the growth of the client base and the number of system users

Support

Consultation, debugging and support takes place remotely and is often not included in the tariff. A custom contractor allocates specialists for personal training of your employees

Hidden payments

CRM vendors do not always announce a complete list of paid services on their sites. Read user agreements carefully to avoid surprises such as storage overage charges

Fig. 5.9 – The main disadvantages of ready-made solutions

Owners of large, medium and small businesses are involved in the process of e-commerce and understand that the development of trading platforms and complex online stores takes the first place in business scaling. Creating marketplaces helps businesses sell products to their customers around the world. Websites break the barrier of business geographic location and offer a wide range of audiences and therefore the opportunity to increase sales.

Creating an online store according to an individual scheme is not an easy task, so it should be entrusted to experienced developers who have experience in this field. Below we will talk about the features of its creation and the stages of work. The process of developing e-commerce projects (*Fig. 5.10*):

1. COMPLEX ONLINE STORE

Helping to implement the project, if the functionality of the store goes beyond the scope of ready-made CRM systems

2. DROPSHIPPING PLATFORM

Connecting service for suppliers and sellers. Selling goods around the world in a few clicks

3. CASH-BACK SERVICE

Refund of part of the funds from purchases

4. MARKETPLACE

Aggregator of millions of products from various sellers

5. NOTICE BOARD

A platform that enables individuals to sell and buy goods

6. TENDER SITE

A platform for bidding and public procurement

7. AUCTION

A platform that provides comprehensive interaction between sellers and buyers with the possibility of adjusting the price of the product depending on the level of demand for it

8. ONLINE CATALOG

Online showcase of your business with detailed information about the company and the possibility to place an order

9. PERSONAL OFFICE

Interaction with customers or partners through the website. Purchase history, current prices, feedback and much more

Fig. 5.10 – Sequence of e-commerce projects development

CREATION OF A SITE WITH A PERSONAL CABINET. A personal account is an element of the site interface that makes the experience more personalized for the user. Due to the availability of this option, users get access to the functionality specific to their own accounts (for example, to personal data, a discount program, payment cards, etc.).

Table 5.2 **– Types of personal offices**

For clients of e-Commerce projects	For business, it gives an opportunity to directly interact with customers, allows you to accelerate scaling due to the automation of the purchase-delivery process. For the client, it increases the level of convenience of cooperation, which will result in increased loyalty and repeat orders
For service companies	The most important component in the digitalization of interaction with customers. Enables the client to track statuses, communicate with the support service, participate in marketing activities
For interaction with dealers and representatives	The office is aimed at automating work and speeding up the interaction process. Online ordering, current prices and balances. Document management. Exchange leads. Marketing materials
For interaction with b2b customers	Document flow. Order history. Personal loyalty program. Support. Ability to integrate with your own accounting system
For the public sector	To provide citizens with access to public information, as well as organization of interaction with authorities
For patients of medical facilities and veterinary clinics	Appointment. Medical card. Test results. Payment for services. Doctor's call
For consumers of communal services	Apply for connection, consumption reporting. Details for payment. Balance. Document flow. Statistics on price changes
For the educational sector	Cabinet for online educational programs. Companies for the organization of language training, private schools
For buyers of cars and special equipment	View offered cars. Order additional inspections. Track purchase status

Creating a personal account is necessary for sites:

1. **Online store**. A personal account is a mandatory element necessary for the functionality of such sites. In particular, thanks to the personal account, users will be able to reserve products in the basket, apply discounts "linked" to their personal account, speed up the purchase process by pre-filling their data for the order, view previous purchases, as well as monitor the status of the current order.

2. **Internet portal.** The majority of users will enter from mobile devices. Therefore, it is worth focusing your attention on displaying the site in them:

– mobile version design;

– mobile first layout;

– thorough testing, on all kinds of devices/browsers (we use special software for these purposes).

3. **Company website.** Company websites often have several access options – for ordinary users, for company employees and for administrators. To distinguish access rights between these groups of visitors, personal accounts are created.

Questions for self-control:

1. How does the value creation process take place in the digital economy?
2. What is the digital transformation of the company?
3. What are the advantages of the company's digital transformation?
4. What are the types of digital business transformation?
5. What is the sequence of stages of digital business transformation?

5.3. Digital performance management based COBIT 2019

Combining business and IT as an integral part of the enterprise

In many proto-models, business and economics were considered separately from IT. Boards of directors and middle management could delegate, ignore or avoid decisions related to information and technology. In most sectors and industries, such an attitude is currently "ill-advised". In the light of digital transformation, information and technologies (hereafter referred to as IT) have become essential for the support, stability and growth of enterprises. According to SOVIT-2019, IT and business are two puzzles that successfully complement the full picture of the company's activity – it is IT that enables the successful presentation of data and information, and efficient business certifies success.

Three *main roles of IT in business and economy* are defined:

– ***support*** – to provide support to basic corporate services and stabilize operations, in order to obtain an effect;

– ***improvement*** – provision of business and partnership, consolidation of management information and integration of orientation process, for efficiency;

– ***innovativeness*** – to provide inter-enterprise solutions, enable business growth, flexibility and business analytics, for the sake of transformation.

Impact of digital efficiency on business and economy (Fig. 5.11):

– the creation of the values of interested parties – stakeholders (that is, the realization of benefits at the optimal cost of resources while optimizing risk) is often due to a high degree of digitization in new business models, efficient processes, successful innovations, etc.

– modern organizations (i.e. digitized enterprises) increasingly depend on IT for survival and growth.

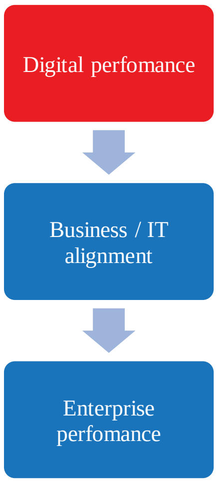

Fig. 5.11 – The impact of digital efficiency on business and the economy (according to COBIT-2019)

Leverage digital efficiencies and benefits EGIT

Leverage is a factor that acts with a small change and gives a significant change in the resulting indicator (“leverage effect”).

Digital Efficiency Leverage:

– the digital efficiency of the enterprise depends on the management and management of information and technologies at the enterprise;

– given the centrality of IT to enterprise risk management and value creation, over the past three decades there has been a particular focus on enterprise information and technology management – Enterprise Governance of Information and Technology (EGIT).

Management of information and technologies at the enterprise (EGIT) according to SOVIT-2019 (Fig. 5.12):

1) EGIT is an *integral part* of corporate governance;

2) EGIT is *complex* and multifaceted;

3) there is *no perfect way* to design, implement and maintain the effectiveness of EGIT in an organization;

4) EGIT consists of *management and managerial activities*.

Fig. 5.12 – Context EGIT

Advantages of effective EGIT:

1. Realization of benefits – provides value creation for the enterprise through IT.

2. Risk optimization – entails addressing the business risk associated with the use, ownership, operation, involvement, impact and adoption of IT in the enterprise.

3. Resource optimization – ensures that appropriate capabilities are available and sufficient to execute the strategic plan, and that sufficient, appropriate and effective resources are provided.

EGIT framework

IT needs quality management. The framework for EGIT is the COUNCIL (Fig. 5.13):

– frameworks have been developed and presented over the years to *assist* in the process of understanding, designing and implementing EGIT;

– COBIT 2019 builds on and combines more than 25 years of development in this field, not only incorporating new ideas from science, but also operationalizing these ideas as practice;

– from its inception in the IT audit community, COBIT has evolved into a broader and more comprehensive IT governance and management system and continues to be established as a generally accepted framework for *IT governance*.

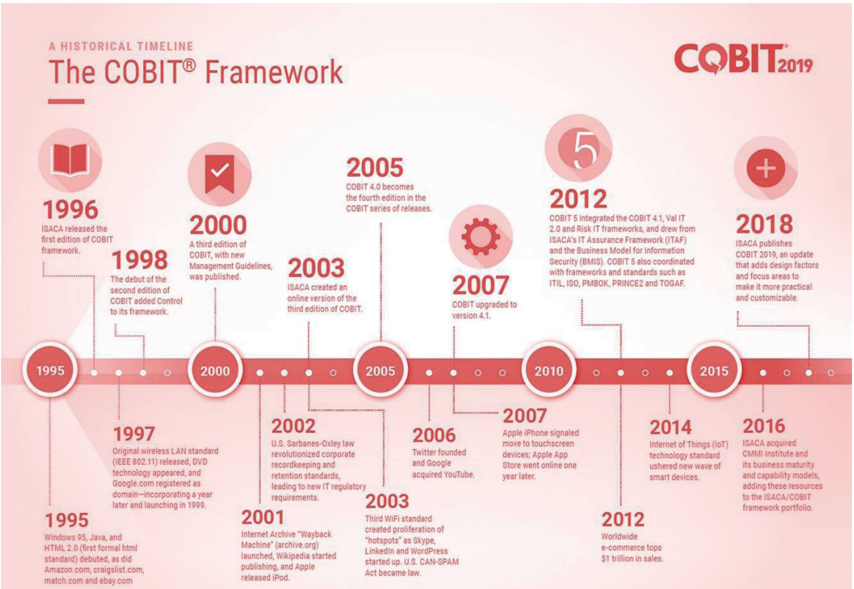

Fig. 5.13 – COBIT framework

What is COVIT-2019:

– COBIT is the framework for GEIT aimed at the entire enterprise;

– COBIT defines components for building and maintaining a management system;

– COBIT defines constructive factors that must be considered by the enterprise in order to build the best management system.

Management of digital technologies in the company and its benefits

With the advent of the concept of the digital economy, the digital transformation of business and the development of IT technologies and communications have become of key importance in companies to ensure their growth and stability. Previously, as a rule, the highest management staff and top management ignored the need for management decisions in the field of IT implementation, which is still the case in certain sectors of the economy. Creating value for a company's stakeholders through IT implementation is typically characteristic of new and more innovative business models.

Based on the central importance of IT for risk management and value creation by modern companies, interest in enterprise governance of information and technology (EGIT) has grown significantly in recent decades.

EGIT is an integral part of corporate governance, which consists in ensuring the implementation of processes, structures and mechanisms of such connections in the organization that enable both business owners and IT personnel to fulfil their functions of aligning the business through the implementation of IT and creating business value through investment in business IT technology (Fig. 5.14).

Fig. 5.14 – The content of information and technology management in the company

Information and technology management in a company is complex and multifaceted and must consider individual characteristics and needs, as well as the means and culture of their company's value creation to build a customized IT management system.

EGIT is focused on obtaining value from the digital transformation of business and reducing its risks, which are the result of digital transformation. In general, three main results of the successful adoption of EGIT can be considered (Fig. 5.15):

Obtaining benefits

This means creating company value through the use of IT, maintaining and growing value through IT investments, and divesting IT initiatives and assets that do not generate economic benefits at a satisfactory level

Risk optimization

This entails the elimination of risks associated with the use, ownership, disposition, involvement and perception of IT within the company. In particular, they include IT-related events that could potentially have a negative impact on the business

Resources optimization

This means that the appropriate resources are used where they allow the plans to be carried out, and that the resources themselves are used appropriately and efficiently

Fig. 5.15 – Benefits of information and technology management in the company

Companies that do not develop and implement information and technology management systems are less able to adapt their business to digital transformation strategies. Such companies are less likely to achieve their strategic development goals and will not create adequate value as a result of digital transformation.

Concept and structure of COVIT 2019

To better understand, design and implement information and technology management systems, best practices have been developed and disseminated over the years. As a result, the COBIT 2019 methodology was developed to support the implementation of such management systems in practice.

Since its inception, COBIT has been developed into a broader and comprehensive concept of information and technology management.

COBIT is a concept for enterprise-wide information and technology management, meaning that company information and technology are used and processed to achieve company-wide goals, not limited to the IT department.

When implementing the COBIT concept, a distinction should be made between governance and management, which include different types of management activities, require different organizational structures, and serve different goals (Fig. 5.16).

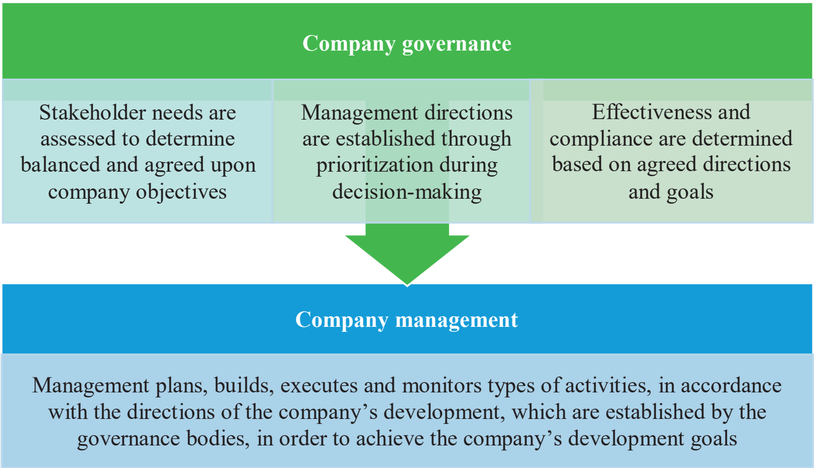

Fig. 5.16 – The connection between the company's management system and the management system

The COBIT concept defines tools for building a stable management system (Fig. 5.17):

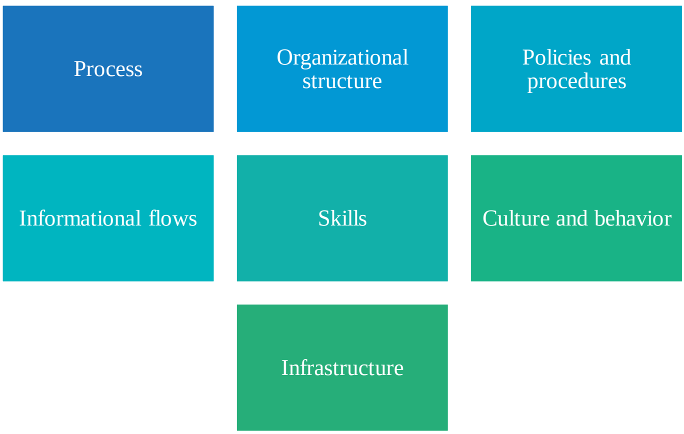

Fig. 5.17 – Components of the information and technology management system in the company

At the same time, the COBIT also suggests factors that should be taken into account when developing and designing an information and technology management system in a company.

For a better understanding of the essence of the COBIT concept, the distinguishing features of this concept should be pointed out:

– COBIT is not a complete description of the entire IT environment of the company;

– COBIT is not a concept of organization of business processes;

– COBIT is not a technical framework for managing all technologies;

– COBIT does not make any decisions related to IT, but it says which decisions should be made, how and by whom.

Stakeholders of digital efficiency management

Stakeholders of digital efficiency management can be conditionally divided into two groups (Fig. 5.18):

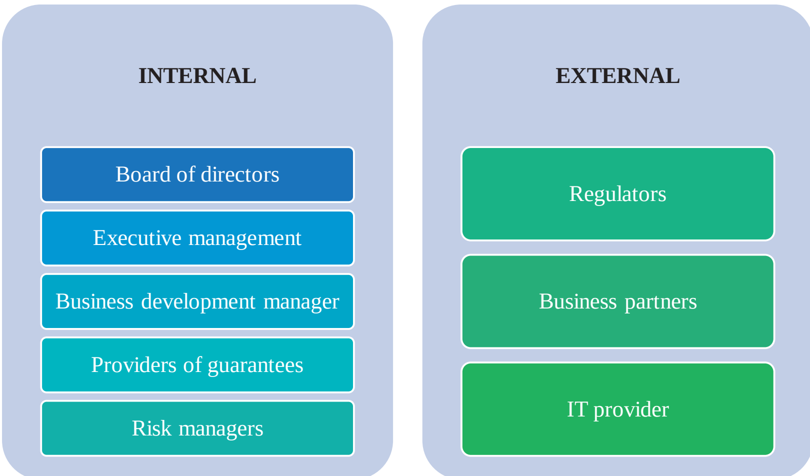

Fig. 5.18 – Stakeholders of the company's information and technology management system

The benefits of implementing the COBIT concept for various stakeholder groups are detailed in Table 5.3.

Table 5.3 – **Stakeholder benefits of the company's information and technology management system from implementation COBIT**

Stakeholder Benefits from the implementation of COBIT	*Stakeholder Benefits from the implementation of COBIT*
Internal stakeholders	
Board of Directors	Provides insight into how to derive value from the use of IT and explains the board's respective responsibilities.
Executive Management	Provides recommendations on how to organize and monitor the effectiveness of IT use throughout the company.
Business Development Manager	Helps to understand how to make the IT decisions that the company needs and how best to use new technology to realize new opportunities for the company.
Providers of guarantees	Provides recommendations on how to better build and structure the IT department, manage IT efficiency, effectively carry out IT operations, control IT costs, bring IT strategy closer to business priorities.
Risk Managers	Helps ensure identification and management of any IT-related risks.
External stakeholders	
Regulators	Helps to ensure that the company complies with applicable rules and regulations and has the right local management system in place to support such compliance
Business Partners	Helps ensure that the company's transactions with business partners are secure, reliable and compliant with rules and regulations
IT Provider	Helps ensure that the company's dealings with IT suppliers are secure, reliable and compliant with rules and regulations

A certain level of experience and a thorough understanding of the internal and external environment of the company's functioning is mandatory to obtain the appropriate benefits from the implementation of the COBIT concept. This allows users to adapt (customize) the basic principles of COBIT to the individual characteristics and goals of the company, considering the context of its activity.

The target audience for the implementation of COBIT in this case are those responsible persons who are involved in the entire life cycle of search and decision-making.

Questions for self-control:

1. How is the management of digital technologies in the company?
2. What are the advantages of managing digital technologies in the

company?
3. Name the main elements of the structure of the COBIT 2019?
4. Who are the stakeholders of the digital technology management system in the company?
5. What are the benefits of the company's information and technology management system stakeholders from the implementation of COBIT?

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Chapter 6
MOBILE APPLICATIONS AS MEANS OF INTERACTIVE CONNECTION WITH THE COMMUNITY

Content

6.1. Modern transformations of digital marketing and the role of mobile applications

New digital methods of processing and using information become the main source of increasing the effectiveness and efficiency of marketing activities. In the conditions of information-concentrated society, the Internet and modern capabilities of mobile devices are changing the forms and methods of marketing activity. They have been becoming an impetus for the emergence of a new form of marketing activity called digital marketing.

The term “digital marketing” have been used from 1990s. In 1993, marketers have used an interactive banner for the first time. With the development of mobile devices and the possibilities of using Internet technologies, digital marketing is launching new momentum.

Digital marketing is marketing that provides interaction with customers and business partners using digital information and communication technologies and electronic devices. In a broader sense, it is the implementation of marketing activities using digital information and communication technologies.

Digital marketing is the usage of all possible forms of digital channels to promote a company and its products. Television, radio, Internet, social media, mobile devices are all digital marketing tools. Digital marketing is closely intertwined with Internet marketing, but it has already developed a number of techniques that allow you to reach your target audience even in an offline environment. It solves the following tasks:

1) brand image support;

2) support for bringing a new brand or product to the market;

3) increasing recognition;

4) sales promotion.

Digital marketing uses the following basic tools, each with a set of terms.

1. ***Mobile marketing*** – marketing activity using mobile devices.

2. ***SEO*** (English search engines optimization) – site optimization in search engines, promotion of the site to the first page of search engine results for key queries.

3. ***SMM*** (social media marketing) – social media marketing, media advertising in the form of static or animated pictures placed on website pages for the purpose of product promotion.

4. ***SMO*** (social media optimization) – optimization for social networks, advertising in social networks: blogs, forums, online diaries.

5. ***Big Data technology*** – research of large data sets.

6. ***Marketing of games*** – promotion of games, including the process from creating a game to selling the game and making profit from the game.

7. ***SEM*** (English search engine marketing) – marketing activity in search engines aimed at increasing website traffic.

8. ***Remarketing*** – retargeting, repeated display of previously viewed Internet advertising.

9. ***E-mail marketing*** – text messages of an advertising nature sent by e-mail.

10. ***Web analytics*** – analytics in the field of digital marketing.

11. ***Google AdWords contextual advertising.***

12. ***RTB*** (English real time bidding) – bidding in real time.

Such tools attract new customers and provide services to existing customers that help develop customer relationships through CRM systems. Customer Relationship Management (CRM) is the usage of digital communication technologies to increase sales to existing customers and encourage continued use of online services through methods such as databases, personalized web messages, customer service, chat bots, email and marketing in social networks. However, if you want to be successful in digital marketing, it is necessary to integrate traditional media with such tools as print, television, direct mail, and PR. They are part of multi-channel marketing communications in mobile devices.

The ranking of the frequency of use of digital marketing tools is as follows:

1. The first place takes SEO (site optimization in search engines). About 90 % of enterprises use the method.

2. The second place take SMM (social media marketing) and SMO (optimization for social networks. About 65 % of enterprises use the method.

3. The third place take mobile applications (they increase every month by 2–3 %).

4. The fourth place is contextual advertising. About 60 % of enterprises use the method.

5. The fifth place takes SEM (search marketing). About 60% of enterprises

use the method.

The first place of search optimization is explained by the fact that 70–90 % of consumers, depending on the type of market (B2C, B2B), start their search for a product from search engines. This is the basis of the paradigm and concept of digital marketing, which is manifested in the philosophy: "Cooperate with those who want it". This approach is a priori the most effective. When a user turns to a search engine, his request is recorded, and thus the needs of consumers are determined. Further, with the help of other digital marketing tools, he is offered alternative options for meeting demand.

The second place of marketing activity in social networks is due to the popularity of social networks and a high level of trust in the recommendations of acquaintances and friends. Social networks are an artificial platform for realizing the biosocial propensity of people to communicate. This is facilitated by unlimited interactive communications, direct participation of users in the generation and relaying of media content, a high degree of involvement in the communication process, maximum feedback speed, and user personalization. Meanwhile, in addition to social networks, there are other types of social media that also allow influencing the position of consumers: Internet forums, blogs, photo and video hosting, virtual worlds, communities for the production of joint content, joint projects, geosocial services, event communication communities, dating sites, social aggregators. That is why the methods of SMM and SMO are so important, which allow you to form and consolidate a positive image of the company among the network community. Optimization of social networks occurs due to the organization of media sites and attracting the target audience to them, placement of advertising or PR content in places of concentration of the target audience, creation and management of blogs, cooperation with bloggers, creation or sponsorship of additional software products, holding contests.

An additional tool for social networks is viral marketing, which is effective under the condition of harmonizing the content of commercial information and the form of its illustration. Mobile marketing is not yet among the leaders of digital marketing, but it is rapidly gaining momentum and its share in the total volume of advertising should be expected to increase in the near future. The increasing potential of mobile devices, the growing number of GPS devices and various mobile applications will lead to a restructuring of digital marketing in favor of mobile marketing. Mobile marketing is 2–5 times more effective than internet marketing.

The creation of mobile applications strengthens the presence of the product in the digital network and involves understanding the target audience, the portrait of the client and proactively developing digital solutions to solve the company's problems. Before creating concepts and features of mobile applications, companies should answer the following questions:

1. Is the offer limited by issues of reach, understanding, trust or loyalty?
2. Are there problematic issues with important customer touch points?
3. If there are gaps in brand perception, how can digital marketing tools close or bridge them?

Taking this into account, the effective operation of the company is achieved by the synergy of the actions of Internet marketers and employees of other departments, in particular the marketing department. The strategy for the development and operation of mobile applications should not operate in a reactive mode. Digital marketing is involved during the planning and design phase of mobile software, and its application should not be delayed. For example, Starbucks reinforces its offline value proposition with an app that lets you take advantage of quick checkout, tip, earn stars, find stores, choose personalized offers, and more. Such a strategy is aimed at obtaining a sustainable advantage in the future, which is supported by the application of innovations and an aggressive brand strategy.

Digital mobile transformation is the introduction of modern technologies into the enterprise's business processes with the help of mobile software products.

This approach involves not only the installation of modern equipment or software, but also fundamental changes in management approaches, corporate culture, and external communications. As a result, the productivity of each employee and the level of customer satisfaction increase, and the company gains the reputation of a progressive and modern organization.

Digitization of processes is relevant not only at the level of individual enterprises: entire industries choose this path of development as the only opportunity to meet the rapidly changing conditions of the surrounding world. Thanks to this, the digital transformation of industry, retail trade, the public sector and other areas is already changing the life of every person and every company today.

The use of digital media, data and technology to support marketing activities has given rise to a wide range of terms proposed by practitioners and academics alike (digital marketing, Internet marketing, electronic marketing and web marketing). Digital marketing is the evolution of internet marketing.

The digital economy is a global network of economic and social activity that is accessible through platforms such as the Internet, mobile and sensor networks. Since the digital economy is, on the one hand, a derivative of the electronic economy, and on the other, the next stage of development, the identification of fundamental differences in marketing in the conditions of the digital economy is unresolved.

The new phenomena that give the digital economy independence and specificity are:

– mobile technologies;

– cloud technologies;

– business analytics based on digital technologies;

– social media.

Mobile technologies significantly change business models, as various actions with information can be carried out remotely. Smartphones are a personified multifunctional network device that has a wide range of applications, video cameras, cameras, allows you to connect with all devices on the Internet, with other people.

The higher the economic growth rate, the faster the number of smartphones increases. Currently, China's economy has reached the first place in the world in terms of growth rates, accordingly, China ranks first in the world in terms of the number of smartphone owners. In second place is the US economy – the US ranks second in the number of smartphone owners.

Cloud technologies allow processing large arrays of unsystematized information, systematizing it. It certainly makes marketing decisions easier. Therefore, the costs of implementing cloud services are increasing in the world. Currently, 60 % of the information collected in the world is stored in the cloud. National programs for the development of cloud services have been adopted in the USA and EU countries: in the USA – "Federal Strategy for Cloud Computing"; in the EU – "Unlocking the potential of cloud computing in Europe" (2,5 million additional jobs, 160 billion euros in annual additional income).

Business analytics on the basis of digital technologies changes the traditional, time-stretched scheme of analytical work: information was collected for a certain time, and then analyzed. Nowadays, automatic network analysis of the flow of undocumented data, directly or indirectly related to the enterprise, is important. Business analytics tools are: business analytics platforms (business intelligence, BI), performance management tools (corporate performance management, CPM), advanced analytical applications. The largest specialized manufacturers are SAP and Microsoft.

Social media harmonize the cross-functional coordination of business units and communication with consumers and partners. The recent growth of social networks is due to two factors: the increase in the number of people who connect to the Internet through mobile phones, and the growth of the audience of social networks at the expense of people of older age groups.

Techniques have already been developed that allow you to influence the target audience even in an offline environment (phone applications, SMS/MMS, advertising displays on the streets). This is the latest type of marketing, which is based on the use of data in digital form and devices that process them (computers, phones, smartphones).

Digital marketing is broader than Internet marketing by:

1) new possibilities of mobile communication:

– text messages (SMS);

– automatic voice menu (IVR);

– multimedia messages (MMS);

– local radio communication between communication devices (Bluetooth);

– wireless data transfer protocol (WAP);

– mobicod – a combination of numbers that makes it possible to make payments or receive discounts;

– QR-code – a picture on printed products, which allows a quick transition to the virtual environment;

– technologies Click To, Flash SMS, Location Based Services (LBS) – technologies for convenient downloading of software products;

2) new possibilities of television:

– technology of augmented reality in mobile devices (AR) – technology of reproduction of virtual elements in reality;

3) new possibilities of interactive mobile screens:

– 3D-projections (3D-mapping) – the technology of projecting an image onto an object in the environment;

4) new possibilities of POS terminals, video cameras:

– biometric technologies – the technology of automated identification of consumers based on physiological (fingerprints, facial recognition, DNA, iris pattern, palm or ear shape, smell) or behavioral (handwriting or keyboard handwriting, voice) characteristics.

5) new e-mail features:

– sending electronic advertising messages in the form of SMS to mobile devices, i.e. telephone marketing is combined with postal mailing.

Advantages of digital marketing using mobile technologies:

– interactivity – active involvement of the consumer in interaction with the brand;

– absence of territorial restrictions during the implementation of marketing ideas;

– ease of access to the resource (web and wap resources);

– significant spread of the Internet and mobile communication ensures active involvement of the target audience;

– the ability to quickly evaluate campaign activities and manage events in real time.

Mobile marketing is divided into:

1. ***Pull-form:*** the consumer independently selects the information he needs, the platform (content) and turns to the brand himself. In this case, the audience uses what is offered to them.

2. ***Push-form (pushing):*** the consumer, regardless of his desire, receives information (SMS, SPAM, etc.). This form has a significant drawback – the information obtained in this way is often not paid enough attention, and therefore such efforts are sometimes useless. Sometimes the consumer is forced to download a mobile application to receive the offline services he needs, such as a taxi quote.

In order to develop a reliable and effective digital strategy in modern conditions, it is necessary to understand the new, more complex path of the buyer, which includes a wide range of forms of online presence, accordingly, three main types of media channels should be distinguished: paid (paid), owned (owned) and earned / purchased (earned) media channels. Let's consider the key differences between media channels and the impact of each of them on the development of mobile applications.

Paid media channels are communication with the user, in which funds are purposefully invested. The channel expands the reach of the advertising campaign and increases brand recognition with the help of media advertising, advertising through bloggers, affiliate marketing, conversions as a result of search marketing optimization or other tools: video advertising, display advertising, native advertising, special. projects, promotions The Paid Media audience is Internet users who have not heard of the company before, but are potentially interested in the product. Paid media channels are designed for large-scale Internet campaigns aimed at increasing brand awareness and conversion. In this case, corporate mobile technologies are used, which help to form the principles of flexible project management within the team. In addition, Paid Media clients can be members of a closed user club of one of the companies. A significant advantage is the ability to measure key performance indicators and marketing metrics that reflect the ratio of spent funds and efforts. These are catalysts that react with the company's resources and lead to the formation of Earned Media.

Earned Media – earned media channels that form a recognizable, honest and reliable brand image. This is the result of planned and implemented activities in Paid Media and Owned Media. The audience is attracted through the complex actions of users and media towards the brand, including editorials, comments and publications on the Internet, discussions on Internet platforms, likes and comments. This is advertising generated by the brand's audience: online reviews, content distribution, and word of mouth. Earned Media audiences are users targeted by an advertising campaign and those already engaged through paid and organic online channels. It also includes fans of the brand, their friends and followers. Now, earned media also includes discussion that can be driven through viral and social media marketing.

Owned Media – own media channels that are created and controlled directly by the business owner. There are the following platforms for posting brand content: product website, social media pages, company blog, YouTube channel, email, mobile apps, retail stores, print ads. The audience of Owned Media is regular, new and potential customers. The conversion of users into customers through paid media depends on the quality and relevance of the company's content. Owned Media is a push to encourage customers to use mobile software in their daily activities. US scientists found that in developed countries more than 80 % of the population uses the mobile interface for almost 8 hours a day.

In some situations, the own channels of some companies become paid media for others – for example, when an online or virtual store implements advertising spaces in its mobile application. The expansion of the spectrum of media formats reflects fundamental changes in the perception and understanding of advertising messages by consumers. In this regard, there is a need for thorough research and expansion of the "paid, owned, earned" media mix model, since in modern conditions the concept of paid, owned and earned channels is not sufficiently developed and comprehensive. How, for example, should a marketer respond to offers to purchase advertising spaces on sites dedicated to other companies' products? What measures should be taken to mitigate the consequences caused by the actions of web agitators spreading a negative opinion about a product or an advertising campaign? Obviously,

Thus, sold media channels mean own resources, the traffic of which is large enough for other organizations to be interested in posting information and using e-commerce mechanisms. This trend, which is still only developing, has already proven its effectiveness on the example of retail trade and tourist services (airlines and hotels), so it will undoubtedly continue to gain momentum in the future. Johnson & Johnson, for example, offered a completely independent media project, BabyCenter, which advertises not only ancillary products, but also competitors' products. In addition to income, third-party companies bring elements of objectivity to the site, help increase traffic for the benefit of all interested parties. In this case, mobile applications for choosing and ordering children's cosmetics from several companies will be a very effective marketing campaign.

On the one hand, mobile innovations have opened up additional (and more diverse) communication opportunities for marketers. On the other hand, they increased the risk that the reaction of dissatisfied consumers could be immediate and public. So, a stolen media channel is the exact opposite of an earned one, as the results of an advertising campaign are controlled by consumers, shareholders or activists who speak negatively about a brand or product. Participants of social networks have already mastered the hijacking of media channels in order to put pressure on the owners of advertising materials. Among the loudest examples are Domino Pizza with a humorous video posted on YouTube where two employees dirty sandwiches, Red Bull (drift on Sofiivska Square).

In each case, active consumers tried to convince others to boycott certain products, putting the company's reputation at risk. In such situations, the reaction of the brand owner is often not quick or thoughtful enough. Since different types of advertising are interconnected and interdependent, marketing plans and resources must be adapted to new realities and take into account all five types of media resources. This approach has a synergistic effect and comprehensively solves the client's media tasks.

Questions for self-control:

1. What are biometric technologies?
2. What types of cloud technologies exist?
3. What is the process of digitization in the interaction of different groups of respondents?
4. What is remarketing?
5. What is mobile marketing?
6. Name the principles of branding when creating mobile applications.

6.2. Strategy and audit of the use of mobile applications

The mobile application development strategy is inextricably linked with the overall business strategy, as it is a set of planned actions to achieve the company's business goals. Implement the strategy according to the established schedule using the most appropriate online channels to increase revenue, increase company awareness and improve relations with the audience. The company cannot limit itself only to the use of mobile applications and must activate social networks and website operation.

The mobile application development strategy is a content plan for achieving the company's goals with the help of mobile technologies. The purpose of the strategy is the process of identifying, formulating and implementing digital opportunities that will give the organization competitive advantages.

Digital marketing includes the main areas: content marketing, email marketing, search engine marketing (SEM), search engine optimization (SEO), contextual advertising, marketing in social networks, partner marketing. The goal of a mobile application development strategy is to combine all these elements into one plan, allowing you to save time, money and effort.

The need to develop a strategy for the development of mobile applications is:

– in the opportunity to receive more information;

– in establishing direct contact with the audience;

– increasing sales and customer loyalty while simultaneously reducing costs thanks to the acquisition and analysis of new insights;

– obtaining real data and increasing flexibility in decision-making;

– structuring actions to achieve the company's overall strategy;

– increased ROI, increased return on investment;

– improving the customer experience and increasing the value of the product with the help of digital capabilities;

– creation of new easy-to-use sales channels with effective and inexpensive service at the same time.

Stages of creating mobile application development:

1. Determination of goals, taking into account the business goals of the company.

2. Defining the target audience.

3. Formation of a unique sales offer, mobile product ideas.

4. Analysis of technologies and tools, identification of external and internal digital tools and channels.

5. Creation of mobile application functionality and block chains.

6. Setting the general KPIs of the mobile application.

7. Monitoring and management.

8. Performance analysis, determination of performance indicators of each stage and overall strategy.

9. Control and adjustment.

The development of a content marketing strategy involves the use of the POST method (People, Objectives, Strategy, Technology). Individual elements of the method are listed in Table 6.1.

***Table 6.1* – Characteristics of POST method elements**

POST method	*Analysis of the target audience*
1	*2*
People	This stage determines which types of online activities consumers prefer, which functions of mobile applications are clear to them.
Objectives	Definition of clear goals. The company must have clearly defined goals for its future campaign for introducing a new mobile product to the market.
Strategy	Development of relations with consumers. To implement this stage of strategy development, first of all, you need to answer the following question: “How do you want to change your relationship with the client?”. Define three main strategies that most modern companies tend to use in the field of customer relations: – listening: researching what customers are saying about the company’s products or services. In this case, when creating mobile applications, it is necessary to provide for a feedback system; – expression: using social media to spread announcements, ideas and opinions to customers. Companies actively use chat groups and interactive platforms; – attracting customers to the business to achieve goals. This strategy allows consumers to be involved in the creation of ideas for new products, such as choosing the color of a laptop or designing clothes for a doll.

Continuation of Table 6.1

1	*2*
Technology	Selection of functional capabilities of mobile applications that will be understandable for ordinary consumers. It is necessary to conduct a thorough analysis of consumers regarding their literacy in the use of software. An example can be a social service mobile application for calculating pensions and social benefits. Not everyone over 60 has skills in using mobile smart devices. You should also pay attention to consumer preferences in using certain operating systems (Android, iOS).

When using mobile marketing, it is important to constantly monitor the main indicators characterizing the effectiveness of the actions performed. KRI (Key performance indicators) – a system of indicators of key performance metrics of mobile applications – which includes:

1. *Traffic:* the number of visitors, returns and hours of operation in the mobile application.

2. *Conversions:* the ratio of the number of unique views to the total number of actions performed (page views, clicks, link conversions, viewing time, viewing depth).

3. *Backlinks* (incoming links from other sites).

4. *Mention* (textual reference to the domain).

In addition, ROI (return on investment) indicator is used to determine profitability, which makes it possible to assess the return on costs of creating and distributing content valuable to the target audience (the ratio of the profit obtained as a result of certain actions to the costs of implementing actions is determined).

ROI is determined for profitability management, forecasting, and competitor analysis. To evaluate the effectiveness of investments in mobile marketing, several variations of the ROI formula are used: evaluation of sales according to individual conversion, evaluation of sales in terms of one-time leads, evaluation of advertising for traffic from social networks of the campaign. Also, the ROI calculation can include indicators reflecting the degree of interconnectedness of the company’s social networks with involvement in the use of the mobile application.

In addition to measuring KPIs and ROI, software such as SAP can be used to determine the effectiveness of mobile marketing. Instead of tracking indicators for individual content units, within SAP, you can calculate the payback index of customer engagement in a mobile application. It shows the level of consumer engagement generated by a company's content in a specific category or market.

So, the key differences of mobile marketing from other elements of communications are the different marketing impact on consumers and the CRI of each element, i.e. indicators of determining the effectiveness of each tool of the mobile application. The obtained results deepen the applied aspects of digital marketing. Their practical use will make it possible to purposefully choose the most effective marketing measures in a specific market situation using the capabilities of the Internet.

A properly configured digital marketing system of the company is the main factor in the efficiency of business processes in companies and allows for comprehensive analysis of external and internal information and effective management decisions aimed at optimizing business processes and obtaining maximum profit.

Changes in consumer preferences and behavior, the intensity of competition in the markets, the development of new technologies and other factors force modern companies to make more prompt, aggressive and effective decisions. A marketing audit is an effective way of evaluating the effectiveness of marketing activities.

A marketing audit is a study of the micro- and macro- environment of the enterprise, its marketing goals and strategies, covering all the main areas of marketing activity. The company conducts an audit in the event that sales begin to fall and companies go through periods of crisis (P. Kotler, 2012). At the expense of the effectiveness of mobile applications, a marketing audit is conducted based on the comparison of sales results through an offline network, through its own website, social networks, and a mobile application.

Philip Kotler identified six areas of marketing audit:

1. Audit of the marketing environment: macro and micro environment.

2. Marketing strategy audit – business, marketing goals and objectives, strategy.

3. Audit of the marketing organization – organizational structure, functional efficiency, effectiveness of interaction.

4. Audit of marketing systems – marketing information system, marketing planning system, marketing control system, new product development system.

5. Audit of marketing products – analysis of profitability, analysis of cost effectiveness.

6. Audit of marketing functions – products, prices, distribution, advertising, sales promotion, product promotion, sales staff.

In modern marketing, a separate digital sphere is added, which includes the audit of social networks, marketplaces, the company's own sites and mobile applications. In this case, the analysis of the operation of mobile applications is carried out alongside the analysis of the operation of the entire digital marketing of the enterprise.

Reasons for conducting a marketing audit when working with mobile applications:

– changes in the company's product policy;

– the need to increase the volume of sales of goods through digital networks;

– price fluctuations on the market, the possibility of price comparison in mobile applications;

– formation of a basket of purchases and negative reviews of consumers;

– insufficient information about the behavior of consumers who downloaded the mobile application;

– insufficient information about the market, competitors;

– procurement planning and forecasting of financial results due to the introduction of a mobile application.

As a result of conducting a marketing audit, the company can receive answers to relevant pricing issues that will allow management to adjust pricing goals, develop or improve pricing strategies and methods of pricing based on customer requests and formed values, develop mechanisms for providing discounts, which will contribute to increasing the competitiveness of products.

Principles of marketing audit of mobile applications:

– *comprehensiveness* – coverage of all areas of marketing;

– *systematicity* – taking into account the factors of the external and internal environment, goals and strategy of the company;

– *regularity* – identifying problems and solving them in marketing activities at the stages of implementing the company's strategy;

– *periodicity* – development of plans for the implementation of the company's marketing strategy;

– *uniformity* – comparing the performance of mobile applications at the same time of the same product.

The digital marketing audit mechanism includes the following stages:

1. Determination of marketing goals and tasks of mobile applications: entering a new market, reaching a larger number of customers, informing society about the company's work, attracting a new market segment, increasing competitiveness, increasing the use of products among existing customers, improving the level of service, etc.

2. Digital understanding of the consumer, personalization of the consumer according to the main characteristics: geographical, demographic, behavioral, etc. Creation of a portrait of consumer behavior and a map of the consumer's journey, which will allow to specify the object of the marketing audit and make informed decisions regarding the achievement of the company's marketing goals.

3. Analysis of the competitive environment: identification of the company's main competitors (3–5 significant competitors in the industry), especially in the digital space, and research of the competitive environment using methods and

tools of Web analytics, which will allow assessing the company's weaknesses compared to competitors and opportunities for development.

4. Drawing up a road map of work during a marketing audit, i.e. conducting an inventory of all available intangible and tangible marketing assets.

5. Analysis of data obtained as part of a marketing audit.

6. Development of a work plan based on the results of a marketing audit and identification of responsible persons.

Therefore, the marketing audit, as a systematic, independent and periodic check of the external and internal marketing environments, goals, strategies and individual types of marketing activity, allows timely identification of "critical points" of such activity and weak points in the implementation of management decisions.

When conducting a company audit, it is very important to establish the level of customer satisfaction with goods and services. On this occasion, a portrait of the consumer is drawn up. A consumer portrait is a marketing tool that allows you to fully satisfy the needs of the target audience, which will contribute to effective communication with customers and business profitability.

Digital understanding of the audience is advisable:

– when developing an updated version of the mobile application;

– planning new company projects;

– simultaneous creation of groups in social networks, blogging, development of a YouTube channel;

– during media planning and targeting settings (determining the most effective communication channels and choosing the format of advertising campaigns);

– during the development of product design and packaging design;

– for conducting effective PR actions;

– to develop new markets and expand the client base.

A consumer portrait is a collective image of a buyer, consisting of certain characteristics: demographic, social, behavioral, personal, and others. The more detailed and accurate this portrait is made, the more accurately the company's digital marketing will work. For him, they will form a list of desired products, current promotions, new products of the company, as well as offer additional services. Google, Facebook, etc. ads will be targeted at him.

Key characteristics of the consumer for the formation of a portrait (required information):

1. Credo (basic rules of life).
2. Demographics (gender, age, marital status, family size).
3. Geography (place of residence).
4. Lifestyle (education, language, status in society, level of income, average check).
5. Psychotype (type of thinking, tasks, goals, problems, pains, interests).
6. Behavior during purchase (motives, key selection criteria, objections, impulsivity, decision-making methods, product expectations, product fears and apprehensions, product knowledge).
7. Information consumption (groups, audience of social networks, desired type of content, etc.).

Sources of obtaining information about customers:

1. Web analytics systems (Google Analytics). Google Analytics in the "audience" tab provides insight into the following data of visitors to your own site and the mobile version:

– gender and age;
– interests;
– geography;
– devices and browser;
– keywords (not all information);
– the most visited pages, goods and services.

2. Statistical data of social network pages – Facebook, YouTube, Instagram

regarding the direct transition of customers to the mobile application. Facebook page statistics provide an understanding of how content is consumed by day and time of day (statistics / publications). Understanding audience interests can be taken from the Facebook Social Graph. The statistics of Instagram pages are very similar to those provided by Facebook and other social networks: gender, age, geography. YouTube statistics, in addition to standard things, provide an interesting opportunity to analyze the socio-demographic characteristics of individual videos.

3. Google Display Planner and Facebook Audience Insights advertising planners. Google Display Planner (or KMS Planner) is a tool that can be found in your Google AdWords advertising account. Data on the audience of any site can be obtained in a few clicks and receive the following information: gender, age, interests, devices.

Facebook Audience Insights (or Audience Statistics) – a tool for evaluating the audience on Facebook, which allows you to get information: gender, age, interests, marital status, level of education, position.

4. Polling the audience through a direct link in the mobile application: some things that can reveal the fears and expectations of the audience can be discovered with the help of a survey in the mobile version. At the same time, it is advisable to offer some kind of bonus for completing the survey.

To form a consumer portrait, it is advisable to take into account the theory of generations developed by the Nile Hove and William Strauss, which describes the cycles of generations:

1. The baby boomer generation is people born between 1943 and 1960, who pay much attention to spiritual values and choose traditional ways of communication. When choosing a product or service, baby boomers prefer rational consumption. Baby boomers are the first generation to grow up watching television, so television advertising will continue to appeal to these people, unlike future generations.

2. Generation X – people born from 1961 to 1981. They try to maintain a work-life balance and are willing to spend a lot more money on vacations. Generation X uses computers intensively, which has greatly influenced the way they buy goods, they are interested in digitalization of processes.

3. Millennials or Generation Y is a group of people born between 1982 and 2004. This is a generation of tech-savvy people who have been using cell phones and other devices from an early age. Mobile applications are an integral part of their lives.

4. Generation Z was born between 1997 and 2010–2012. Given that Gen Z grew up in an age of advanced technology, the marketing approach to them should be even more digital than to Gen Y. Marketing to Gen Z should focus on quality. When selling products through mobile versions, companies decided to influence the behavior of consumers of generation Z with the help of photos and videos.

5. Generation Alpha – born after 2010. The definition of the Alpha generation was given by the Australian sociologist Mark McCrindel. The Alpha generation will be the most technological and educated. The researcher also calls them the Glass Generation, emphasizing the fact that Instagram and the iPad appeared simultaneously with their birth in 2010. McCrindel also says that after 2025 it will be time for a new generation, and that will likely be the beta generation.

Applying a generational cycle approach to digital marketing is more difficult than it might seem at first glance. For example, choosing a millennial as a marketing audience solves several problems at once. You already have the age range and characteristics that determine consumer behavior. However, it is necessary to think over many more nuances – from transformations and archetypes to locations. This is a fairly basic overview of generational theory, but it can be a solid foundation for building a company's overall target audience, improving marketing strategies and seasonal campaigns for different age groups.

In order to personalize the consumer's profile, it is necessary to give him a name. To visualize the portrait, give it a face that would be associated with the image, create a history of the relationship between the collective image of the client and the company, and allow him to feel, experience, experience difficulties.

For a more detailed analysis of audiences, create consumer mapping and an empathy map.

The Customer Journey Map is a marketing tool that visualizes the experience of interaction between the client and the company at all stages of the product sales funnel. CJM helps clarify such important questions as:

– where exactly do customers find information about products;

– in which places they find products: on the website, mobile application, store;

– how the audience reacts to the product;

– what is the age of the consumer segment;

– what objections arise on the way to making a purchase decision;

– how buyers react to the sales method;

– in which cases clients are maximally satisfied;

– when they feel frustrated.

All these points are entered in a table or graphs, then this information is analyzed, decisions are made about improvement and exclusion of negative points.

The empathy map is a marketing tool that allows you to put yourself in the customer's place and look at yourself and your product through his eyes. They help to collect and visualize detailed characteristics of the target audience: problems, pain points, values, achievements, motives, and so on. The empathy map complements the client portrait. A typical empathy map includes six elements: who is the customer; why the company is researching the client; what the client sees; what the client says; what the customer is doing; what the client feels. However, the main thing in modern marketing is the client's pain and expectations. In this regard, the mobile application provides a more thorough response to the client's feelings. It is advisable to conduct a customer satisfaction analysis after all steps of the customer journey. So the information is the main one for the audit of the mobile application.

Questions for self-control:

1. What does a mobile app development strategy include?
2. Name the characteristics of the elements of the POST method.
3. What should a KPI scorecard for mobile applications include?
4. List the six areas of marketing audit according to Philip Kotler.
5. Name the principles of marketing audit of mobile applications.
6. What stages does the Digital Marketing Audit Mechanism include?
7. Name the main characteristics of the consumer to form a portrait.

6.3. Mobile versions of social platforms and the development of SMM

Mobile app marketing is the easiest way to reach a large audience. Currently, half of the world's population, 3,8 billion people, use social networks, and the use of mobile applications is growing every month. In June 2011, there were 250 thousand applications in the Google Play Store, and already in June 2021, there were 2,9 million of them. Social platforms are essential for increasing company brand awareness. According to data from Hootsuite, 52 % of online companies use social media. That's where most people recognize new brands.

According to Statista, in the first quarter of 2018, the population spent an average of 295,4 billion hours on social media and communication using mobile applications. In the fourth quarter of 2021, this indicator reached 411 billion hours. During this period, the population also spent 243,7 billion hours viewing photos and videos in mobile applications. Therefore, mobile applications open up great opportunities for attracting the target audience and building long-term relationships. Statista made a forecast until 2026 regarding the use of mobile applications through the App Store and Google Play. In fact, in 2021, consumers spent $ 85 billion on mobile apps through the App Store and $ 45 billion on mobile apps through Google Play. It is predicted that in 2026, consumers will spend $ 161 billion on mobile apps through the App Store and $ 72 billion on mobile apps through Google Play. In total, consumers will spend more than $ 230 billion annually. This shows the relevance of using mobile applications in the company's marketing campaign in the coming years.

Marketing media and communications in mobile applications is a set of specific online marketing activities that influence the target audience through downloaded digital programs and are aimed at achieving the company's marketing goals.

The role of social media marketing in the development of mobile applications is significant:

– increase in sales;
– reduction of marketing costs;
– promotion of business partnership;
– increase in ranking in search engines;
– promotion of business development;
– promotion of traffic;
– attraction of potential customers;
– customer support and feedback;
– targeting capabilities;
– forming the loyalty of the target audience.

Most people cannot imagine their life without communication through mobile applications that speed up the time to receive feedback. Therefore, social networks and mobile applications are inextricably linked. The most popular social networks in the world have millions of users.

A social network is a network of people who meet in a digital space to communicate by posting information and images, leaving comments or sending messages. Members can expand their personal and business contacts by contacting others at mobile versions of social networks.

Classification of social networks:

А. **By audience:**

1. Broad social networks accept all users, regardless of their origin. Facebook started as a network for students, but now it is the main network for friendship. Moreover, Facebook has communities and groups formed around brands and interests.

2. Niche social networks aim to connect people who come from a specific niche and have a common goal. For example, The-Dots is a community for creators who want to collaborate and share their skills.

Б. **By appointment:**

1. Informational social networks inform communities about news and events and solve everyday problems. These include discussion forums and consumer review social networks such as Yelp, Zomato, TripAdvisor and Reddit.

2. Educational social networks allow students to communicate. Some popular examples are Pinterest (to some extent) and ResearchGate.

3. Social dating networks are suitable for people who want to build relationships. Examples include Badoo, How About We and Tinder.

4. Multimedia and social content sharing networks allow users to share their unique content (articles, photos, etc.) through blogs and publications.

5. Social networks allow people to keep in touch with each other. Networks like Twitter and Facebook bring people together.

6. Work-based platforms include e-commerce platforms (TaskRabbit, Airbnb) and consumer review platforms (Zomato, Foursquare). People can search for information about brands, products and services and make purchases.

7. Shopping networks allow users to shop online.

B. By platform:

1. Web networks can only be accessed from desktop computers. Facebook, YouTube and Twitter – some of the most popular social networks today – started as web social networks.

2. Hybrid networks combine Internet and mobile capabilities and can be accessed from any device. They are optimized for mobile devices and have mobile apps for iOS and Android. Take Facebook and LinkedIn as examples. You can access these platforms from your laptop, PC, tablet and mobile phone.

3. Pure mobile networks are applications designed to run on mobile devices such as smartphones, tablets and smartwatches. Some popular examples include Telegram and Snapchat.

Building a marketing policy in social networks with the help of mobile applications is created at the expense of storytelling. Storytelling in digital marketing creates a new format for conveying information to the end customer. First, it delves deeply into the problem of society and reveals issues that are relevant for consumers. For example, the need to look at a problem from the other side, to discover new criteria and requirements for a product or service. Second. Convey timely and relevant information in a language understandable to the consumer. Thirdly, high-quality storytelling personalizes the appeal, and the consumer understands that the brand solves exactly his need (a story about safe headlights on bicycles for those who ride at night, big wheels on a baby carriage when off-road on city streets). Fourth, storytelling inspires new ideas and innovation for other businesses.

The main factors of the influence of storytelling on the brand [40]:

1. Storytelling creates neural connections. The received information affects the work of the brain in such a way that it creates an opportunity for a person to make parallel connections with his own life and experience, that is, to apply the idea of storytelling to a personal situation.

2. Mirroring. The receiver of information not only perceives and processes such information, but also distributes and reflects it as a speaker.

3. Creates the production of dopamine – a substance that causes positive emotions, sensations and euphoria. With the help of this substance, the listener remembers information better and can reproduce it clearly.

4. Activity of the cerebral cortex. A good story that is memorable and evokes extraordinary feelings can touch the parts of the cortex responsible for emotions, mobility, and sensuality. A person can reproduce information with movements and gestures.

Due to the fact that different parts of the human brain are activated, effective storytelling should be accompanied by visual content. In the case of a story about the success of a brand or the implementation of a new idea in business life, graphs, diagrams and tables are widely used. Thus, an interesting business story should captivate and constantly attract attention, "be on the ear", as well as "transfer" the consumer into the reality of the hero of the story [41].

There are three rules for the effective use of graphs, drawings and diagrams in the creation of storytelling [42]:

1. Who. It is necessary to clearly identify and justify who is the main audience to whom the information will be presented. It is necessary to reveal the main key questions: what is the relationship of the audience to the brand? What motivates them to buy products? What can excite and disturb? The answers to these questions substantiate the special characteristics and behavior of the consumer. If the answers are given correctly, the story will help not only attract attention to itself, but also provide a solution to the problem that exists in the potential consumer.

2. What. The information must be clear, distinct and unambiguous. After reading or listening to a story, the consumer must understand what is relevant and necessary today. If in the case of cases, the solutions can be different, then storytelling should have a bright finale. This finale should directly correspond to the obligations and slogan that the author tried to convey. For example, if the story is about the dangers of plastic toys, the story should have an ending about what could possibly happen when using or disposing of such a toy.

3. How. Visualization should be insightful. Information should confirm the story, not divert from reality. Block diagrams, drawings with stages will be useful for visualizing logical decision-making. To attract the attention of the audience, photos of situations, visualization of trends with the selection of individual elements will be relevant. Different colors and fonts are used to emphasize a separate important idea.

The usual storytelling mechanism is based on eight stages [43]:

1. Understand the importance of context.
2. Determine the appropriate graph type.
3. Recognize and eliminate clutter.
4. Direct the attention of the audience.
5. Think like a designer when visualizing data.
6. Use the power of storytelling to make your message resonate with your audience.
7. Practice storytelling at home and at work.
8. Make the closing content.

When creating a business history, there are well-known principles and approaches [44].

Classic storytelling. The reader or listener needs to be presented with the general rules that send him on the “customer journey”. There are several models of story scenarios (heroes’ journeys, the search for a guru, personal victory, etc.). The story has three main components: beginning, plot, ending. In such a story, it is clear who to love and who to hate. From the point of view of branding, the consumer receives frank “true” information. However, the story should not be boring, because the consumer must go his “way” to the end together with the main character of the story.

An authentic story. It is necessary to make the story truthful through belonging to a part of the community. Every woman pays attention to information when it comes to diet products. Such a story highlights the problem of an individual woman, her life, her problems related to diet. This story model is favorable to the majority because most consumers see their relevance to the events being covered. They consider themselves part of such history.

Storytelling is not about sales. A story is not meant to sell a product, a story represents a brand. It conveys the most important information about ways to satisfy consumer needs. In the story, the consumer must find himself and a way to solve his problem.

Visualization. Each person perceives information differently: someone pays attention to colors, while someone, on the contrary, needs audio support. It is necessary to specifically imagine for yourself what the potential consumer reacts to (numbers, emotions, sounds, smells, etc.).

Conflict in history. The conflict in the story must be open and understandable to the consumer in order to arouse him to events and reactions (caring for children, protecting animals and plants, lack of resources). When the average person tells a story, they usually tell about themselves, mostly guided by experience, and not based on numbers. Information is better perceived not by dry numbers, but by empathy.

Accident. Despite all the existing rules of creating a story, an unexpected situation can not only attract attention, but also get ahead of competitors.

Time to create. One and the same story will be transmitted through social networks, channels, websites, etc. Therefore, it takes time to agree on the structure and form of information submission. When creating a story, it is necessary to plan time not only for creation, but also for the editing and design of the story.

The language of storytelling. It is necessary to use the "natural" language of consumers, that is, to communicate in the "language" of the consumer, to use phrases and quotations of consumers for a better perception of information.

Advantages of storytelling:

1. Consumer confidence. Consumers determine important criteria for

themselves according to the information provided in the story. Thanks to the advice, the consumer feels like an expert when choosing a specific product or service.

2. Transfer of personality. Social networks are an ideal place for bringing people together. Telling stories about your own brand brings the consumer closer to the brand, if they find their participation in the characters of the story or in the events covered in the story.

3. Memorization. Storytelling creates memorable appeals. A creative approach, a high-quality script and an interesting text leave the main appeal in the memory. The consumer will, if necessary, take the time to recall the story and find the information again.

4. Increase in sales volumes. With the manifestation of trust in the brand, a greater number of consumers become supporters and bearers of positive information about the brand.

5. Competitive positions of the brand. As the story spreads, more and more customers read it and become part of the story and thus the brand. This creates a competitive potential of the product and boosts sales.

6. Business expansion. Competitors read the stories and implement the ideas in their business.

7. Spreading experience. Involvement of customers and consumers in acquiring knowledge and general rules for choosing a specific product.

8. Increasing attention and establishing interest. A short story of success or innovation attracts attention, is remembered and spread among other contact groups.

9. Labor efficiency and involvement of specialists. When creating storytelling, photographers, models, video editors are involved, which makes them a team with a single goal.

Companies have actively started using the principles of viral marketing in mobile applications. According to the Cambridge dictionary, viral marketing is a type of marketing activity in which information is distributed among people, in most cases through the Internet [45]. In general, viral marketing is a tool for spreading information at an increasing rate based on organic search or word of mouth [46]. In today's digital space, viral marketing is more common in mobile applications through the transmission of memes, holiday cards, gifs, individual avatars. In 2021, viral marketing in video format on the TikTok network is gaining momentum. The dissemination of information occurs according to the principle of progression: each person spreads information through several persons, thus creating a network for communication.

There are several types of viral marketing that marketers use to attract the attention of customers and consumers [47]:

1. Emotional. Consumers can react strongly to any informational link. Therefore, the purpose of this model of viral marketing is to evoke emotions of joy, happiness, pride, willingness to care, compassion, confusion, etc. Both tears and a smile can encourage a person to take active actions: share information, discuss it with loved ones, save it for later use, distribute it to the masses. For example, when selling shoes, negative emotions can be caused by videos with killed animals, the skin of which is used in production.

2. Incentive. Incentive viral marketing creates a reward for the active participation of its readers and viewers. The more a person encourages their contact audience to the brand, the more rewards they receive. For example, when offering a new range of pasta for children, every mother who shares a photo on Instagram of her child eating such pasta is offered the next package at a discount. Also, offering a reward for each subsequent customer is also considered by viral marketing. For example, bring a friend or relative to life insurance or home loan.

3. Engineering. Many viral marketing campaigns are well-planned and take into account the step-by-step involvement of consumers in the communication. The goal of engineering viral marketing is to gradually introduce a new brand into the consumer's life. For example, when selling dolls, the client will immediately be offered to buy a basic set of elements and components so that the child has acquired superficial skills of playing with the doll. Next, the client will be offered to buy additional items (clothing, wardrobe item). After that, a mini-series or promo game with the main character Lyalko will be released on Internet channels with a link in the mobile application. After that, the child is encouraged to support other girls who do not have the opportunity to buy such clothes and to donate part of the purchased items to the created fund. Next to this, groups are created in the mobile application to support the doll: "fashionable hairstyles of the Doll".

4. Successful. Successful or unplanned viral marketing deals with an unexpected turn of events. With such a model, a brand can receive feedback after a certain period, or information can resonate with a potential audience of customers in a short time. Usually, this model of viral marketing is not planned, or expected, that some kind of advertising can potentially become an element of viral marketing. For example, setting up a photo zone and taking pictures near it can advertise the existing event even among those who did not attend it. At the same time, memes near the photo zone and incorrect photos can contribute to the negative spread of information about the brand.

5. Capricious. Whimsical viral marketing or gossip marketing should cause an explosion of emotions so that people try to spread information as quickly as possible among their contact audience, not only in the online space, but also in everyday life. The result of such a model of viral marketing can be that a person, without even seeing an information link, can become a full-fledged carrier of information.

John Berger, a famous American marketer, identifies six characteristics that make marketing viral [48]:

1. *Social currency:* we share viral ads because it makes us look good.
2. *Triggers:* we share this because it matters.
3. *Emotions:* we share them because they make us feel something.
4. *Publicity:* we share this to imitate what others are doing.

5. *Practical value:* we share this if it is useful to others.

6. *Stories:* we share this to tell a story.

Common characteristics that make viral marketing effective [48]:

– strategic planning of information dissemination stages;

– audience engagement and active actions of potential consumers;

– the spectacle in social networks and the involvement of the press in the discussion;

– use of humor and other positive emotions;

– value for consumers;

– attracting stars and opinion leaders;

– low barrier to penetration into information networks;

– promoting distribution among the audience;

– exclusivity and novelty of information;

– propagation speed.

Not every advertisement can become a part of viral marketing. Audience interest and engagement makes marketing viral [49]. Gamification engages customers through winning a prize at the end. The rooks try to collect as many bonuses as possible in order to receive the declared prize. Involving the press in a marketing event potentially increases the audience of people who will be interested in using the product. Resonant events are covered by well-known Internet bloggers. The interactivity that can be created in a viral ad encourages consumers to be a part of a uniquely created performance. In this case, an engaged target audience potentially increases brand recognition. Advertising companies actively practice the use of targeted marketing elements when creating a viral appeal, which makes it more personable. For example: “Hello guy”, “Dear lady”.

A strong factor in the success of viral marketing in mobile versions of sites is the involvement of famous people who automatically spread such an appeal among their audience. In this case, the main thing for viral marketing is to choose a star that has a group of fans that is relevant to the target audience of the brand.

Another tool of effective viral marketing is consumer activity when creating a new product or changing technology. In the mobile application, consumers are invited to take part in a discussion, questionnaire or focus group with the aim of creating a new taste of the product or a new design. Humor and positive emotions also play an important role in viral appeal. Consumers are already saturated with television products that highlight world issues. Moreover, they do not have time to spend on long entertainment programs.

In general, there are 6 rules of effective viral marketing in mobile versions [50]:

1. Create an appeal with an emotional undertone.
2. Make it shared.
3. Choose the perfect time.
4. Create uniqueness.
5. Radiate authenticity and reality.

While most people think of viral advertising as random, at the same time, viral marketing is a well-formed, strategic brand campaign based on careful research into consumer behavior and preferences. Marketers use 5 basic techniques to make an ad go viral [51]:

1. Get attention quickly. Consumers spend a lot of time on social networks, scrolling through information in search of interesting and useful information. In this case, it is necessary to create a text appeal that will evoke emotions, or use an image that could stop the consumer's gaze.

2. Engage your audience. The virality of advertising is based precisely on the active participation of the audience and the dissemination of information through potential consumers. The appeal should contain a call to action.

3. Evoke emotions. Each person has his own emotional mood when viewing an advertisement. Mundane, boring information is rarely remembered and remembered among consumers. With the manifestation of strong positive or negative emotions, there is a high probability that the information received at this time will be remembered for a long time. Before publishing the appeal, it is necessary to re-read it and determine which part of the appeal attracts attention and is more memorable.

4. Create simple appeals. The simpler the text form, the more it is remembered, used in everyday life, and transmitted between listeners. Using two or more references can distract the audience from the main idea, or the idea can be distorted. What's more, short audible statements better match the beat of the music, which makes it possible to use audio alongside text and graphics. You should also pay attention to short appeals in social networks, and do not clutter it with hashtags and links to other contacts.

5. Set goals. The goal itself should be the basis of a viral appeal and should not focus on itself. The title of the appeal should reveal the purpose of viral advertising, and at the same time attract action. Moreover, all specialists involved in the work (photographers, models, text writers, video editors) must clearly understand the goals and desired result of viral marketing. The results should have a unit of measurement so that it is clear which KPIs have been achieved.

The main KPI today is recognized as the viral hit rate (formula 6.1) [52]:

$$V_i = \frac{(C \times R \times CR)}{100}, \qquad 6.1$$

where C – number of clients;

R – average number of referrals (distribution) per client;

CR – the average conversion rate of referrals (distributions).

Advantages of viral marketing:

1. Low costs. Spending is limited to creating a video or visual story that customers want and want to share.

2. Reach. Can reach more widely than planned and expected.

3. Speed. A network of thought leaders spreads information faster than conventional visual forms of communication.

4. Trust. The transfer of information creates a credit of trust among customers due to the provision of feedback and recommendations. Viral marketing improves brand reputation through the opinions of its followers.

5. Discussion in the crowd. Information is usually shared among close people: relatives, friends, colleagues. Each medium can transmit messages to more than 10 people at the same time. Thus, the dissemination of information occurs according to an arithmetic progression.

6. Creativity. Viral information is remembered better than ordinary advertising and remains in memory longer. Thanks to creativity, consumers pay attention to the problem from the other side.

7. Innovativeness. Viral marketing helps spread the value and innovation of a product by attracting fans and consumers.

Questions for self-control:

1. Define the role of social media marketing in mobile application development.
2. Describe the classification of social networks.
3. Name three rules for the effective use of graphs, pictures and diagrams in the creation of a story.
4. What are the known principles and approaches when creating a business story?
5. What types of viral marketing do marketers use to gain the attention of customers and consumers?
6. What methods do marketers use to make an ad go viral?
7. Name the Advantages of Viral Marketing.

6.4. Principles of branding when creating mobile applications

Brands, as symbols of today's consumer culture, are becoming an important means of demonstrating identity, markers of social space, and a "mirror" of social reality. The importance of brands and branding in this approach is particularly important. The analysis of brand advantages provides new opportunities for studying the dynamics and transformational changes in modern society.

It is necessary to distinguish between two concepts that are often used by representatives of Ukrainian enterprises, and sometimes in translation in professional literature, are perceived as identical: trademark and brand. In short, a trade mark is more of a legal term that indicates a company's ownership of a certain name, emblem, design, etc.

A brand is a differentiated trademark, i.e. a brand that is associated with certain advantages or benefits in the consumer's mind, clearly differs from competitors' brands and is characterized by a high level of consumer loyalty. In short, a brand is something that resides in the consumer's mind. The false identity of these concepts leads to the fact that Ukrainian manufacturers often mechanically, without proper marketing support, giving brand names to products of their own production believe that they have introduced a new brand to the market.

So, any brand is a trademark, but not every trademark is a brand. A trademark becomes a brand only when the relationship between the product and the buyer acquires permanent psychological ties. The transformation of a mark into a brand is possible if the product has a unique selling proposition (USP). The main role in the implementation of the branding mechanism, even in the mobile application, is played by advertising, creating and broadcasting informative and visual messages about the product to the target audience within the general strategy of promoting the brand. Now the struggle of corporations comes down to the positioning of their products, and brand perception is mostly emotional, given that most products are technologically the same with similar consumer properties.

In this standardized atmosphere, the phenomenon of anti-branding emerges. This is the rejection of the existing brand at the level of the consumer's consciousness, the change of the brand to its antithesis – something that cannot be bought, which indicates the absence of consumer qualities declared by the brand; it is the destruction of the positive image of the product or the campaign in general and, finally, questioning the reputation of the brand of the campaign. Passive opposition to branding occurs in every consumer, because consumers do not see the need for this product, do not make significant claims to the product, because it is a product of everyday demand or people already have a similar product. When working with a brand in mobile applications, in this case, a situation occurs when the consumer does not immediately pay attention to the application, does not view the news, and then deletes the application altogether.

But the consumer quickly gets used to brands and avatars of mobile applications. Certain niches for different concepts and categories have formed in human consciousness. Protecting itself from the huge flow of information, the brain filters out most of it. The same applies to the advertising flow: consumers have already grouped products and brands according to certain sectors in their minds, accordingly, the brand that won the first place is perceived as UTP. The majority of companies occupy the 2nd and 3rd places in the specified niches of consciousness. In nine cases out of ten, an attack on the leader from the outside will not be successful, because anti-branding of the new product is taking place at the level of the consumer's consciousness. The way out is provoking new, non-standard marketing creative solutions to create new niches of non-standard perception of brands in the mind.

In the modern conditions of development of mobile applications and their competition between them for free space in the phone's memory, the brand must be recognizable, but at the same time not catch the eye. It should be like air – imperceptible, but vitally necessary with a minimalistic and concise identity. A single phrase, logo, color are used in different contexts, on different information channels.

Digital branding is based, as defined by the Digital Branding Institute, on the development of an individual or organizational identity, visible and authoritative in society, which interacts with business on the Internet or with the help of other digital media. Such a concept makes digital branding important for own construction and creation of brand history, as well as presence in the digital world.

Digital branding involves a fully digital media influence strategy that goes beyond standard online tactics, as is often seen with internet branding, which is labeled as posting daily tweets, promotional messages, or emails. In mobile app branding, the company's logo or symbol, as used when downloaded and displayed on the phone, is extremely influential. In digital branding, the brand is considered from the standpoint of digital communication and its role in business strategy and media planning. It is determined that digital channels and assets are used to communicate brand positioning (or purpose) within the brand's multichannel engagement programs.

Thus, there is a change in the paradigm of investing in business development, which is transformed from the classic design: "company – consumers – product – brand" to a modern design that determines the primacy of the brand and the priority of consumers of the brand itself: "brand – consumers – product – company". So the chain starts with the brand and its digital story. Building a digital brand story focuses on creating a common brand myth, and the specifics of modern branding is to create your own digital story. The digital story defines the time when the brand moved to direct personal communication with the customer and shows when the brand began to transform from the object of the relationship to the subject of the relationship. That is, the brand in the digital branding system acquires certain human traits.

The set of trends of the "new economy" – the globalization of the market space, the introduction of innovative developments, new technologies of marketing and brand management, the strengthening of the role of the consumer, the emergence of new types of services, professional platforms for interaction and communities, interactive mobile applications – leads to the need to develop a new model of brand management. A. Kearney proves that traditional brand attributes are less effective than a positive online consumer experience. The focus of the company's activities should be aimed at attracting new consumers to use applications on a daily basis, meeting the needs of these consumers, retaining them, and establishing long-term relationships with consumers through interactive interaction. The scientist offers an i-brand model with such components ("7C").

Convenience – a component that provides for the creation of a system of working with a mobile application that is as comfortable as possible for the user, as well as the ability to perform operations at any time of the day and easy search for information. Fast app loading and easy navigation are the most significant factors in building brand loyalty. E-loyalty is a system of indicators such as quality support, timely and free delivery, customer incentives, privacy and security.

Content reflects the reliability and completeness of information that meets the interests of consumers in the mobile version. According to research, 79 % of site visitors do not read, but "scan" the page in search of easy-to-understand information.

Unfortunately, the content of messages, the content of mobile applications is often not harmonized with the image of the company, its brands; the information content does not meet the principles of necessity and sufficiency, visibility and interactivity of the presentation; not the target audience's requests, but search robots' requests are satisfied.

Customization as a component of Internet branding provides the possibility of choosing personal settings of the mobile version in accordance with consumer tastes.

Connectivity (interaction, connection) involves the interaction of sites and mobile applications with each other and the connection of consumers, for example, through the placement of links in search engines, portals, social networks and popular sites, where the presence of the target audience is possible.

Customer care – consumer care, as a component of Internet branding, involves providing all kinds of assistance to consumers online at all stages of contact with the brand. In mobile applications, various forms and methods are used for this purpose – electronic notification, online payment, delivery registration and other additional functions.

Communication ensures the construction of a dialogue with users with the help of bots, coordination of discussion in chats and forums, and by conducting online surveys.

Community involves the creation of a contextual space for user communication in the form of "interest clubs", forums, chats, etc.

A brand community is a set of people interested in maintaining emotional or rational contacts with a brand. The basis of the brand community is the customers who are loyal to the brand, as well as strategic partners and investors.

Researchers T. Andrew Young, Dan D. Kim, V. Dalwani, Trai K. Wee emphasize the need for one more component in the classic 7C model – collaboration. Scientist R. Cleland emphasizes the rapid dynamics of brand development, which requires a review of traditional strategies, tools and the search for new formats of activity, including an interactive approach to attracting customers and increasing loyalty (Table 6.2).

***Table 6.2* – Review of traditional strategies, tools and the search for new formats of activity, including an interactive approach to attracting customers**

Traditional approach	Interactive ("one-to-one") approach
Monologue	Dialogue
Public	Private
Mass	Individual
Anonymous	Named
Competition	Collaboration
The focus is on one-time transactions	Focus on long-term relationships
Remote studies	Personal sources of studying consumer behavior
Manipulative approach – "stimulus-reaction"	The service approach is driven by real needs
Standardized	Non-standard

The scientist offers an interactive model of brand-building in the Internet environment, which consists of five stages: attraction (Attraction), engagement (Engage), retention (Retain), study (Learn) and connection (Relate).

Particular attention is directed to clarifying the specifics of communication interaction at the following levels:

– linear interaction or lack of interactivity, when the sent message is not related to the previous ones;

– reactive interaction, when the message is related to only one previous message;

– multiple or dialogic interaction, when the message is related to many previous messages and the relationships between them;

– interactive interaction, when the message is part of an information exchange in real time and is related to the context of other exchanges.

The directionality of actions of the communication process, which is characteristic of the offline environment, is vertical and limited by configurations: “from one to one”, “from one to many”, “from many to one”. Therefore, traditional marketing communications implement a model of pushing information to consumers who play a passive role and have a rather limited choice of information channels, the mediation of which is mandatory. They are linear in nature and the flow scenario is “one to many”). Media receive revenue from advertisers, companies have access to media consumers, and consumers have access to relevant information.

The Internet facilitates non-linear free-flow communication and information exchange based on the many-to-many principle, which automatically includes both one-to-one and one-to-many models. That is, the basis of marketing communications on the Internet is the pull model, which assumes the active role of consumers, immediacy and interactivity of contacts. Information is provided upon request.

In today’s conditions, it is necessary to emphasize the importance of attracting consumers through advertising, word-of-mouth technology, placing links on partner sites, using cookie data, which help establish the habits and interests of each individual user by analyzing his profile, which contains data about viewed sites, searches, purchases in online stores, etc. Some companies collect “router” information, IP addresses and various environmental parameters for internal use, for example, to improve the security of the mobile version and transactions on it, or to improve the use of this site. Online surveys using e-mail, special applications and web pages offer real opportunities to better understand the needs of customers and are characterized by flexibility, fast processing.

In the second half of the 2000s, there was a mass transition of citizens to social networks, and the public was divided into two categories: Internet networkers and TV viewers, while the second category can understand events, but cannot discuss them, and the first one actively reacts to information and enters into a dialogue. Therefore, the focus of a large part of scientific research is the influence of user-generated content (UGC) and electronic word-of-mouth (eWOM) on brand equity, loyalty and purchase intention.

An effective mobile app strategy requires the balance and interdependence of company-generated content (FCC) and user-generated new media content (UGC) and the impact on brand equity (BE), brand attachment (BA) and purchase intent (PI). Branded content is the creation of content that is fully controlled by the company, driven by the agenda of the marketing strategy.

In Internet communities, the evolution of WOM theory is analyzed and four different communication strategies are proposed in social media (analysis, outreach, endorsement, and clarification). Each of which depends on the narrative nature of the narrator, the norms of the virtual community, the communication format (blogs, Facebook, Twitter, etc.) and the marketing elements of the promotion.

The effectiveness of brands of mobile applications and mobile versions of social networks can be determined through psychological determinants, under the influence of which the consumer begins to independently spread information about the online brand: the strength of ties between community members; homophily; trust; interpersonal influence.

There is a model of online consumer behavior when interacting with a brand. Watching a video on YouTube, discussing a brand on Twitter and uploading brand-themed photos to Facebook, sharing, commenting on posts, and finally downloading a new application to a mobile device are all examples of consumers' online brand related activities (COBRAs).

Within this concept, scientists have clustered a wide range of behavioral characteristics (consumer – consumer; consumer – brand), integrating all concepts describing synchronized online behavioral phenomena. For example, electronic word-of-mouth (eWOM) is associated primarily with consumer-to-consumer brand relationships. The term user-generated content (UGC) is used in the Western literature mainly for data created and uploaded mostly by users rather than companies. In addition, the COBRA concept includes the typology of consumer behavior in the virtual environment, presented in the work of D. Hoffmann and T. Novak.

The spread of digital media makes it possible to visualize the brand through the implementation of the most creative ideas, while the cost of creating this visualization is much lower than creating traditional (classic) ones.

Visualization of a digital brand occurs through the use of professional photos, video shoots, commercials, infographics, gifs, reels. If some time later (roughly in the period 2000–2010) all digital channels fell under the single definition of Internet marketing, then starting in 2010 the identification of individual digital channels became more active, and this initiated the stage of rapid development of interactive mass media. Due to the development of TikTok in mobile applications, consumers pay more and more attention to reels. All this has further strengthened the importance of segmentation, targeting and positioning. And not so much socio-demographic characteristics as behavioral ones came to the fore. The growing importance of consumer analytics databases is becoming critical. This is proven by Charles Duhigg in his work “The Power of Habit”, where he thoroughly examines, how companies predict consumer habits and manipulate them based on the use of giant databases. The company identifies each client by its number and collects information accordingly.

Digital branding channels are gaining special importance. The advertiser’s main goal is to find channels that lead to maximum two-way communication and improve the overall ROI for the brand. Determining which Internet media channels work best for business in general and for a digital brand in particular will allow you to effectively move your business forward. First of all, media advertising is of great importance. This channel includes designing graphic advertisements and placing them alongside content on the digital brand’s own or company’s websites, email messages and other digital media, as well as instant messaging applications. By participating in Internet surfing, the client receives letters from the digital brand or links to various events related to the digital brand, in addition.

In recent years, social networks such as Facebook, MySpace, LinkedIn, blogs, microblogging sites, Twitter, forums, Wikis or open encyclopedias, content from communities such as Flickr and YouTube, as well as podcasts of all forms of social media have become particularly important. All these forms involve the creation of networks or communities that enable users to interact with each other. Social media tools encourage users to share ideas, participate in discussions and interact with other people in real time. Thus, social media can be the best means to position a digital brand or company and maintain contact with customers in a “non-stop” mode 24/7/365.

Typically, when great brand stories are told, it’s almost always about the sales funnel and its contribution to creating a positive brand experience and laying the foundation for building lasting brand loyalty. If the brand is firmly integrated into the consumer’s memory, a certain context of expectations is created. The brand becomes emotional and is already chosen even before the purchase itself is made. In the classic "brand-consumer" design, there are many more elements among its components: the company itself, retail chains (and/or branded stores), sellers. The era of digital branding eliminates these intermediate elements and brings the brand to the direct level of interaction with its consumer, moving to the model of direct interaction "brand-client" (Fig. 6.1).

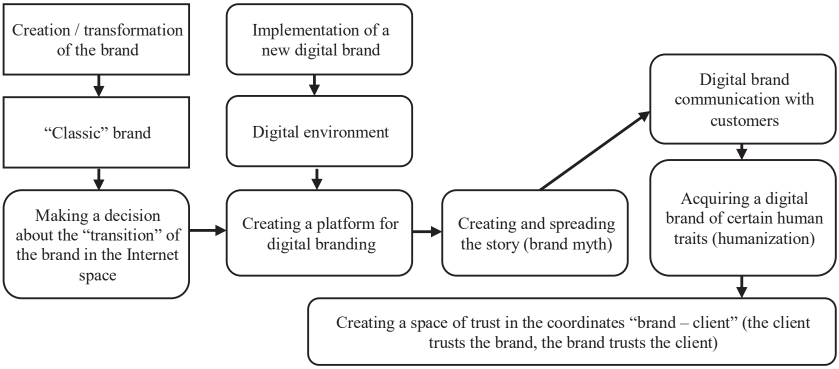

Fig. 6.1 – The process of building a digital history of digital brands

Timely delivery of the message is formed in real time and transmitted through Social Media. Thus, the conceptual principles of delivering brand appeal in the digital marketing system are much broader than identifying the nature of the brand. In this sense, the digital appeal itself requires that the interaction between the brand and the customer takes place in a "one-on-one" format and also in an appropriate emotional tone.

There are 4 digital components identified by D. Aaker that can play an important role in building a brand. In the consumer market, companies that are focused on digital marketing focus on so-called connective or connected brands through interaction points (so-called touch points) both in the online environment and in traditional means of information dissemination. In this sense, it is advisable to use a methodology that identifies opportunities specifically for the brand, which significantly increases relevance and memorability by the client, as well as optimizes the conversion rate and maximizes the company's income. It is digital capabilities that are becoming increasingly necessary for businesses looking to build or expand their brands through branding programs. Digital branding is a powerful tool specifically for creating brands with many brand-building advantages, which are reproduced in Fig. 6.2.

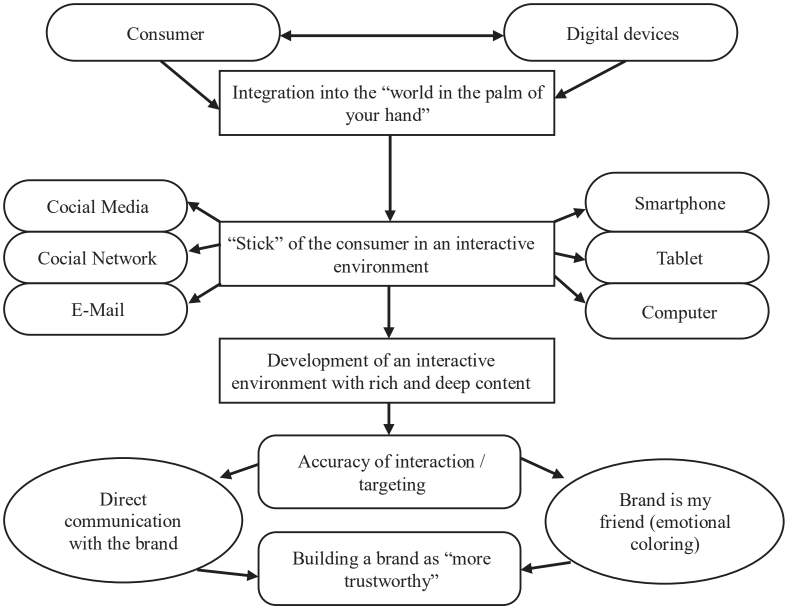

Fig. 6.2 – Advantages of using the Digital environment in creating brands

The creation of a digital brand should take place on the basis of a centralized media planning system, within which the media strategy and media tactics are determined, taking into account the fact that the construction and development of a digital brand takes place precisely in a mobile device. It is necessary to know: where the client is – in order to interact; how to stand out – to attract the attention of customers in the sea of Internet noise and spam; does the mobile app cause – to engage the consumer. However, it should be noted that the center of the brand’s interaction with the consumer is the “voice” of the brand, which is formed by mixing the requests of the target audience and mass media.

The brand team creates the “voice” of the brand and speaks it to the target audience in general and to each individual customer. Therefore, the digital content of the brand should collect as many impressions as possible. Usually, the consumer should get an answer to his question "why", why exactly the brand exists and what company values are inherent in it. At the point when the digital brand defines the "why", systemic and comprehensive marketing efforts and strategies of both the brand and the company itself can be integrated into digital branding.

R. Kay Green's research is interesting and thorough, where he specifies ways to implement maximum brand presence on the Internet and states that "an Internet brand is what people think of you when you are not available. Most customers today are technologically savvy and tend to rely on a company's online presence as a test of its credibility in the marketplace". Today's operations involve the ability to track all marketing efforts of both the brand and the business based on the use of new digital key performance indicators (KPIs) such as visibility, engagement, relationships, opportunities, sales. The effective development of a digital brand should contain the so-called "benchmark" points, which will determine the overall effectiveness of the promotion:

1. The relevance of digital brand'y is the main strategy of the firm reflected in the mobile application.

2. Creation and optimization of a mobile application (place in the digital environment).

3. Activation of social networks and other digital tools alongside the work of mobile applications (principles of search and communication with the client).

4. Improving and updating the quality of content (style and language of communication).

5. Press release (the main message about the company) on the main page of the mobile application.

6. Levers of communication (visualization, chats, blogging, chat bots).

Therefore, it is expedient to form a digital brand system based on "benchmark" points, which integrates the classical theory of branding, taking into account the growing orientation of brands to promotion via the Internet. Due to the fact that for many goods or services the target audience is active users of the Internet in general and social networks in particular, it is necessary to actively integrate the work of all digital marketing technologies.

Questions for self-control:

1. Name the components of the i-brand model (“7C”).
2. List traditional strategies, tools and search for new business formats, including an interactive approach to customer engagement.
3. Name the specific levels of communication interaction.
4. Name Modern Operations, which includes the ability to track all marketing efforts as a brand.
5. What should effective digital brand development contain?

6.5. Future mobile application tools

According to international marketing agencies, more than 30 % of the world’s population uses voice search on the Internet. Most voice search users are under the age of 18. In 2020, the number of sales of smart speakers reached 150 million. Voice search takes much less time than text typing. Therefore, the number of voice search users will only increase in the future. 49 % of voice search users noted that they tried the same search method for the first time in the last six months, which corresponded to the first period of the lockdown. In the coming years, 50 % of searches will be conducted using voice technologies [53]. Voice search is an important tool for increasing mobile application users. A person tries to spend less time searching for information and getting goods, therefore trying to download and use the mobile version of the site. Moreover, mobile applications remember the client’s past search results and reduce the time spent searching for and choosing a product offer.

Search virtual assistants help not only find information, but also process it and offer additional solutions. For example, a consumer can find a washing machine in the mobile application of the market place by voice search, and the virtual assistant can additionally give advice on the peculiarities of washing different fabrics and the use of washing powders. There are search features for different virtual assistants, depending on the model of the mobile device (Table 6.3).

***Table 6.3* – Virtual assistants and their functions**

Virtual assistant	Devices	Functions	Benefits
Cortana	Windows, iOS, Android, Xbox OS	Creates a notebook, formulates requests and reminders	Cortana on mobile is capable of capturing notifications from the device and sending them to the Windows 10 device.
Siri	All Apple developments	Searches for any information, sends messages, sets reminders and appointments	Reformulates and narrows searches, if she does not understand, translates into different languages
Google Assistant	With any devices	Uses calendar information, controls music, creates timers and reminders	Provides privacy and security during voice search, controls a smart home
Amazon Alexa	With any devices	Searches for information, converts sound waves into text, plays music, live sports events	Allows you to control the TV/audio video system by voice, controls the smart home

Voice search is changing approaches to SEO on websites and mobile versions. Users request and search for information in different ways using voice and test search:

– a voice query is created in the form of questions, while a text query is created by a set of phrases. Therefore, when optimizing the search, it is necessary to take into account the question;

– in a voice search, a person uses more words to form an appeal, while a text search is limited to three to five words. This means that when optimizing, keywords can be grouped into longer keyword phrases;

– voice and text search have geographic differences. Voice search is more about local search. A person is looking to find a local restaurant, children's entertainment center, shoe repair, etc.;

– a text search displays a list of pages that most closely match the keyword query. Only one link is displayed in voice search. Therefore, optimization and a set of keywords must be selected more carefully;

– in voice search, the consumer's speech and query may be slurred, inarticulate and quiet.

Today you can order Domino's pizza without entering the online store. You just need to make a voice order in the search. PayPal users can enlist Siri to send money to friends or family. Tide provides advice on removing stains caused by more than 200 different substances [54].

There are principles and approaches to managing voice search when using mobile applications [55–56].

Search principles are not based on optimization and efforts to be on the first search page. With the text search format, the first 10 messages that are more relevant to the search query appear on the first page. Only one link is provided in voice search.

During voice search, users use full sentences that consist of a large number of words. You can't limit yourself to phrases and abbreviated sentences. The search query should consist of frequently used, natural questions.

Voice search is local rather than national. When speaking a question, users are looking for the location or the possibility of choosing a product in the region. When creating a search, you need to focus on key issues related to brand localization.

Voice search is faster in the set, so users do not pay attention to the screen and the image on it. In this case, voice search requires higher quality search word content. Moreover, it is desirable to concentrate the main questions and their answers in the FOQ section, which Google will automatically pull up in the search.

Influencer marketing is a type of marketing that uses opinion leaders and experts and brand promotion in the market. Unlike targeted marketing, in which the marketing tools are search optimization, influencer marketing invites influencers to spread the word about the product and give a positive expert opinion.

According to statistics, 9 out of 10 world-famous brands use influence marketing. 84 % of enterprises plan to develop and activate influence marketing strategy in the next year. For every dollar spent on a marketing campaign, the company receives $ 18 in revenue [57].

Influence marketing is used in the event that the company has lost contact with the client, it is necessary to form awareness about the brand, or there is a need to enter new markets.

Influencers can be not only screen stars or famous people in the country, but also ordinary bloggers or experts in the field, who have a potential influence on the consumer segment. In the case of clothing advertising, influencer marketing can involve a person of the same age and gender for whom the clothing is being offered. When selling milk and dairy products, an influencer can be a person who certifies products, deals with allergy treatment, etc. The main thing in choosing a person of influence is the scale of his audience and a quick channel of communication with it. For consumers, such a person is a reliable source of information. Influential people will convey the necessary information in a language that is natural for the audience.

Marketers use various types of cooperation with influencers when introducing mobile applications and their advertising [58]:

1. Paid posts. Such a post should contain relevant information for the consumer about the benefits of using the product.

2. Partnership in social networks. An influencer makes a post linking to a

mobile app and invites their followers to engage with that brand.

3. Known content. Influencers amplify and generate mobile app content through their social networks.

4. Customer reviews. Not all customers leave feedback after using a product or visiting an establishment. Influencers provide information about positive experiences so that potential consumers feel more confident in purchasing a product.

5. Brand ambassador. This is a person who for some time represents the interests of the brand and is an active user of the products. She provides advisory support to advocates who may be potential consumers of the product.

Famous persons participating in the organization of an influence campaign have their own income from participation. According to an analysis by *Influence.co*, the average price per post of a person with 1,000 followers is $ 83, and the price of a post of a person with an audience of 100,000 is $ 763. Bigcommerce names 4 reasons why influencer marketing will grow in the future:

1. More and more people are becoming influencers.
2. Influencer marketing agencies are growing in popularity.
3. The possibilities of content are increasing.
4. Influencers are more real.

Before developing a strategy of marketing influence, it is necessary to determine whether this type of communication is effective for the enterprise when creating a mobile application. To do this, it is necessary to justify the goals of the future strategy (increasing sales of a certain product for a certain period of time, generating more visitors to the website, increasing the number of mentions of the brand on the Internet, etc.). According to the conducted analysis, it is necessary to determine whether this industry, product, brand is popularized in social networks. It is also necessary to take into account the return on investment from influence marketing (average revenue per unit of cost of the post). Calculate the campaign budget and justify the expediency of its organization.

There is a mechanism for finding an influencer [59]:

1. Choose the app store that your customers use.

2. Create your brand presence in this store.

3. Enter search terms related to the benefits of a mobile app to find someone who posts about it.

4. Determine how many followers the influencer you plan to engage should have. The cost of the influencer marketing campaign will depend on this.

5. Calculate the budget and main KPIs.

6. Choose a few potential influencers for your company and establish contact.

7. Enter into a contract.

Individual branding is a company's marketing strategy in which each product has its own brand (mission, vision, appeal). Along with the existence of different classifications of branding, brands are divided into individual (each product has its own brand) and family (all products under one brand). There is a fundamental difference between them. The role of personal branding increases during the reduction of risks in the market. When it is impossible to support the entire range of products and all subsidiaries, the market remains more competitive.

Individual brand. The company uses a different philosophy, symbolism, appeal for each product. The uniqueness of the brand and its name emphasizes the value of the product and makes it possible to conquer the market as quickly as possible. If there are problems with one product, it does not affect the others in any way. Each of the brands can be aimed at a different market segment.

A family of brands. The company uses a single concept for the maximum possible product lines. Promotion of one product or assortment helps promote the entire brand. If a new product appears, it is offered to an existing customer under a brand name known to him. This creates an economic effect: the costs of promoting the brand are dispersed among all product lines.

Examples of personal (individual) branding are Nestle, Unilever and P&G.

All these companies take into account the peculiarities of the national market and create national brands. For example, Svitoch chocolate of the Lviv factory, which is part of the Nestle brand, is widely in demand in Ukraine.

However, in order to form an effective marketing campaign, it is necessary to know all the pros and cons of personal branding [60–62].

Advantages of using personal branding:

– the parent company will cover a larger market through different brands;

– the reputation of the parent brand will not suffer if one of the personal brands is uncompetitive on the market;

– a personal brand reduces the pressure of the corporate style of the parent brand;

– the ability to use different marketing strategies for different brands;

– companies can use different approaches to meet consumer needs;

– brands can produce products of lower quality without affecting the image of products of other brands;

– each brand can have its own distinctive corporate style;

– each personal brand will have its own consumer properties;

– products can be branded so that different products can cater to different target audiences;

– the ability to get several levels of customer loyalty.

Disadvantages of using personal branding:

– high level of risk within the parent brand;

– high costs of releasing a new brand to the market;

– it takes time to build customer loyalty;

– constant support of customer presence for each brand;

– the need to attract more specialists to support brands;

– customers do not always associate a personal brand as part of a well-known parent brand;

– different brands may compete internally;

– consumers do not always trust the quality of a personal brand, especially if it is new on the market;

– the presence of competition in the company due to the fact that employees who are involved in a more successful brand will be considered more professional.

To form a personal brand and implement it in the mobile version, the following requirements must be met [63]:

– availability of capital;

– involvement of specialists in brand creation;

– the possibility of using technological resources, innovations and ideas;

– the credit of the company's trust in the market;

– excellent marketing opportunities.

With the development of artificial intelligence, augmented reality, robotics, approaches to business development are changing. Marketing is becoming more customer-oriented and personalized. The main principles of modern communication channels are [64]:

– ***flexibility*** – social media and communication channels are constantly changing to keep your customers online. If the company will change its concept along with changes in digital channels, then it will have competitive advantages unique to it in the future;

– ***continuous learning and research*** – It is impossible to introduce innovations in your business, and it is also impossible to take into account modern approaches to the work of Internet networks in your business, if the company's specialists do not monitor changes in such processes. Staff must constantly, continuously learn and explore the digital market to meet the most relevant consumer demands;

– ***quality content*** – today, consumers pay attention to high-quality concise, short content that is divided into subsections, has an emphasis on key issues. The content can be not only text, but audio, video or graphic format;

– ***empathy and interest*** – in order to interest a consumer in a brand today, you need to understand and feel his needs and pain. When an entrepreneur puts himself in the place of a consumer, he finds the most effective communication channels, which provides an opportunity to establish deeper business relationships.

In order to maintain relations after the purchase of products and inform about the brand in the future, attention will be paid to the following communication tools:

– creation of an individual brand;
– organization of interactive events;
– encouragement to communicate and share experiences;
– raising awareness through news content;
– creation of interaction with customers through live broadcasts;
– additional customer service, advice on using products;
– risk management;
– organization of entertainment events;
– consumer education.

Questions for self-control:

1. Describe virtual assistants and their functions.
2. Describe how voice search is changing approaches to SEO on websites and mobile versions.
3. How do users request and search for information in different ways using voice and test search?
4. Name 4 reasons why influencer marketing will evolve in the future.
5. Describe the influencer search mechanism.
6. Name the advantages of using personal branding.
7. Name the disadvantages of using personal branding.
8. What needs to be done to form a personal brand and implement it in the mobile version?

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UDC 004.056

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Chapter 7
METHODS OF INFORMATION PROTECTION OF ELECTRONIC DATA

Content

The constant development of information technologies makes adjustments to the life of a person as a member of a digital society. Using the digital world also requires new solutions for information protection. The use of cloud technologies, IoT systems, and blockchain technologies in everyday and professional activities require new knowledge and competencies from a modern specialist regarding the protection of information and digital data in cyberspace in particular.

To prevent the leakage of information and counteract unauthorized access to it, in particular digital, to reduce damages from the disclosure of confidential information and loss of data, it is necessary to carefully choose measures and means of information protection and correctly use modern information technologies.

Let's first analyze the main terms for understanding information protection processes and further mastering the methods and technologies of digital data protection. It is also necessary to know the main legislative provisions in this area, organizational, software and technical, and other measures to protect information.

7.1. Basic concepts and definitions

The concept of "information" is used quite widely and is versatile today. It is difficult to find such a field of knowledge, wherever it is used. By the middle of the 20th century, information was interpreted as information transmitted by people orally, in writing, or in another way. After the appearance of electronic computing machines, the interpretation of the concept of "information" has changed somewhat. Information according to Shannon (entropy approach, American mathematician D.E. Shannon) began to be understood as a decrease in the degree of uncertainty of knowledge about any object, system, process, or phenomenon, as a change in the uncertainty of the state of the object, system, phenomenon, process itself [18].

At this time, a general scientific interpretation of the concept of "information" as changes in the volume and structure of knowledge of system perception appears. Here, the perceptual system is understood not only as of the person himself or his derivatives (collective, society), but also as any system, for example, a biological cell that is a carrier of genetic information.

According to ISO/IEC 27002:2022, "information" is property (or assets) that, like other important business assets, has value to the organization and therefore must be protected accordingly. Two types of assets are distinguished:

– *primary* (information, business processes, and activities);

– *auxiliary* (hardware, software, computer network, personnel, site, organizational structure) [10].

"Attack" means a successful or unsuccessful unauthorized attempt to destroy, modify, delete or gain access to an asset for disclosure, theft, or unauthorized use of assets.

Information is characterized by a life cycle, which can be represented by the following components (Fig. 7.1) [18]: obtaining information is the acquisition, acquisition, and accumulation by the current legislation of documented or publicly announced information by citizens, legal entities, or the state; information processing – the entire set of operations (collection, input, recording, conversion, reading, storage, destruction, registration) carried out with the help of technology and software tools, including exchange via data transmission channels; the use of information is the satisfaction of the information needs of citizens, legal entities, and the state; information storage means ensuring the proper state of information and its material carriers; destruction; updating – formation of information in the source of information.

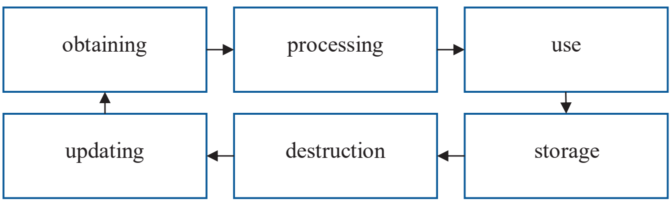

Fig. 7.1 – The life cycle of information

Together with the term "information" the term "data" is used. Data differ from the information in a specific form of presentation and is a certain subset, defined by the purpose and tasks of information collection and processing. For example, data on employees of any organization in the form of formalized record cards of the personnel department contain only a certain list of the necessary information, in contrast to a huge amount of information characterizing each specific person.

Unstructured and structured forms of data presentation can be distinguished. Examples of unstructured forms are coherent text, graphic data in the form of photographs, drawings, and other unstructured images. Examples of structured data are questionnaires, tables, and graphic data in the form of drawings, schemes, and diagrams.

Information has always been, is, and will be the most important communication resource. The famous stock player Nathan Rothschild used to say: "He who owns information owns the world".

The main factors that increase its vulnerability are:

– increasing the amount of information that is accumulated, stored, and processed with the help of computers;

– concentration in databases of information of various purposes and belonging;

– expansion of the circle of users who have direct access to the resources of the computing system and data arrays;

– a complication of operating modes of technical means of computing systems;

– exchange of information in local and global networks, including over long distances.

Features of the information:

– immateriality (has no mass, energy, etc.);

– transmitted and stored on physical media (books, disks, external hard drives, flash drives, etc.);

– any material object contains information about itself or another object.

Information has the following properties [18]:

1. Information, if it is contained in a physical medium, is accessible to a person.

2. Information has value. The value of information is determined by the measure of its usefulness for the owner. Possession of valid (reliable) information gives its owner certain advantages. Information that distorts reality (unreliable information) can cause significant material and moral damage to the owner. If information is intentionally distorted, it is called disinformation.

3. The value of information changes over time. As a rule, the value of information decreases over time. Dependency is defined by the following expression (formula 7.1):

$$C(t) = C_0 e^{-\frac{2,3t}{t}} , \qquad 7.1$$

where C_0– the value of the information at the time of its occurrence (acquisition);

t – the time from the moment of information generation to the moment of determining its value;

τ – the time from the moment of information creation to the moment of its aging.

4. Information is bought and sold. Information should be considered as a commodity that has a certain price. The price, as the value of information, is related to the usefulness of information for specific people, organizations, and states. Information may be valuable to its owner, but not valuable to others. In this case, information cannot be a commodity. Information can be obtained in three ways: conducting scientific research; purchasing information; illegal acquisition of information.

5. The difficulty of objective assessment of the amount of information. There are several approaches to measuring the amount of information:

– entropy approach (the amount of information is estimated by the decrease in the recipient's uncertainty (entropy) of choice or decrease in the expectation of events after obtaining information);

– thesaurus approach (proposed by Yu.A. Shrader). The thesaurus approach is based on the understanding of information as knowledge. The amount of information obtained by a person from a message can be estimated by the degree of change in his knowledge);

– practical approach (in practice, the amount of information is measured by volume – pages, bits, bytes).

As a result of copying without changing the information parameters of the medium, the amount of information does not change, and the price is reduced.

By information security, we will understand the state of a certain system in which, on the one hand, it can resist the destabilizing action of external and internal information threats, and on the other hand, its functioning does not pose an information threat to the elements of the system itself and the external environment.

Information security – protection of information from factors that pose a threat to its confidentiality (disclosure), integrity (distortion), and availability.

Through **information protection**, we will understand the activity of preventing leakage of the protected information, and unauthorized intentional influences on the protected information. That is, information protection is a set of methods, means, organizational and technical measures, and legal norms to prevent harm to the interests of the owner of the information or IS and persons who use the information.

The main problems of information protection are:

1) prevention of leakage, theft, loss, distortion, and forgery of information;

2) prevention of threats to the security of the individual, society, and the state;

3) prevention of unauthorized actions to destroy, modify, twist, copy, or block information;

4) prevention of other forms of illegal interference in information resources and information systems; ensuring the legal regime of documented information as an object of ownership;

5) protection of the constitutional rights of citizens to preserve personal secrets and confidentiality of personal data contained in information systems;

6) preservation of state secrets, the confidentiality of documented information by legislation;

7) guarantee the rights of subjects in information processes and the development, production, and application of information systems, technologies, and means of their support.

System vulnerability is the inability of the system to resist the implementation of a certain threat or set of threats.

Protection defects are a set of reasons, conditions, and circumstances, the presence of which can lead to a violation of the normal functioning of the system or information security policy. For the most part, security defects are understood as features of the construction of software protection tools, which under certain circumstances cause their inability to resist threats and perform their functions. That is, protection defects are a special case of system vulnerability.

They are classified according to the relation of the threat source to the information system (IS) (external and internal threats), according to the type of threat source [18]:

a) *physical* – reflect physical actions on the system;

b) *logical* – means by which a person gets access to the logical information of the system;

c) *communication* – refer to the processes of data transmission over communication lines;

d) *humans* – are the most difficult to control and are directly related to physical and logical threats), to the extent of malicious intent (accidental and intentional), etc.

Intentional threats, in turn, can be divided into active (unauthorized modification of data or programs) and passive (unauthorized copying of data or programs).

It is interesting to classify information security threats according to the methods of their possible negative effect. This classification is supported by the vast majority of specialists in the field of information protection and provides for the division of threats into informational, software-mathematical, physical and organizational. **Informational threats** are implemented in the form of: violation of addressability and timeliness of information exchange; illegal collection and use of information; unauthorized access to information resources and their illegal use; theft of information resources from banks and databases; violation of information processing technology.

Software-mathematical threats are implemented in the form of:

1) introduction into hardware and software products of components implementing functions not described in the documentation for these products;

2) development and distribution of programs that disrupt the normal functioning of information systems or their information protection systems.

Physical threats are implemented in the form of:

– destruction, damage, radio-electronic suppression or destruction of means and systems of information processing, telecommunications, and communication;

– destruction, damage, destruction, or theft of a computer and other information carriers;

– theft of software or hardware keys and means of cryptographic protection of information;

– interception of information in technical communication channels and telecommunication systems;

– introduction of electronic devices for interception of information in technical means of communication and telecommunication systems, as well as on office premises;

– actions on password-key protection systems for means of information processing and transmission.

Organizational threats are implemented in the form of non-compliance with the requirements of legislation in the information sphere; illegal purchase of imperfect or outdated information technologies means of informatization, telecommunications, and communication.

We note that as a result of information security threats, serious damage may be caused to the country's vital interests in the political, economic, defense, and other spheres of state activity, as well as causal socio-economic damage to society and individual citizens. The realization of threats can make it difficult to make the most important political, economic, and other decisions, undermine the state authority of the country in the international arena, disrupt the balance of the interests of the individual, society, and the state, discredit the state authorities and management, disrupt the functioning of the system of public administration, credit and financial and banking spheres, as well as systems for managing troops and weapons, objects of increased danger.

The consequence of the implementation of threats can be significant economic damage in various spheres of public life and business, a decrease in the rate of scientific and technical development of the country, and an undermining of the defense potential. It is clear from the above that a large number of various threats to information security of various origins are known. Different authors offer some approaches to their classification. At the same time, the types of dangers generated, the degree of malicious intent, the sources of threats, and so on, are used as criteria for dividing a multitude of threats into classes. Based on the methods of system analysis, it can be reduced to some system classification given in Table 7.1 [18].

Table 7.1 **– System classification of information security threats**

Classification parameters	**Classification parameters**	**Classification parameters**
1	*2*	*3*
1. Species	1.1. Physical integrity	Destruction (distortion)
	1.2. Logical structure	Distortion of the structure
	1.3. Content	Unauthorized modification
	1.4. Privacy	Unauthorized receipt
	1.5. Property right	Appropriation of someone else's right

Continuation of Table 7.1

1	*2*	*3*
2. Nature of origin	2.1. Accidental	Failures, failures, errors, natural disasters, side effects
	2.2. On purpose	Malicious actions of people
3. Prerequisites of appearance	3.1. Objective	Quantitative insufficiency of system elements, qualitative insufficiency of system elements
	3.2. Subjective	Foreign intelligence, industrial espionage, punitive elements, unscrupulous employees
4. Sources of threats	4.1. People	Third parties, users, staff
	4.2. Technical devices	Registration, transfer, storage, processing, issuance
	4.3. Models, algorithms, programs	General purpose, applied, auxiliary
	4.4. Technological schemes of processing	Manual, interactive, intra-machine, network
	4.5. Environment	The state of the atmosphere, side noises, side signals

1. *Types of threats.* This parameter is the main one, which determines the target orientation of information protection.

2. *Origin of threats.* The table highlights two values of this parameter: accidental and deliberate. Accidental refers to the origin of threats, which are caused by spontaneous and independent circumstances that arise in IS during its functioning. The most famous events of this plan are failures, failures, errors, natural disasters, and adverse effects. The essence of the listed events (except for natural disasters, the essence of which is clear) is defined as follows:

– *refusal is* a malfunction of any element of the system, which makes it impossible to perform its main functions;

– *failure is* a temporary malfunction of any element of the system, the consequence of which may be its incorrect performance of its function at that moment;

– *an error* is an incorrect (one-time or systematic) performance of one or more functions by an element, which occurs as a result of its specific (permanent or temporary) state;

– *a side effect* is a negative effect on the system as a whole or individual elements, which is caused by any phenomena that occur inside the system or in the external environment.

The intentional origin of the threat is determined by the malicious actions of people.

3. *Prerequisites for the emergence of threats.* The table shows two possible types of prerequisites: objective (quantitative or qualitative insufficiency of system elements) and subjective (intelligence activities of foreign states, industrial espionage, activities of punitive elements, actions of unscrupulous system employees).

The listed types of prerequisites are interpreted as follows:

– *quantitative deficiency* – physical shortage of one or more elements of the system, which disrupts the technological process of data processing and overloading of existing elements;

– *quality deficiency* – imperfection of the design (organization) of the system elements, due to which the possibility of accidental or intentional negative impact on the information being processed or stored may appear;

– *intelligence activity* of foreign countries is a specially organized activity of state bodies, professionally-oriented to obtain the necessary information by all available methods and means.

The main types of intelligence include:

– **intelligence** (unauthorized activities of professional intelligence agents, recruited agents, and so-called “well-wishers”) and technical intelligence, which includes radio intelligence (interception by radio-electronic means of information circulating in telecommunications channels), radio-technical intelligence (registration of electromagnetic radiation of technical systems by special means) and space reconnaissance (use of spacecraft and artificial satellites of the Earth to observe the territory, photograph it, register radio signals and obtain useful information by any other available means);

– ***industrial espionage*** is the clandestine activity of an organization (that is, its representatives) to obtain information that is specially protected against its unauthorized leakage or theft, to create favorable conditions for itself, and obtain maximum benefits (unfair competition);

– ***malicious actions of criminal elements*** – theft of information or computer programs for profit;

– ***actions of unscrupulous employees*** – theft (copying) or destruction of information arrays and programs for selfish or selfish motives, as well as a result of non-compliance with the established procedure for working with information.

4. *Sources of threats.* The threat source is understood as its immediate generator or carrier. Such a source can be people, technical means, models (algorithms), programs, external environment.

Let's try now, based on the given system classification of threats to information security, to determine the full set of threats that are potentially possible in modern information systems. At the same time, we must take into account not only all known (previously manifested) threats, but also such threats that were not manifested before, but could potentially arise with the current concepts of the architectural construction of IS and technological schemes of information processing.

We classify all possible channels of unauthorized obtaining of information (CUOI) according to two criteria: the need for access (physical or logical) to IS elements for the implementation of one or another CUOI and the dependence of the appearance of CUOI on the state of the IS.

According to the first criterion, CUOI can be divided into those that do not require access, that is, which allow obtaining the necessary information remotely (for example, by visual observation through the windows of the IS premises), and those that require access to the IS premises. In turn, CUOI, which can be used only after gaining access to the IS premises, are divided into traces that do not leave in the IS (for example, visual viewing of images on monitor screens or documents on paper media) and CUOI, the use of which leaves those or other traces (for example, theft of documents or computer media).

According to the second criterion, the CUOI are divided into those potentially existing regardless of the state of the IS (for example, information carriers can be stolen regardless of whether the IS means are in working order or not) and existing only in the working state of the IS (for example, side electromagnetic radiation and guidance).

According to the above, the classification structure of CUOI can be represented by the following table (Table 7.2) [18].

***Table 7.2* – Classification structure of channels of unauthorized information acquisition**

Dependence on access to system elements	Attitudes to information processing	
	Appears unrelated to processing	Appears during processing
Do not require access	***1st class*** Public constants	***2nd class*** Publicly available functional
Requires access without changing system elements	***3rd class*** Narrowly accessible permanent without leaving traces	***4th*** Narrowly available functional without leaving traces
Requires access to change system elements	***5th grade*** Narrowly available specials that leave traces	***6th grade*** Narrowly accessible functional with leaving traces

We will give an approximate list of channels of unauthorized obtaining of information about the classes we selected. *1st-class CUOI* – channels that appear regardless of information processing and without the attacker's access to system elements. This may include eavesdropping on conversations, as well as provoking conversations of persons related to IS, and the use of visual, optical, and acoustic means by the attacker. This channel can also manifest itself through the theft of information carriers when they are outside the premises where the IS is located.

2nd-class CUOI – channels that appear in the process of information processing without the attacker's access to IS elements. This can include electromagnetic radiation from various PC devices, equipment, and communication lines, parasitic guidance in power circuits, telephone networks, heat supply, ventilation, and sewage systems, grounding buses, connection to the information and computing network of interference generators, and recording equipment. The same class can include inspection of production waste falling outside the controlled zone.

CUOI of the 3rd class – channels that appear regardless of information processing with the attacker's access to IS elements, but without changing the latter. These include all kinds of copying media and documents, as well as theft of industrial waste.

CUOI of the 4th class – channels that appear in the process of processing information with the attacker's access to IS elements, but without changing the latter. This may include memorizing and copying information during processing, using software traps, flaws in programming languages and operating systems, as well as affecting software with malicious bookmarks, and masquerading as a registered user.

CUOI of the 5th class – channels that appear regardless of information processing with the attacker's access to IS elements and with the change of the latter. Among these channels: substitution and embezzlement of information carriers and equipment, inclusion in programs of blocks such as "Trojan horse", "computer worm" and the like, reading residual information contained in memory after the execution of authorized requests.

CUOI of the 6th class – channels that appear in the process of processing information with the attacker's access to IS elements and with the change of the latter. This may include illegal connection to equipment and communication lines, as well as the removal of information on the power buses of various IS elements.

Information protection must be ensured at all stages of its life cycle in the IS, at all technological stages of information processing, and in all operating modes of the AS.

The main tasks of protection can be:

1) organization and coordination of work on the protection of information that is processed and transmitted by IS means;

2) definition, classification of IS resources subject to protection;

3) ensuring the specified confidentiality, integrity, and availability of

information during the creation (IDC) and operation of IS, preventing the leakage of restricted information and the loss of its physical media;

4) creation of a mechanism and conditions for prompt response to threats to information security;

5) effective prevention, timely detection, and neutralization of threats to IS resources, causes, and conditions that cause or may lead to disruption of its functioning;

6) organization of the information protection service;

7) organization and implementation of a system for admitting personnel (users) to work with information that needs protection;

8) management of information protection means, management of user access to IS resources, monitoring of their work by information protection service personnel, prompt notification of NSD attempts to access IS resources;

9) creation of conditions for the maximum possible compensation and localization of damages caused by illegal and unauthorized actions of violators, reduction of the negative impact of the consequences of a security breach on the functioning of IS;

10) ensuring the confidentiality regime during the processing of classified information;

11) development of organizational, administrative, and working documentation, which defines the requirements and procedure for protection and processing of IDC;

12) organization of accounting, storage, and circulation of information that needs protection and its material carriers;

13) registration, collection, storage, and processing of data on all events in the system that are related to information security;

14) implementation of control over the protection of IDC and the preservation of its material carriers.

The threat model is developed for a specific IS and must take into account the features of functioning, the composition of the IS, information processing technology, etc. The main types of threats to information security that can be implemented about IS should be determined and should be taken into account in the threat model (threats of an objective nature, accidental and intentional threats of a subjective nature).

An offender model is an abstract formalized or informal description of an offender. The offender's model reflects his practical and potential capabilities, a priori knowledge, time and place of action, etc. [14; 18].

When developing a model of a violator, the following are defined:

– assumptions about the category of persons to which the offender may belong;

– assumptions about the motives of the violator's actions (the goals he has);

– assumptions about the level of qualification and awareness of the violator and his technical equipment (regarding the methods and means used in committing violations);

– restrictions and assumptions regarding the nature of possible actions of violators (by time and place of action and others).

It is assumed that according to his level, the offender is a highly qualified specialist who has complete information about the system. Usually, 5 types of violators are considered. First, they are divided into two groups: external and internal violators. Among the external violators, the following are distinguished:

a) a well-armed and well-equipped force group that acts from the outside quickly and head-on;

b) a lone intruder who does not have access to the facility and tries to act stealthily and cautiously because he is aware that the response forces have advantages over him.

Among the potential internal violators can be noted:

a) auxiliary personnel of the facility, admitted to the facility, but not admitted to the vital center (VC) of the IC;

b) the main personnel admitted to the VC (the most dangerous type of violators);

c) employees of the security service, who are often formally not admitted to the VC but have wide enough opportunities to collect the necessary information and carry out the action.

The possibility of collusion between violators of different types must also be considered, which further complicates the task of formalizing violator models. But it should be noted that such a division is very general, and not all groups are important for all ICs.

The following categories of personnel can be distinguished among internal violators:

1) users (operators) of the system;

2) personnel servicing technical equipment (engineers, technicians);

3) employees of software development and maintenance departments (application and system programmers);

4) technical personnel serving the building (cleaners, electricians, plumbers, and other employees who have access to the building and the premises where IS components are located);

5) employees of the security service;

6) heads of various levels and job hierarchies.

Third parties who may be violators:

a) clients (representatives of organizations, citizens);

b) visitors (invited for any reason);

c) representatives of organizations engaged in ensuring the vital activities of the organization (energy, water, heat supply, etc.);

d) representatives of competing organizations (foreign services) or persons acting on their behalf;

e) persons who accidentally or intentionally violated the access regime (without the intention of violating security);

f) any persons outside the controlled zone.

Three main motives for violations can also be distinguished: irresponsibility, self-assertion, and a useful purpose.

In the case of violations caused by irresponsibility, the user purposefully or accidentally performs destructive actions that are not related, however, to malicious intent. In most cases, this is the result of incompetence or negligence. Some users consider gaining access to system data sets a significant success, starting a sort of user-versus-system game for self-affirmation, either in their own eyes or in the eyes of their colleagues.

A breach of IS security can be caused by the self-interest of the system user. In this case, he will purposefully try to overcome the protection system to access information in the IS. Even if the IS has means that make such penetration extremely difficult, it is almost impossible to completely protect it from penetration.

All violators can be classified according to the level of knowledge about IS [9; 12–15; 18]:

1) knows the functional features of the IS, the basic regularities of the formation of data arrays in it and the flow of requests to them, and knows how to use standard tools;

2) has a high level of knowledge and experience in working with technical means of the system and their maintenance;

3) has a high level of knowledge in the field of programming and computing, design and operation of information systems;

4) knows the structure, functions, and mechanism of action of protective equipment, their strengths, and weaknesses.

By level of capabilities (methods and means used):

1) uses purely agent methods of obtaining information;

2) uses passive means (technical means of interception without modification of system components);

3) uses only standard means and shortcomings of the protection system to overcome it (unauthorized actions using authorized means), as well as compact magnetic media that can be secretly passed through security posts;

4) applies methods and means of active influence (modification and connection of additional technical means, connection to data transmission channels, implementation of program bookmarks, and use of special instrumental and technological programs).

By the time of action:

– in the process of functioning (during the operation of the system component);

– during the period of system inactivity (during non-working hours, during planned breaks in its work, breaks for maintenance and repairs, etc.);

– both in the process of functioning and during the period of inactivity of system components.

By place of action:

– without access to the controlled territory of the organization; from the controlled territory without access to buildings and structures;

– inside the premises, but without access to technical means;

– from workplaces of end-users (operators);

– with access to the data area (databases, archives, etc.);

– with access to the security control area.

The following limitations and assumptions about the nature of the actions of possible violators are also taken into account: recruitment work and special measures make it difficult to create coalitions of violators, that is, unification (collusion) and purposeful actions to overcome the protection system of two or more violators; the violator, planning an attempt at NSD, hides his unauthorized actions from other employees; NSD can be the result of errors by users, system administrators, as well as errors in the adopted information processing technology, etc.

Determining the specific characteristics of potential infringers is largely subjective. The model of the violator, built taking into account the specifics of a specific subject area and information processing technology, can be presented by listing several variants of his image. Each type of violator must be characterized according to the classifications given above. All values of the characteristics must be evaluated and reduced to the appropriate forms.

However, when forming a model of the violator, the following must be determined at its output: the probability of the threat's realization, the timeliness of detection, and information about the violation. It should be noted that all crimes, including computer crimes, are committed by humans. IS users are its component, a necessary element. On the other hand, they are the main cause and driving force of violations and crimes. Therefore, the issue of security of protected IS is a question of human relations and human behavior.

Based on the above, a differentiated approach is appropriate for choosing the initial behavior model of a potential violator. Since the qualification of the violator is a rather relative and approximate concept, four security classes can be taken as a basis [18]:

– *1st class* – to protect vital information, the leakage, destruction, or modification of which could lead to losses for the user. The strength is designed for a professional offender;

– *2nd class* – used to protect important information when several users are working, having access to different data arrays, or creating their files, inaccessible to other users. The strength is designed for a high-class offender, but not professional.

The 3rd class is recommended for the protection of important information, the permanent NSD which, through its accumulation, may lead to the leakage of more important information. At the same time, the strength of protection should be calculated for a relatively qualified violator – a non-professional.

Class 4 is recommended to protect other information that is not of interest to serious infringers. However, its necessity is dictated by the observance of the technological discipline of accounting and processing of official use information for protection against NSD.

The implementation of the listed security levels should be ensured by a set of appropriate protection means that cover a certain number of possible NSD channels by the expected class of potential violators. The security level of protection within the class is provided by a quantitative assessment of the strength of individual protection means and an assessment of the strength of the circuit of protection against intentional means of protection and an assessment of the strength of the circuit of protection against intentional NSD.

Questions for self-control:

1. Name the factors that increase the vulnerability of information.
2. Define the terms “information protection”, “information security”.
3. List the components of the information life cycle.
4. What data are structured?
5. List the features of the information.
6. Name the properties of information.
7. What data cannot be classified as restricted-access information?
8. Define the terms “threat model”, and “electronic viruses”.
9. In what form information threats are implemented.
10. In what form are organizational threats implemented?
11. Name the parameters of information security threat classification.

7.2. Methods and means of information protection

The main ways to prevent leakage of information through technical channels include organizational measures and the use of various technical means of protection. Moreover, effective protection is achieved with the complex application of the mentioned approaches.

All used technical means are used either to detect information capture or to prevent it. Currently, there are three areas of implementation of these tasks [18]:

a) detection of active means of covert recording of acoustic information (radio microphones, microphones transmitting information via alternating current power grid circuits, radio broadcasting and other wired networks, telephone transmitters transmitting information via a radio channel, radio stethoscopes, and the like);

b) constant or periodic monitoring of the loading of the radio range (radio monitoring), detection and analysis of new emissions, and potential and specially organized radio channels of information leakage (for example, digital radio jamming devices or devices with storage and subsequent transmission);

c) conducting special studies of confidential information processing systems to determine the leakage channels, the level of information security, and the subsequent implementation of measures to ensure the fulfillment of information protection requirements.

Let's take a closer look at the technical solutions used here. Protection against information leakage through the acoustic channel. It should be noted right away that detecting the presence of acoustic control with the help of directional microphones, electronic stethoscopes, and laser detectors is rather complicated. Therefore, for protection purposes, means of preventing the removal of information are more often used. These include audio jamming generators that produce a noise jamming signal with varying amplitude and frequency and can be portable (pocket), desktop, or stationary.

More or less effective means of detection include only devices that allow establishing the fact of the use of recording dictaphones. The principle of operation of such devices is based either on the registration of the magnetic fields of the working electric motor of the recorder or the registration of the fields of magnetization and erasure currents. Modern digital recorders do not have an electric motor, so it is almost impossible to detect them.

To protect against the control of acoustic information, in exceptional cases, special transparent protective booths are used, which guarantee protection against any type of listening. The material for such cabins and interior furniture is transparent plastic. Such cabins are used as the most effective means of protection against eavesdropping in the embassies of the world's leading countries.

The spectrum of technical means designed to detect special electronic speech control devices is significantly wider. According to the principle of operation, they can be divided into two groups:

– electromagnetic radiation search and control equipment, which is used only to detect working electronic data acquisition devices emitting radio waves (radiation detectors, receivers, scanners, spectrum analyzers, frequency meters, selective microvoltmeters, as well as automated software and hardware complexes that perform radio monitoring functions);

– passive detection equipment, which is used to detect technical means of recording information regardless of their mode of operation (non-linear locators, endoscopes, flaw detectors, metal detectors, thermal imagers, and the like).

Passive detection equipment allows you to detect technical means of information capture even if they are not functioning at the moment. The principle of their work is based on the detection of abnormal features in premises and building structures. For example, with the help of nonlinear locators, the presence of semiconductor devices can be detected, with the help of endoscopes, defect scores, metal detectors, changes in the traditional structure of the structures of rooms and buildings, and with the help of thermal imagers, and anomalies in temperature.

Protection of information in communication channels. The technical means of protecting information in communication channels include devices that establish the fact of connection of eavesdropping devices to telephone channels, spectrum analyzers of communication channels, and devices for protecting confidential conversations on telephone channels. Modern spectrum analyzers of communication channels, as a rule, are combined devices that are also decisive for the task of radio monitoring.

In speech communication systems, there are two main methods of closing speech signals, which are divided by the method of transmission over communication channels: analog scrambling and speech discretization followed by encryption. Scrambling means changing the characteristics of a speech signal in such a way that the received modulated signal, having the properties of intelligibility and unrecognizability, occupies the same frequency band as the original open speech signal.

In discretization systems, speech components will be transformed into a digital data stream using an analog-to-digital converter, which is mixed according to a certain algorithm with a pseudo-random sequence produced by a key generator according to one of the cryptographic algorithms, and the closing speech message obtained in this way is transmitted to the communication channel. At the receiving end, the conversion is performed in reverse order.

Protection of information from leakage through the side electromagnetic radiation and guidance (SERG) channel. Passive, active, and combined methods are used to protect information from leakage at the expense of SERG. Passive protection consists in reducing radiation levels to values commensurate with natural noises, using a special elemental base, and constructive refinement of equipment processing confidential information.

There are different ways to implement this method. One of the simplest technical solutions is to place all the equipment in a safe and shielding radio radiation environment. This is used for small-sized equipment, allowing to keep its cost at an acceptable level. For large systems, shielding entire halls and even buildings can be extremely expensive, so the problems of providing electronic protection for them are considered at the design stage.

For example, for communication systems, the safety requirements of individual components of each section of the entire system are defined. The developer can require shielding of individual devices of the system using a metal protective coating or use standard shielded housings for equipment blocks. я Where shielding of components is impractical, sufficient isolation of data and power lines is assumed due to various combinations of filters, signal suppression devices, and low-impedance grounding.

Active protection involves hiding information signals due to noise or blocking interference with the help of special noise generators. *Active radio technical masking* consists of the formation and emission of a masking signal near the masked system. In this case, energetic and non-energetic methods of active radio technical masking are distinguished.

During energy masking, a broadband noise signal is obtained with a level that significantly exceeds the level of system radiation in the entire frequency range. At the same time, noise oscillations are induced in the outgoing circuits. Energy masking can be implemented only if the level of radiation is significantly less than established by existing standards for electromagnetic compatibility and medical requirements. Otherwise, the cloaking device will either cause interference to various radio devices located in the vicinity of the protected system, or it cannot be used for medical reasons.

The non-energetic method of active radio technical masking (statistical) consists in changing the probability structure of the signal that can be received by the attacker’s receiver. Such a signal change requires a special device that can be built directly into the system or placed nearby. The level of the masking signal emitted by this device does not exceed the level of informative radiation of the system, so such devices do not create noticeable interference for other electronic devices located nearby, and are also safe for the health of the system operator.

Combined protection is the reduction of radiation levels to specified values with the simultaneous use of both passive and active protection.

Closing the channels of unauthorized information acquisition should begin with the control of user access to IS resources. This task is solved based on some fundamental principles [18]:

1. *The principle of the reasonableness of access.* This principle consists of the mandatory fulfillment of two main conditions: the user must have a sufficient “form of admission” to receive information of the required level of confidentiality, and he needs this information to perform his production functions. Let’s note here that in the field of automated information processing by users, active programs and processes, as well as information carriers of various degrees, can act. Then the access system assumes the definition for all users of the appropriate software and hardware environment or information and software resources that will be available to them for specific operations.

2. *The principle of sufficient access control depth.* Information protection means should include mechanisms for controlling access to all types of information and software resources of the IS, which should be divided between users by the principle of the reasonableness of access.

3. *The principle of separation of information flows.* To prevent a violation of information security, which, for example, may occur when the secret information is recorded on non-secret media and in non-secret files, it’s transferred to programs and processes not intended for processing secret information, as well as when the secret information is transmitted over unprotected channels and communication lines connection, it is necessary to carry out appropriate separation of information flows.

4. *The principle of purity of reused resources.* This principle consists of cleaning resources containing confidential information when they are deleted or released by the user before redistribution of these resources to other users.

5. *The principle of personal responsibility.* Each user must bear personal responsibility for his activities in the system, including any operations with confidential information and possible violations of protection, that is, any

accidental or intentional actions that lead or may lead to unauthorized access to confidential information, its distortion, or destruction, or make such information unavailable to legitimate users.

6. *The principle of the integrity of means of protection.* This principle implies that the means of information protection in the IS must accurately perform their functions by the listed principles and be isolated from users, and their support must include a specially protected interface for control means, signaling about attempts to violate the protection of the processes in the system.

The implementation of the listed principles is carried out with the help of the so-called "request monitor", controlling any requests to data or programs from users according to the types of access to these data and programs established for them. Schematically, such a monitor is presented in Fig. 7.2.

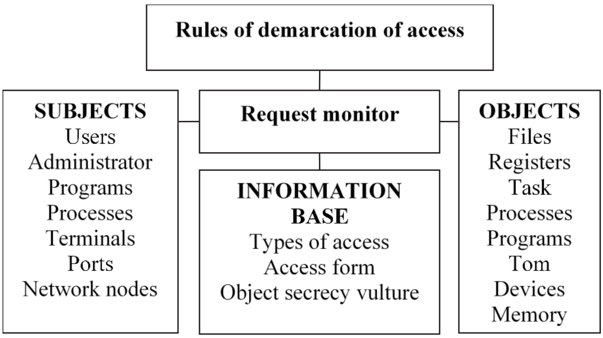

Fig. 7.2 – The structure of the request monitor

The practical creation of an access monitor, as can be seen from the given figure, involves the development of specific rules for demarcating access in the form of a so-called information protection model.

The behavior of this model is described by the following simple rules:

a) the user is allowed access to the system if he is part of the set of users known to the system;

b) the user is allowed access to the terminal if he is part of the subset of users assigned to this terminal;

c) the user is allowed access to the file if the user's confidentiality level is not lower than the file's confidentiality level; the application area of the file is included in the application area of the user task; user task access mode includes file access mode; the user is included in the subset of users allowed in the file.

Hartson's model [18] uses the set of the so-called five-dimensional "security space" as the main characteristics (Fig. 7.3):

– established powers;

– users;

– operations;

– resources;

– states.

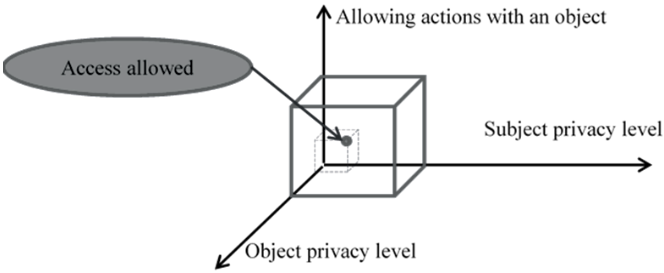

Fig. 7.3 – Hartson model

The area of safe states of the system is represented as a Cartesian product of the listed measurements. Each access request is represented by a four-dimensional projection of the security space. Requests are eligible for access when they are completely placed in the appropriate subspaces.

One of the first fundamental defense models was developed by Lampson and then improved by Graham and Danning (Fig. 7.4) [18]. The basis of their model is the **access matrix (table)** A, in which:

1) columns $O_1, O_2, \dots, O_n$ are access objects;

2) lines $S_1, S_2, \dots, S_m$ are access subjects;

3) the table element $A[S_i, O_j]$ contains a list of types of access $T_1, T_2, \dots, T_k$, which determines the privileges of the subject regarding the object O_j.

	O_1,	O_2 …	O_j,		O_n
S_1	R	R, W	E		R
S_2	R, N	–	R		E
… S_i	R	–	–		R
…					
S_m	RW	–	E		E

Fig. 7.4 – Matrix model

This model assumes that all attempts to access objects are intercepted and checked by a special controlling process. Thus, the subject S_i will receive access T_k, initiated by him to the object O_j only if the element of the matrix $A[S_i, O_j]$ has the value T_k.

These models can be used both for the protection of operating systems (OS) and for the protection of databases (DB). Taking into account that such single models, as practice shows, significantly complicate the consideration of security issues, some authors have made attempts to develop special models of database protection.

The information protection models considered above belong to the matrix class and have become the most widespread because they serve not only to analyze the logical functioning of the system but also can be successfully implemented in specific programs.

The rule of demarcation of access is as follows: a person is allowed to work with a document only if the access subject's permission level is equal to or higher than the document's confidentiality level, and the set of categories assigned to this access subject contains all the categories defined for this document. In IS, all rights of the access subject are fixed in its mandate. The entity must have a set of mandates to access all the objects it needs. Mandate management allows you to simplify the access control process because when creating a new object, it is enough to create its mark. However, with such management, the confidentiality of information has to be overestimated due to the impossibility of detailed demarcation of access. The Bella-La Padula multi-level protection model (Fig. 7.5) [18], became the most widespread.

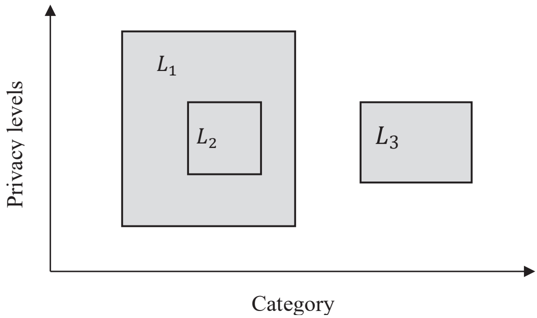

Fig. 7.5 – Model Bella La Padula

The basis of this model is the concept of the level of confidentiality (a form of admission) and category (application area) of the subject and the object of access. Based on the specific levels and categories assigned to each subject and access object, their security levels are determined in the model, and then their interaction is established. At the same time, the model assumes that one level of security dominates another if and only if its corresponding level of confidentiality is greater than or equal to the level of confidentiality of another, and the set of categories includes the corresponding set of others. *Privacy levels are ordered, while security levels are partially ordered, so some subjects and objects may not be comparable.*

Since programs in these models act as subjects in the access rules, they can, if necessary, extend the rights of specific users. For example, an application may have the right to sort a file that the user is not allowed to read.

Another type of model is the multi-level model. They differ from matrix models in several aspects. First, these models consider access management not within the framework of those set by some rights administrator, but within the framework of representing the entire system so that data of one category or area is not available to users of another category. Secondly, multi-level models consider not only the fact of access to information but also information flows within the system.

Summarizing the consideration of two classes of information protection models, we note that the advantage of matrix models is the ease of presenting a wide range of information security rules. The main drawback of these models is the lack of control over information flows. For its part, the main drawback of multi-level models is the impossibility of managing access to specific objects based on accounting for the individual characteristics of each of the subjects. So, both approaches seem to suggest the search for different compromises between efficiency, flexibility, and security. The optimal solution to security issues should be developed using both types of protection models.

The implementation of specific models of protection against unauthorized access should be based on appropriate administrative (procedural) measures and technical means aimed primarily at the identification and authentication of users of the automated system.

The identification of IS users consists in establishing and securing for each of them a unique identifier in the form of a number, cipher, code, etc. This is because the traditional identifier of the surname-name-patronymic type cannot always be used in a specific IS. For identification purposes, various systems are widely used, for example, the so-called personal identification number (PIN), social security number (SSN), personal number, security code, etc. [18]. Such identifiers are used in the construction of various access delimitation and information protection systems.

Authentication consists in verifying the authenticity of the user based on the identifier presented to him, for example, when logging into the system. Such verification should exclude falsification of users in the system and their compromise. Without verification of authenticity, the very meaning of user identification and the use of access control tools built based on personal identifiers is lost. The lack of reliable means of verifying the authenticity of users can significantly complicate the implementation of the principle of personal responsibility, which was mentioned above.

Verification of authenticity (authentication) can be carried out by various methods and means (Fig. 7.6) [18]. Currently, the systems use three main methods of authentication based on the following characteristics:

1) password or personal identification number (the user “knows”);

2) some item that the user has (the user “has”);

3) any physiological signs characteristic of specific individuals (the user “is”).

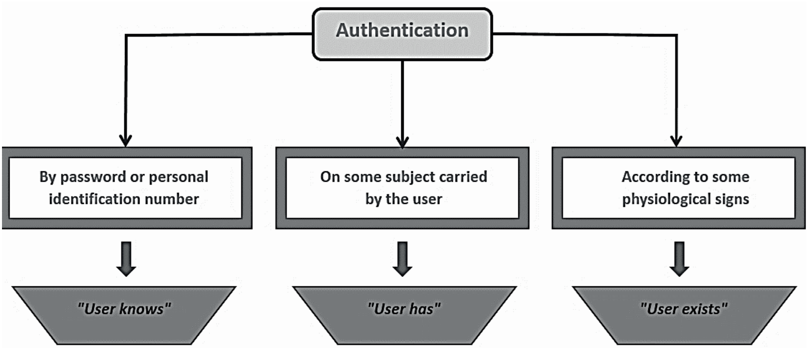

Fig. 7.6 – Authentication methods

The first method is implemented by software authentication tools used in most operating systems, database management systems, teleprocessing monitors, and network packages. The essence of this method is that each registered user is given a personal password, which he must keep secret and enter into the system every time he accesses it. The special program compares the entered password with the standard stored in memory, and if the passwords match, the user’s request is accepted for execution.

The simplicity of this method is obvious, but its obvious disadvantages are also obvious: the password can be selected by going through possible combinations, and a skilled attacker can penetrate the memory area where the reference passwords are stored. Measures to increase the security of password authentication systems include storing password lists in an encrypted form and shortening the validity of passwords up to the use of single-use passwords. Recently, the so-called “request-response” method is widely used for authentication purposes, which allows not only to authenticate the user but also enables the user to authenticate the system with which he works. This is of fundamental importance when working in a network since the use of a fake PC, OS or program is one of the ways of unauthorized receipt of messages or passwords of legitimate users. It should be noted that the need for such mutual authentication is confirmed by the international standard for interoperability of open systems.

A variant of the first method of authentication is the so-called recognition in dialogue mode, carried out according to the following scheme. In the files of the protection mechanisms, personalizing records containing the user’s data (date of birth, height, weight, names, and dates of birth of equals and relatives, etc.) or a fairly large and ordered set of passwords are created in advance. At the user’s request, the protection program offers him to name some data from an existing record, which is compared with those stored in the file. Based on the results of the comparison, an admission decision is made. To increase the reliability of knowledge, the data requested from the user can be selected differently each time.

As an item available to the user (the second method of authentication), so-called identification cards (IC) are used, on which data personalizing the user are applied: a personal identification number, a special cipher or code, etc. These data are recorded on the card in an encrypted form, and the encryption key can be an additional identifying parameter since it can be known only to the user, it is entered by him every time he accesses the system and is destroyed immediately after use.

The information on the card can be written and read in different ways or a combination of several ways. For example, the IC is placed in the reader, the light source illuminates the microcrystalline dot-matrix installed on the card. Since only the non-polarized elements of the matrix will be transparent to light, the corresponding code containing information about a particular user will be read.

Another type of IC is an information card with several rows of signs, letters, etc. specially applied to its surface using phosphor. Reading data from the device in this case is two electrodes, one of which is transparent.

Another type of IC is an electronic identification card built on an integrated microcircuit. Individual magnetic cards were the most widespread among authentication devices of the "user has" type. The popularity of such devices is explained by the universality of their use, relatively low cost, and high accuracy, they are easily completed with a terminal and a PC. Since the readers of these devices do not identify a person, but a magnetic card, they are equipped with a special, often digital keyboard for the card owner to enter his cipher, and password. To protect cards from unauthorized reading and forgery, as in previous cases, special physical and cryptographic methods are used.

To learn the components of data processing, i.e. PC, OS, functional processing programs, data arrays (such knowledge is especially relevant when working in a network), special hardware units-set-top boxes are used, which are devices that generate individual signals. To prevent the interception of these signals and their subsequent malicious use, they can be transmitted in an encrypted form, and not only the encryption key, but also the used method (algorithm) of cryptographic transformation can change periodically.

Physiological user recognition systems have recently begun to gain increasing importance. Only with this approach is it established that the user claiming access to the terminal is exactly who he claims to be. When using this class of authentication means, the problem of "social acceptability" arises: the authentication procedure should not degrade human dignity, create discomfort, simply be too cumbersome and take a lot of time.

There are quite a few physiological signs that indicate a specific person, (Fig. 7.7) [18]. These include prints of feet and hands, teeth, enzymes, breathing dynamics, facial features, and so on. For the authentication of terminal users of automated systems, fingerprints, hand geometry, voice, and personal signature are considered the most acceptable.

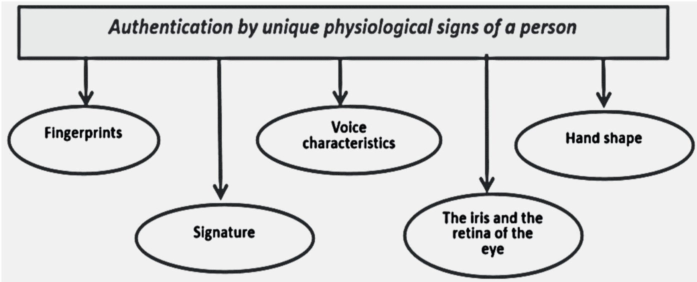

Fig. 7.7 – Physiological methods of authentication

The main conclusion that comes from the experience of creating authentication devices is that obtaining high accuracy of user knowledge is possible only by combining different methods.

It should be noted that all considered authentication methods in the event of non-authentication must implement a temporary delay before serving the next request. This is necessary to reduce the threat of identification features (especially passwords) being picked up automatically. At the same time, all unsuccessful attempts to gain access should be registered to ensure effective supervision (control) of system security.

Cryptography is an extremely important mechanism for protecting information. Since this complex and broad branch of mathematics requires a separate detailed study, here we will present only the basic information on cryptology.

The problem of protecting information by transforming it, which excludes its reading by an outsider, has troubled the human mind since ancient times. The history of cryptography is the same age as the history of human writing. Moreover, initially writing itself was a cryptographic system, because in ancient societies it was possessed only by the chosen ones. With the spread of writing, cryptography began to form an independent science. The first cryptosystems are found already at the beginning of our era. So, in his correspondence, Caesar already used a more or less systematic cipher, which received his name. Cryptographic systems developed rapidly during the First and Second World Wars. From the post-war period to the present day, the advent of computing has accelerated the development and improvement of cryptographic methods.

Cryptology deals with the problem of protecting information by transforming it (Kryptos – secret, logos – science). Cryptology is divided into two areas: cryptography and cryptanalysis. The goals of these directions are directly opposite [18].

Cryptography deals with the search and research of mathematical methods of information transformation. The sphere of interest of cryptanalysis is the study of the possibility of deciphering information without knowing the keys.

Modern cryptography includes four major sections [18]:

1. Symmetric cryptosystems.
2. Cryptosystems with a public key.
3. Electronic signature systems.
4. Key management.

Among the main areas of use of cryptographic methods, we note transmission through information communication channels (for example, e-mail), establishing the validity of transmitted messages, and saving information (documents, databases) on media in an encrypted form. Here are some of the most commonly used cryptography terms.

As information is subject to encryption and decryption, texts built on some alphabet are considered. The *alphabet* is a finite set of signs used to encode information. *Text* is an ordered set of elements of the alphabet.

Encryption is a transformation process: the original text, also known as plaintext, is replaced by encrypted text. *Decryption* is the reverse process of encryption. Based on the key, the encrypted text is converted into the original. *A key* is an information that is necessary for seamless encryption and decryption.

A cryptographic system is a family of plaintext transformations. Members of this family are indexed or denoted by the symbol k; parameter k is the key. The space K is a set of possible key values. Usually, the key is a consecutive series of characters from the alphabet.

Cryptosystems are divided into symmetric and public keys. In symmetric systems, the same key is used for both encryption and decryption.

Public key systems (PKS) use two keys – public and private – which are mathematically linked to each other. Information is encrypted using a public key available to anyone and decrypted using a private key known only to the recipient of the message.

The terms *"key distribution"* and *"key management"* refer to the processes of the information processing system, the content of which is the compilation and distribution of keys between users.

An electronic (digital) signature is its cryptographic transformation attached to the text, which allows when the text is received by another user to check the authorship and validity of the message.

Cryptoresistance is the characteristic of a cipher that determines its resistance to decryption without knowledge of the key (i.e., cryptanalysis). There are several indicators of crypto-resistance, including:

1. Number of all possible keys.
2. Average time required for cryptanalysis.

The transformation of the text is determined by the corresponding algorithm and the value of the parameter k. The effectiveness of encryption to protect information depends on the preservation of the secret of the key and the cryptoresistance of the key.

Abstractly, an *encrypted communication system* can be described as a set of mappings of a set of open messages into a set of closed ones. The choice of a specific type of conversion is determined by the encryption (or decryption) key. The mappings must have the property of mutual ambiguity, that is, when deciphering, a single result must be obtained that coincides with the original open message (Fig. 7.8) [18].

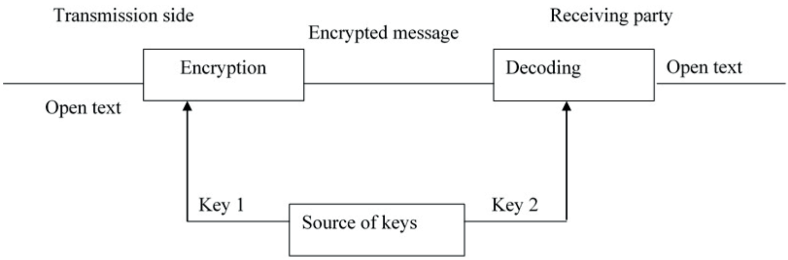

Fig. 7.8 – The general structure of the classified communication system

The encryption and decryption keys may in general be different, although for the sake of simplicity we will assume that they are identical. The set from which the keys are selected is called the *key space.* A set of encryption processes, a set of open messages, a set of possible closed messages, and a key space is called an *encryption algorithm*. A set of decryption processes, a set of possible closed messages, a set of open messages, and a key space is called a *decryption algorithm.*

The operation of the classified communication system can be described as follows:

1. An encryption key *K* is selected from the key space and sent over a reliable transmission channel.

2. A specific transformation F_k determined by the key *K* is applied to the open message *C* intended for transmission to obtain an encrypted message $M: M = F_k(C)$.

3. The received encrypted message *M* is forwarded over the data channel.

4. On the receiving side, a specific transformation D_k, determined from all possible transformations by the key K is applied to the received message M to obtain an open message $C: C = D_k(M)$.

Let’s consider the basic requirements for cryptosystems. The process of cryptographic closure of data can be carried out by both software and hardware.

The hardware implementation is significantly more expensive, but it also has advantages: high performance, simplicity, security, etc. The software implementation is more practical and allows for certain flexibility in use.

The following generally accepted requirements are formulated for modern cryptographic information protection systems:

1) an encrypted message must be readable only in the presence of a key;

2) the number of operations required to determine the used encryption key based on a fragment of the encrypted message and the corresponding plaintext must not be less than the total number of possible keys;

3) the number of operations required to decrypt the information by sorting through various keys should have a strict lower estimate and go beyond the capabilities of modern computers (taking into account the possibility of using network computing);

4) knowledge of the encryption algorithm should not affect the reliability of protection;

5) a slight change in the key must lead to a significant change in the appearance of the encrypted message;

6) the structural elements of the encryption algorithm must be unchanged;

7) additional bits are introduced into the message during the encryption process. must be completely and securely hidden in the encrypted text;

8) the length of the encrypted text must be equal to the length of the original text;

9) there should be no simple and easily established dependencies between keys used consistently in the encryption process;

10) any key from a set of possible ones must ensure reliable protection of information;

11) the algorithm should allow both software and hardware implementation while changing the key length should not lead to qualitative deterioration of the encryption algorithm.

Cryptographic algorithms are based on mathematical transformations that allow to achieve high practical stability of most algorithms (Fig. 7.9) [18].

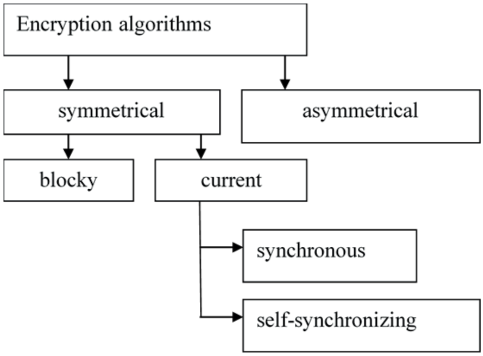

Fig. 7.9 – Classification of encryption algorithms

It has been proved that there are only two main types of transformations in cryptography – substitutions and permutations, all others are just a combination of these two types. In permutation ciphers, the symbols of the plaintext change their location. On the other hand, in substitution ciphers, one plaintext symbol is replaced by a ciphertext symbol.

In classical cryptography, four types of substitution ciphers are distinguished:

– ciphers of simple substitution (monoalphabetic ciphers). One plaintext character is replaced by one ciphertext character;

– ciphers of complex substitution. One character of the plaintext is replaced by one or several characters of the encrypted text, for example: “A” can be replaced by “3” or “PO4E”;

– block substitution ciphers. One block of open text symbols is replaced by a block of closed text, for example: “ABC” can be replaced by “CPT” or “KAP”;

– polyalphabetic substitution ciphers, in which several simple substitution ciphers are applied to the plaintext.

After some time, symmetric algorithms were divided into two larger classes – block and stream. In the former, the plaintext is divided into blocks of a suitable length, and each block is encrypted. In streaming algorithms, each character of the plaintext is encrypted independently of the others and decrypted in the same way. In other words, the transformation of each plaintext character changes from one character to another, while block algorithms use the same cryptographic transformation as part of block encryption.

The main idea embodied in-stream encryption algorithms is to generate a sequence of characters from the input alphabet, with which the encryption algorithm works, based on the secret key. These can be, for example, English characters and numbers of the decimal system, while the input text will be converted according to the selected alphabet. It should be noted that such a sequence has a length equal to the plain text. It is sometimes called gamma.

Encryption and decryption can, for example, be done by modular addition of a plaintext symbol with a gamma symbol. The stability of stream encryption algorithms depends on the extent to which the generated gamma will have the property of equal probability of the appearance of the next symbol. Flow algorithms have a high encryption speed, but certain difficulties arise when using software, which narrows the scope of their practical application.

It should be noted that in recent years, based on the improvement of electronic technologies, new theoretical developments in the field of quantum cryptography, based on the principles of Heisenberg's uncertainty, have appeared. All the variety of existing cryptographic methods can be reduced to such classes of transformations (Fig. 7.10) [18].

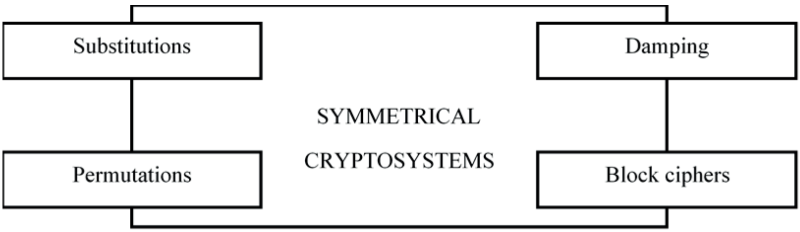

Fig. 7.10 – Classification of symmetric cryptosystems

Permutations – a method of cryptographic transformation, which consists in permuting the symbols of the source text according to a more or less complex rule. It is used, as a rule, in combination with other methods.

Substitution systems are the simplest type of transformation, which consists in replacing the characters of the source text with others (of the same alphabet) according to a more or less complex rule. High cryptographic strength requires the use of large keys.

Hamming is a widely used cryptographic transformation. The principle of encryption by gamming consists of generating a cipher gamma using a pseudorandom number sensor and superimposing the resulting gamma on the open data (for example, using modulo 2 addition).

Block encryption is widely used, which is a sequence (with possible repetition and alternation) of basic transformation methods applied to a block (part) of the text to be encrypted. Block ciphers in practice are more common than "pure" transformations of one or another class, due to their higher cryptoresistance.

No matter how complex and reliable cryptographic systems are, their weak point in practical implementation is the problem of key distribution. For confidential information to be exchanged between two IS entities, a key must be generated by one of them, and then somehow transferred again in a confidential manner to the other. That is, in the general case, the transfer of the key again requires the use of some cryptosystem.

What is the problem with data authentication? At the end of an ordinary letter or document, the executor or responsible person usually puts his signature. Such action usually has two purposes. First, the recipient has the opportunity to verify the authenticity of the letter by comparing the signature with the sample available to him. Secondly, a personal signature is a legal guarantor of the document's authorship. The last aspect is especially important when signing various types of trade agreements, drawing up instructions, commitments, etc.

If it is very difficult to forge a person's signature on paper, and establishing the authorship of a signature using modern forensic methods is a technical detail, then everything is completely different with an electronic signature. Any user can fake a string of bits by simply copying it, or subtly making illegal corrections to a document.

With the significant spread in the modern world of electronic forms of documents (including confidential ones) and the means of their processing, the problem of establishing the validity and authorship of paperless documentation has become especially relevant. It has already been shown that of all the advantages of modern encryption systems, they do not allow for data authentication. Therefore, means of authentication must be used in combination with cryptographic algorithms.

An electronic signature is data in electronic form, which is added to other electronic data or is logically connected with them and is intended to identify the signer of this data.

An electronic digital signature is a type of electronic signature obtained as a result of the cryptographic transformation of a set of electronic data, which is added to this set or logically combined with it and makes it possible to confirm its integrity and identify the signer. An electronic digital signature is created using a private key and verified using a public key.

Let there be two users – Oleksandr and Boris. What violations and actions of an attacker should the authentication system protect against?

Refusal (renegade). Oleksandr declares that he did not send a message to Boris, although in fact, he did. To exclude this violation, an electronic (or digital) signature is used.

Modification (processing). Boris changes the message and claims that Oleksandr sent him this (changed) message.

Fake. Boris forms a message and claims that Oleksandr sent him this (modified) message.

Active interception. Volodymyr intercepts messages between Oleksandr and

Boris for covert modification. Digital signatures are used to protect against modification, forgery, and masking.

Masking (imitation). Volodymyr sends a message to Boris on behalf of Oleksandr. In this case, an electronic signature is also used for protection.

Repeat. Volodymyr repeats the message that Oleksandr sent earlier to Boris. Even though various measures are taken to protect against repetition, it is this method that accounts for the majority of cases of illegal withdrawal and spending of money in electronic payment systems.

The most effective method from repetitions is:

1) use of imitation inserts;

2) accounting of incoming messages.

Sometimes it is not necessary to encrypt the transmitted message, but it is necessary to seal it with an electronic signature. In this case, the text is encrypted with the private key of the sender, and the resulting string of characters is attached to the document. The recipient uses the sender's public key to decrypt the signature and compare it with the text.

A hash function is a one-way function designed to obtain a digest or "fingerprint" of a file, message, or some block of data. The hash code is generated by the function 7.2 H:

$$h = H(M) \tag{7.2}$$

where M is a message of arbitrary length;

h is a hash code of fixed length.

Consider the requirements that a hash function must meet for it to be used as a message authenticator. Consider a very simple example of a hash function. Then we will analyze several approaches to constructing hash functions.

The hash function H, which is used for message authentication, should have the following properties [18]:

1. The hash function H should be applied to a block of data of any length.

2. The hash function H produces a fixed-length output.

3. $H(M)$ is relatively easy (in polynomial time) to calculate for any value M.

4. For any given value of the hash code h, it is computationally impossible to find M such that H $(M) = h$.

5. For any given x it is computationally impossible to find $y \neq x$, such that $H(y) = H(x)$.

6. It is computationally impossible to find an arbitrary pair (x, y) such that $H(y) = H(x)$.

The first three properties require the hash function to produce a hash code for any given message. The fourth property determines the requirement of the one-sidedness of the hash function: it is easy to create a hash code for a given message, but it is impossible to recover a message from a given hash code. This property is important if authentication using a hash function includes a secret value. The secret value itself may not be sent, however, if the hash function is not one-sided, an adversary can easily reveal the secret value in this way.

When the transmission is intercepted, the attacker receives the message M and the hash code $C = H(S_{AB})||M$. If the attacker can invert the hash function, then he can obtain $S_{AB} \,||\, M = H^{-1}\,(C)$. Because the attacker now knows $M\ i\ S_{AB} \,||\, M$, get S_{AB} quite simply.

The fifth property ensures that it is impossible to find another message whose hash function value matches the hash function value of this message. This prevents authenticator spoofing when using an encrypted hash code. In this case, the adversary can read the message and generate its hash code. But because the adversary does not have the secret key, there is no way for the adversary to change the message without the recipient discovering it.

If this property is not fulfilled, the attacker has the opportunity to perform the following sequence of actions: intercept the message and its encrypted hash code, calculate the hash code of the message, create an alternative message with the same hash code, replace the original message with a fake one. Since the hash codes of these messages match, the recipient will not detect tampering.

A hash function that satisfies the first five properties is called a simple or weak hash function. If, in addition, the sixth property is fulfilled, then such a function is called a strong hash function. The sixth property protects against a class of attacks known as the birthday attack.

In many countries today there are standards for electronic (digital) signatures. The digital signature standard DSS (Digital Signature Standard) was adopted in the USA in 1991 and revised in 1994. The standard is based on the DSA (Digital Signature Algorithm) algorithm, which is a variation of the El-Gamal signature [18]. The algorithm uses a unidirectional hash function *H(m)*. As a hash algorithm, the DSS standard provides for the use of the SHA-1 algorithm.

Let's consider the EDS generation algorithm itself [18]. First, three general (non-secret) parameters are selected for a group of subscribers p, q, a:

1) the parameter p must be a simple number between 512 and 1024 bits long;

2) q – a simple number with a length of 160 bits; between p and, q the ratio must be fulfilled $p = bq + 1$ for some whole b. Older bits in p and, q must be equal to units (thus $2^{159} < q < 2^{160}$);

3) number a satisfies the inequalities $1 < a < p - 1$ and is a root of the equation $a \, mod \, p = 1$.

Knowing these numbers, each subscriber of the system randomly chooses a number x that satisfies the inequalities $0 < x < q$, and calculates:

$$y = a^x mod \, p. \tag{7.3}$$

The number x will be the user's secret key and the number y will be the public key. Calculating y from known x is quite simple. However, given the public key y, it is computationally infeasible to determine x, which is the discrete logarithm of y to the base a.

All users' public keys are supposed to be specified in some non-secret but "certified" directory that everyone who is going to verify signatures must-have. At this stage, the selection of parameters ends and subscribers are ready to form and verify signatures.

Let there be a message *m* that one of the users wants to sign. To generate a signature, the user must perform the following actions:

1. Calculate the value of the hash function $h = H(m)$ for a message m. 3the value of the hash function must be within the range $0 < h < q$.

2. Then generate a random number k, $0 < k < q$.

3. Calculate $r = (a^k mod\ p)\ mod\ q$.

4. Determine $s = [k^{-1} \times (H(m) + x \times r)]mod\ q$.

As a result, the user will receive a signature consisting of a pair of numbers *(r, s)* for the message m. The message together with the signature can be sent to any other subscriber of the system. You can check the signature in the following way:

1. Calculate the value of the hash function $h = H(m)$ for a message m.

2. Check the fulfillment of inequalities $0 < r < q$, $0 < s < q$.

3. Calculate $w = s^{-1} mod\ q$.

$$u_1 = [H(m) \times w]\ mod\ q \tag{7.4}$$

$$u_2 = r \times w\ mod\ q; \tag{7.5}$$

$$v = [(a^{u1} \times y^{u2}) mod\ p]\ mod\ q. \tag{7.6}$$

4. Check the implementation of equality $v = r$. If $v = r$, then the signature is considered authentic, otherwise the signature is considered invalid.

Due to the complexity of computing discrete logarithms, an attacker cannot recover *k* from *r* or *x* from *s*, and therefore cannot forge the signature. For the same reason, the author of the message will not be able to renounce his signature, because no one but him knows the private key *x*.

In addition to choosing a cryptographic system suitable for a particular IS, key management is an important issue. No matter how complex and reliable the cryptosystem itself is, it is based on the use of keys. If the key exchange process is trivial to ensure the confidential exchange of information between two users, then in IS where the number of users is tens and hundreds, key management is a serious problem. The key information is understood as the totality of all keys active in the IS. If the management of key information is not sufficiently reliable, then, after taking possession of it, an attacker gets unlimited access to all information.

Key management is an information process that includes three elements:

– generation of keys;

– accumulation of keys;

– distribution of keys.

Let's consider how they should be implemented to ensure the security of key information in IS. At the very beginning, it was said that you should not use non-random keys for the sake of ease of remembering them. In serious IS, special hardware and software methods of random key generation are used. As a rule, sensors of pseudorandom numbers (PRN) are used. However, the degree of randomness of their generation should be quite high. Ideal generators are devices based on "natural" random processes. For example, serial samples of key generation based on white radio noise have appeared. Another random mathematical object is the decimals of irrational numbers, such as π or ε, which are calculated using standard mathematical methods.

In IS with average security requirements, software key generators that calculate PRN as a complex function of the current time and/or number entered by the user are quite acceptable.

The accumulation of keys means the organization of their storage, accounting, and deletion. Since the key is the most attractive object for the attacker, which opens the way to confidential information, it is worth paying special attention to the issue of key accumulation.

Secret keys should never be written in an explicit form on a medium that can be read or copied.

In a rather complex IS, one user can work with a large amount of key information, and sometimes there is even a need to organize mini-databases with key information. Such databases are responsible for accepting, saving, accounting, and deleting used keys.

Therefore, all information about the use of keys must be stored in an encrypted form. Keys that encrypt key information are called master keys. It is desirable that each user knows the master keys by heart and does not store them on any physical media at all.

A very important condition for information security is the periodic recovery of key information in IS. At the same time, both ordinary keys and master keys must be reassigned. In particularly responsible IS, it is advisable to restore key information daily.

The issue of restoring key information is also related to the third element of key management – key distribution. Key distribution is the most responsible process in key management. It has two requirements:

1. Efficiency and accuracy of distribution.

2. Secrecy of distributed keys.

Recently, there has been a noticeable shift towards the use of public-key cryptosystems, which eliminate the problem of key distribution. The key distribution between users is implemented using two different approaches:

1. *By creating one or more key distribution centers*. The disadvantage of this approach is that the distribution center knows to whom and which keys are assigned, and this allows reading all messages circulating in the IS. Possible abuses significantly affect protection.

2. *Direct exchange of keys* between IS users. In this case, the challenge is to reliably authenticate the subjects.

In both cases, the validity of the communication session must be guaranteed. This can be ensured in two ways:

1) *a request-response mechanism* consisting of the following. If user A wants to be sure that the messages he receives from B are not erroneous, he includes an unexpected element (query) in the message sent to B. When responding, user B must perform a certain operation on this element (for example,

add 1). This cannot be done in advance because it is not known what random number will come in the query. After receiving a response with the results of the actions, user A can be sure that the session is genuine. The disadvantage of this method is the possibility of establishing, albeit difficult, regularity between the request and the response;

2) *time estimation mechanism* ("timestamp"). It involves fixing the time for each message. In this case, each IS user can know how "old" the received message is.

In both cases, encryption should be used to ensure that the response is not sent by an attacker and that the timestamp has not been altered. When using time estimates, there is the problem of an acceptable delay time interval for validating a session. After all, a message with a "timestamp" cannot, in principle, be transmitted instantly. In addition, the recipient's and sender's computer clocks cannot be completely synchronized. What lateness of the "stamp" is considered suspicious?

Therefore, in real IS, for example, credit card payment systems, the second mechanism of establishing validity and protection against counterfeiting is used. The used interval is from one to several minutes. A large number of known methods of electronic money theft are based on "wedging" this gap with fake requests to withdraw money. As a generalization of what was said about key distribution, it is worth emphasizing that the task of key management is reduced to finding such a key distribution protocol that would ensure:

– the possibility of opting out of the key distribution center;

– mutual confirmation of the authenticity of the session participants;

– confirmation of the probability of the session by the request-response mechanism, using software or hardware tools for this purpose;

– use the minimum number of messages when exchanging keys.

One of the important practical problems is the encryption of large messages and data streams. This problem appeared relatively recently with the advent of multimedia devices and high-bandwidth networks that provide multimedia data transmission. So far we have talked about the protection of messages. At the same time, they meant rather some textual or symbolic information. However, modern IS uses technologies that require the transmission of significantly large volumes of data. Such technologies include:

– fax, video, and voice communication;

– voice mail;

– video conferencing systems.

If we compare the volume of transmitted information of different types, we can say that the volume of text information is the smallest, the volume of audio information is 2–3 times larger, the volume of graphic information is an order of magnitude larger, and the volume of video information is almost two orders of magnitude larger.

Since the transmission of digitized sound, graphic, and video information in many cases requires confidentiality, the problem of encryption of huge information arrays arises. For interactive systems such as teleconferences, conducting audio or video communication, such encryption should be carried out in real-time and, if possible, be "transparent" for users. This is unthinkable without the use of modern encryption technologies. The most common is stream data encryption. If in the previously described cryptosystems it was assumed that there is a certain final message at the input, to which the cryptographic algorithm is applied, then in systems with stream encryption the principle is different.

The security system does not wait for the transmitted message to end but immediately encrypts and transmits it. The most obvious is the bitwise addition of the input sequence (message) with some infinite or periodic key obtained, for example, from a PRN generator.

Another, sometimes more effective method of stream encryption is block encryption. That is, a fixed amount of information (a block) is accumulated, and then transformed by some cryptographic method and transmitted to the communication channel. As has been repeatedly noted, the problem of key distribution is most acute in large IS. Part of this problem is solved (or rather, removed) due to the use of public keys. But the most reliable cryptosystems with a public key are quite time-consuming, and for encryption of multimedia data, they are not suitable at all.

Original solutions to the problem of “stray keys” are being actively developed by specialists. these systems are somewhat of a compromise between public-key systems and conventional algorithms that require the sender and receiver to have the same key.

The idea of the method is quite simple. After a key is used in one session, it is replaced by another one by some rule. This rule must be known to both the sender and the recipient. Knowing the rule, after receiving the next message, the recipient also changes the key. If the rule of changing the keys is carefully followed by both the sender and the recipient, then they have the same key at each moment. Constantly changing the key makes it difficult for an attacker to disclose information.

The main task in the implementation of this method is the selection of an effective key change rule. The easiest way is to generate a random list of keys. The keys are changed in the order of the list. However, the list will have to be transmitted somehow.

Another option is the use of mathematical algorithms based on so-called sorting sequences. On a set of keys, by the same operation on an element, we get another element. The sequence of these operations allows you to move from one element to another until the entire set is traversed.

Another possibility is the combination of encryption algorithms and information compression. The task of compression is to transform a message within the same alphabet in such a way that its length (the number of letters of the alphabet) becomes smaller, but at the same time, the message can be reconstructed without using any additional information.

In any case, the chosen complex cryptographic methods should combine both convenience, flexibility, and promptness of use, as well as reliable protection against intruders of the information circulating in the IS.

Questions for self-control:

1. Name the main types of technical channels and sources of information leakage.
2. What methods can be used to eavesdrop on conversations on the premises?
3. Name the main principles of information protection from NSD.
4. The structure of the request monitor.
5. Main characteristics of the Hartson model?
6. Main characteristics of the Bella-La Padula model.
7. Name the methods of authentication based on the unique physiological characteristics of a person.
8. Define the terms “cryptography“, ”cryptology“, ”steganography“, “ciphertext”, “cryptographer”, “cryptanalysis”, “key”, “cryptoresistance”.
9. What is the difference between symmetric and asymmetric cryptographic systems?
10. Define the concepts of “electronic digital signature”, “hash function”.

7.3. Methods of safe use of cloud storage and technologies

Recently, we have increasingly used cloud technologies and cloud data storage in our daily and professional lives. However, the basic rules of safe use of such services and technologies should be followed.

Cloud technologies are a new type of service that allows the user to use space for data storage, computing resources, and software for their processing separately (via an Internet connection).

Cloud Computing is a model of convenient use of shared computing resources available through an Internet connection to perform data processing and storage tasks that can be configured and can be released and quickly provided to the user with minimal management costs and calls to the provider.

The architecture of "cloud" computing includes many "cloud" components (Fig. 7.11) that interact with each other through web services – Application Program Interface (API) [24–25].

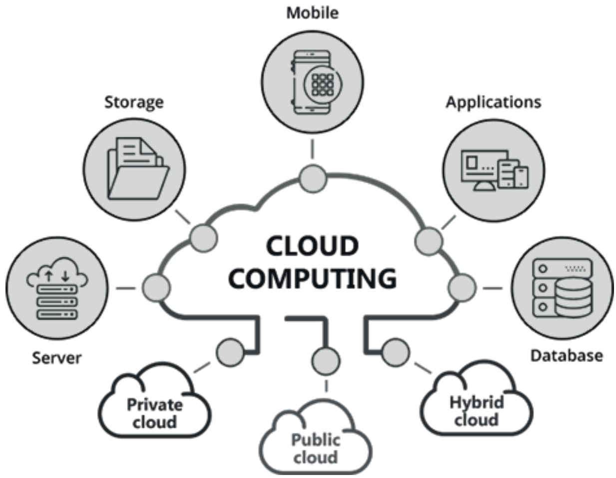

Fig. 7.11 – The architecture of "cloud" computing

Cloud technologies have two components – "Front-end" (the outer part of the cloud) and "Back-end" (the inner part of the cloud). With the help of the Front-end, the user interacts with the cloud (system, virtual machine, resources) from the client computer or other devices and applications used to access the cloud, and the Back-end represents resources (computers, servers, storage data, applications) that are involved in the performance of tasks set by the user, are essentially the "cloud" itself and form cloud services.

The concept of "cloud" data processing includes various models of providing IT services: PaaS, SaaS, DaaS, WaaS, CaaS, and EaaS (Table 7.3) [24–25].

Table 7.3 – **IT service delivery models**

Name of the service	Description
Platform as a service, Paas	Providing an integrated IT platform for creating, testing, deploying, and supporting applications. The client receives remote access to the software infrastructure and development tools.
Software as a service, Saas	The provider hosts the application, providing paid access to it via the Internet. Users pay only for using the program and do not pay for owning it.
Data as a service, Daas	Provision of data at the request of the user regardless of his geographical location or provider or organizational affiliation.
Infrastructure as a Service, IaaS	Provision of on-demand computing resources on which the customer can deploy and run arbitrary software, including operating systems and applications.
Workplace as a service, Waas	Provision of a virtualized workplace, a special case of IaaS.
Communication as a Service, Caas	As services, IP telephony, postal services, Unified Communications, etc. are provided.
Everything as a service, Eaas	A complex of all kinds of "cloud" services, satisfying any IT needs.

There are the following cloud deployment models:

– private cloud (Private cloud);

– public cloud (Public cloud);

– hybrid cloud (Hybrid cloud).

The choice of model depends on the scale of the organization, its structure, IT infrastructure, and specifics of data and tasks.

The private cloud ensures the placement of the virtual environment of the organization on a specific physical server, which is provided for use by one tenant. There is a possibility of placing the equipment (computing resources) in the data center (data center) alongside the equipment of other organizations (tenants), but it should be noted that this model provides for the separation of the cloud for one customer (tenant). Virtual resources are divided between internal structural departments, but they are used by one customer – one organization. The advantages of this model include:

– complete isolation of the IT infrastructure;

– the individuality of the configuration;

– increased reliability of data storage.

Therefore, this model is suitable for organizations with a complex IT infrastructure and meets the conditions of a higher level of security and data privacy. Also, this structure is good for management and allows you to analyze and understand the needs of each structural unit of the organization, which in turn creates positive conditions of use. Private cloud tenants are quite often large companies, namely banks, mobile operators, retail enterprises, insurance companies, etc.

Disadvantages include high cost, deployment time, and limited resource pool, which does not allow for an increase in the capacity of cloud computing if necessary.

The public cloud involves the placement of virtual infrastructures of several customers at once on one physical server. It can be from two to an unlimited number. The data of one company is stored on the same physical server alongside the data of another organization. It should be noted that the data is reliably protected and isolated, including from the intervention of the cloud provider. In this case, the set of physical resources of the provider's data center is divided into several virtual data centers used by customers of cloud services. It should be noted that the physical location of an organization's data server cannot be determined precisely because, in a cluster, virtual machines are moved between servers to balance the load and improve uptime.

Advantages of public cloud:

– relatively low cost;

– flexibility;

– convenience and ease of interaction with cloud hosting;

– with a stable Internet connection, virtual machines are quite easy to expand and collapse;

– at times of peak load, it is possible to increase the computing power and decrease it if necessary.

It should be emphasized that the deployment of the public cloud model is not suitable for those companies or organizations that set special conditions for information protection. However, if the company's equipment is outdated, and its replacement requires significant funds, then, in this case, renting a public cloud will be the best solution.

Comparative characteristics of public and private clouds are presented in Fig. 7.12.

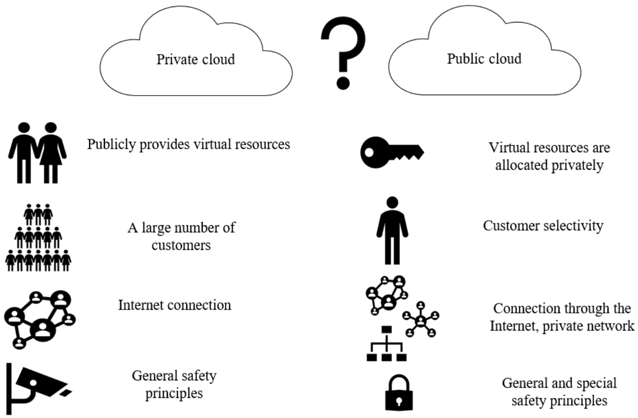

Fig. 7.12 – Comparative characteristics of public and private clouds

A hybrid cloud includes the characteristics of public and private clouds. This model is used when the customer does not have enough capacity in the private cloud, or some tasks are more convenient to perform outside the private cloud. For example, performing tasks that require significant computing resources, or performing tasks that do not require special protection of information and electronic data. Among the disadvantages, attention should also be paid to the fact that there is a possibility of data loss when transferring from a private cloud to a public one, as well as to determine the exact location of data. If it is not critical according to the organization's security policy, then this model is quite attractive for financial structures, insurance companies, and commercial enterprises.

Among the most popular SaaS products, Salesforce.com (Fig. 7.13), Google Apps (Fig. 7.14), Microsoft Office 365 (Fig. 7.15) should be noted.

Fig. 7.13 – Salesforce.com Services

Notable platforms include Microsoft Azure Platform, Google Cloud Platform, and Amazon Elastic Compute Cloud. The Microsoft Azure Platform is a full-featured combination of managed and unmanaged services that allow you to build, deploy, and manage applications in any way you want to achieve incredible performance.

Azure supports all operating systems, languages, tools, and platforms: from Windows to Linux, from SQL Server to Oracle, and from C# to Java. Azure offers enterprise data storage solutions for private, hybrid, and cloud environments with advanced capabilities.

Microsoft is an industry leader and expert in the security of personal data in the cloud.

Fig. 7.14 – Google Apps services

Microsoft's privacy policy prohibits the use and provision of data to third parties for advertising and operational audit purposes. Databases and sites of any complexity can be stored on the Azure platform. For organizations and companies, Microsoft Azure provides the opportunity to use cloud services. This option is very convenient and profitable for enterprises, as the costs of server maintenance are reduced.

Fig. 7.15 – Microsoft Office 365 services

Azure's core mission is to develop support services for computing, storage, networking, and application support that enable you to grow quickly and achieve more while minimizing costs.

Google Cloud Platform is a cloud-based data storage platform that offers to host and supporting infrastructure. Allows you to quickly develop and deploy your applications without worrying about system administration. Cloud-hosted applications can automatically scale to meet the most demanding workloads and scale down when traffic slows down. The cloud platform offers both fully managed platforms and flexible virtual machines, allowing you to choose the scheme that will suit your needs.

Amazon Elastic Compute Cloud is a virtual computing environment that allows you to use web service interfaces.

When using ready-made software products or solutions, you are immediately offered a protection package, in particular when using Google, Amazon, and Microsoft products. The use of social networks, personal PCs, the use of social networks with a professional and personal identity requires that each user adheres to the general rules of safe operation. Let's focus on the main ones.

First of all, you need to find out what information is already available on the Internet about you and the company you work for. For this, you should use OSINT methods and the most common Internet search engines, including Google, Bing, Yahoo, or DuckDuckGo [23]. Advanced search operators should be used. Personal data include:

– your surname and first name;

– date of birth;

– e-mail;

– personal and corporate phone numbers;

– address;

– profiles in social networks;

– passwords.

Restricted information includes:

– intellectual property;

– business research;

– financial information;

– information about customers;

– information about employees;

– access passwords to resources;

– IP, MAC addresses of workstations.

Advanced search operators [23]:

– inurl: username – allows you to see all pages with the specified username in the URL;

– [your name] intext: [personal information, such as phone number, ID card, or address] – will report pages where personal information about a person is found, depending on the request;

– site:docs.google.com "company name" – will show Google Docs documents that it finds in public access, in which the name of the company is indicated;

– "companyname.com" – will show resources that link to the page of this company;

– password filetype:docx site:companyname.com – will output files in .docx format from the company website containing the word "password".

Google Images, Bing Images, and Tineye services are used to search for images. To check publicly available information about accounts and passwords, you should use the following services: Haveibeenpwned, Google Passwords, Spy Cloud, Ghost Project.

Basic safety rules:

1. **Separate accounts.** Separate your professional activities and personal life. When creating accounts, if possible, do not use your name and other personal data – generate an account without linking to personal data. To carry out financial operations, work with your bank cards, and create separate accounts that do not repeat professional and personal accounts.

2. **Use complex and different passwords**. Do not use the same passwords, it is better to use complex passwords, at least 8 characters (using letters, numbers,

special characters, upper and lower case letters). Generate multiple passwords for each online service. For added protection, use two-factor authentication.

3. **Remove metadata and hide geolocation.** Many services ask for access to geolocation. Provide access to such data only in extreme cases, when it is vitally necessary. Turn off geolocation and use a VPN. The EXIF metadata will show the camera model, time and date of the shooting, and course the coordinates of the shooting location (geographical coordinates).

4. **Take photos carefully.** We quite often like to display our photos, post selfies of others, and make corporate photo reports. The most popular social networks have taken care of privacy and automatically remove all EXIF metadata before publishing. But you should pay attention to the clues contained in the photos themselves, in particular, they can be the names of institutions, advertising signs, silhouettes of buildings that are often reflected in mirrors, and papers on the table often with confidential data of both the organization and personal information. Such seemingly insignificant details can lead to the disclosure of confidential information. Therefore, when taking a photo, analyze the place, the area, and everything nearby. Do not post photos that compromise you and do not allow others to take such photos, or simply control their deletion without the possibility of recovery. DO NOT take photos of others without their consent and ask permission to display such photos. Remember that the details of your personal life are a collection of information about you, your life, and your relatives.

5. **Minimize content.** Any comments and other content posted on the network are a threat to the confidentiality of information. When commenting on the quality of photos, or stories, especially during emotional outbursts, an unstable psychological state (a lot of content is precisely designed for such a reaction of a person, posting distorted information, or lies), control the content of the information you share.

6. **Carefully fill out the account with personal data.** All responsibility rests with the user. If you are a public person and want to share the real events of your

life, put your family, relationships, and other events of your life on display, then your own decision is yours and you are responsible for such behavior. Many people are forced to be “famous” on the Internet due to the positions they hold and their professional activities. In such cases, professional activity and personal life should be separated by accounts with the impossibility of tracing the relationship. From the security point of view, it is strongly recommended to fill in the account with false data, so that it is not possible to draw an analogy between the account and a person. Distortion of information will preserve a friendly image, obscure goals, and send competitors down the wrong path. It is recommended not to use the real date of birth (your relatives and friends know this information), enter a random value, do not enter the full name, or use a fictitious one, it is different for each account. For non-public accounts, use “avatars” or random images for the profile, but you need to make sure that this photo is unique and that no one else is already using it.

7. **Create trap files.** Such files may contain information of interest to the attacker, such as passwords, financial statements, and personal data that do not correspond to reality, that is, they are bait. With the help of the Canary Tokens service, you can receive a message when you try to open such a file and track the attacker’s IP address and DNS server. A service like IP Logger will generate a link to place inside the trap file to track the hacker’s IP address and location.

It is impossible to delete all information about yourself from the Internet because there are many open state registers in which you appear (real estate, court cases, vehicles, and others), so the only thing left is to delete accounts that you do not use, as well as exclusion from brokerage databases, an attempt to send requests to remove publications on social networks and other sites.

To delete accounts, you can use the directory of direct links (*https://backgroundchecks.org/justdeleteme/*). Account blocking or deactivation will technically keep your account online and searchable. To be removed from the brokerage database, it is necessary to directly contact the administrators with a request for exclusion. On many sites, an online exclusion request form is available. To exclude your data and information compromising you, it is also necessary to contact the owners of accounts and sites. If you receive a refusal, you can file a complaint with the administration of Facebook, Instagram, LinkedIn, YouTube, and Google.

The issue of security is a continuous process that is dynamically developing. Therefore, it is necessary to constantly update your knowledge in this matter or use the services of security specialists.

Questions for self-control:

1. Define the term “cloud technologies”.
2. What IT service delivery models do cloud technologies provide?
3. Name the cloud deployment models.
4. Compare the characteristics of public and private clouds.
5. What Google services do you know?
6. List Microsoft Office 365 services.
7. What information is classified as restricted-access information?
8. Name the basic safety rules.

7.4. Blockchain

Today, humanity is constantly transforming into a digital society. The development of information technologies leads to the emergence of new technologies and their introduction into everyday life. Blockchain technologies are rapidly developing and expanding the possibilities of their use. The emergence of cryptocurrency has opened up new opportunities for society’s transition to digital finance. The cryptocurrency market is constantly expanding, they have certain fluctuations just like ordinary money. The basis of any cryptocurrency is the blockchain, which is a global ledger created based on combining separate blocks of transaction data. Blockchain technology is based on the use of hash functions.

A hash function is a function that reorganizes an input of letters and numbers into an encrypted output of a fixed length. A hash is created using cryptographic algorithms and is necessary to manage the chain of blocks in cryptocurrency.

Features of the hash function:

– a function that meets the encryption requirements necessary for the blockchain;

– has a fixed length, which is very difficult to guess when trying to break it;

– the hash is calculated based on the information contained in the name of the blocks.

Among the properties of the hash function, it should be noted:

1. Speed – the computation speed of the hash function should be as fast as possible for any input data.

2. Unidirectionality – there should be no way to compute the input data from the hash.

3. The presence of an avalanche effect – the slightest change in the raw data should drastically change the hash, without any reference to the previous hash.

4. Resistance to collisions.

5. Resistance to attacks.

Today, the cryptocurrency market is quite large and has thousands of types. Of course, Bitcoin took the clear lead, and it maintains its leadership. However, the emergence of new altcoins (alternative coins) is primarily aimed at improving the classic bitcoin. It should be noted that each type of altcoin differs from the other and solves the problems inherent in bitcoin in its way. Weaknesses of Bitcoin cryptocurrency include:

– limited functionality;

– insufficient anonymity;

– long transaction time;

– complex and energy-consuming mining.

As a result of the improvement, cryptocurrency projects appeared with additional encryption (Monero (XMR)), minimization of transaction confirmation cycles (Ripple (XRP)), and an increase in the number of transactions in a block, simpler mining models. Ethereum (ETH) altcoin deserves special attention, which is the second largest after Bitcoin. Work on this project led to the emergence of a smart contract that expands the possibilities of using blockchain technology. Today, thanks to smart contracts, blockchain technologies are used in various spheres of human activity, including trade, service provision, and the financial sphere. The essence of smart contracts is the creation of a computer program containing the terms of the contract signed between the parties.

The terms of the contract included in the smart contract are fulfilled if the conditions written in them are fulfilled. It is not possible to affect the execution of a smart contract after it is uploaded to the blockchain, as it is executed automatically when the terms of the contract are met. Blockchain technologies are used from one-click purchases of goods using cryptocurrency to complex functions such as decentralized financing (DeFi) of loans, savings, and liquidity pools.

Blockchain is a decentralized digital ledger (a continuously growing list of electronic records) of transactions that are stored over a long period and protected using encryption. Blockchain registry data is distributed across a network of computers. Its users can independently, and directly interact with the stored data in real-time, without intermediaries to confirm the authenticity of the transaction. Blockchain technologies provide an independent, tamper-proof, and transparent platform for all participants, which allows for the safe storage, transmission, and processing of confidential information.

Main properties of blockchain:

– decentralization;

– equality;

– protection from external influences;

– synchronization by agreement;

– there is no need for verification by a third party;

– all transactions are visible to all participants of the corresponding blockchain.

Decentralized applications (dApps) are applications or programs that are based on blockchain technology and run on a decentralized computer system or P2P network. Their main advantages are open source code and high resistance to possible attacks.

Decentralized applications never stop working due to the absence of a central server. Data in them is distributed between nodes, while all nodes operate independently: if one of them stops, the others will continue working in the network. Examples of decentralized databases that use this feature are the Interplanetary File System, BitTorrent, and independent DHT tables.

Three categories of dApps can be distinguished depending on the blockchain model they use:

1. **Type I.** Programs run on their blockchain (Ethereum platform).

2. **Type II.** DApps that function based on an already existing blockchain (the MakerDAO protocol).

3. **Type III.** These applications are based on Type II dApp protocols, but they require two components to work: a blockchain and an application running on that blockchain (the Augur application).

The limited number of tokens and placement in the network of scarce resources gives profit. The constant growth of the network and the increase in the number of users with a constant number of tokens contribute to the increase in the value of the coins. Owners of computing power (scarce resources), miners, charge a fee for each transaction.

Among the areas of application of blockchain technologies, the game business should be noted. The creation of blockchain games was facilitated by the popularity of cryptocurrency and the transparency of operations, i.e. the impossibility of economic manipulation by game companies, the minimization of payment problems, and the avoidance of disconnection or imbalance of the game process. The core ideas and principles of blockchain technology create a distributed and transparent open-source network for player participation, real-world asset ownership, consensus-based updates, decentralized markets, optimized tokens, and more. The most popular games were CryptoKitties, Alien Worlds, Axie Infinity, Cartesi, and The Sandbox.

The use of smart contracts in the field of real estate made it possible to get rid of such problems as slow transactions, mistrust between buyers, sellers, and intermediaries, administrative disputes, and inheritance registration. The introduction of blockchain technologies allowed for the automation of routine processes, transparent registration, and tracking of data, which led to a reduction in costs and an improvement in the quality of service provision. The use of smart contracts has enabled the implementation of such business models for real estate as fractional ownership of hard-to-share assets, encrypted contracts to speed up transactions, and crowdfunding of real estate through monetization.

The use of smart contracts in insurance has some positive trends, in particular, the reduction of fraud, and the increase of trust in policyholders due to the transparency of paperwork and quick payments in the event of an insurance event. For example, we purchased an insurance policy for flight delays, in the event of such an event, you automatically receive payments immediately to the card. That is, upon the occurrence of an insurance event, which is prescribed in the smart contract, you instantly receive the payments due to you. Also, the use of blockchain technologies allows offering complex versions of insurance products on microinsurance products. Most insurance companies already have this kind of offer for their customers.

The emergence of blockchain technologies did not bypass art. NFTs (non-fungible tokens) have gained widespread use in the art world. Using this technology, works of art are created and sold at auctions at quite high prices, they are authentic and unique. The development of NFTs contributed to the emergence of crypto-art and digital collecting. The use of this technology is also possible for the authenticity of documents for real assets, such as works of art, jewelry, musical and literary works, and poetry. You can access, view, buy, and research works created using NFT technology through the Binance NFT Marketplace. You must have a Binance account to carry out transactions.

Blockchain technologies can provide security from individual accounts to the management of entire states. Recently, the use of blockchain technologies in conducting elections, managing enterprises, holding meetings, and voting on various scales is becoming more and more popular [3]. With an individual level of protection using blockchain technologies, self-sovereign identity is ensured (individual users can control personal information, ensure secure transmission of data, messages, and the necessary level of protection of Internet of Things devices).

Countries such as Malta, China, and Australia are using blockchain technology for government-level security. Blockchain technologies are widely used to prevent denial-of-service attacks at individual vulnerable points.

The use of blockchain technologies in the medical field to protect medical data, reduce fraud, and create a single medical information center for citizens of the country is considered promising [4].

Questions for self-control:

1. Define the term “blockchain”.
2. Define the term “hash function”.
3. Name the properties of the hash function.
4. Describe decentralized applications.
5. What are smart contracts used for?

6. Where are blockchain technologies used?
7. What are the prospects for using blockchain?
8. What difficulties may arise when using blockchain?

7.5. IoT and protection methods

The last few years have seen widespread development and implementation of IoT systems. In connection with the development of IoT technologies, experts in the field of information security express concern [12–14]. In their opinion, the huge number of poorly protected Internet devices provides new opportunities for cybercriminals, who have already managed to hack some IoT systems. This task is especially relevant when using these tools at critical infrastructure facilities.

As a rule, an IoT system includes physical devices, a controller, or other processing and decision-making device that communicate with computers or other devices via the Internet. For example, these can be sensors for protecting the perimeter of your house, video cameras that transmit data to the controller, and the controller transmits all information via the Internet to the specified location (phone, server, PC). When any security sensor (vibration, movement, reed switch) is activated, the signal is transmitted to the controller, and then, depending on the program, for example, a sound siren is activated, a message is sent to the security service, and the owner of the house (Fig. 7.16).

But the use of IoT systems is so wide that they can include the management of the entire city, monitor the health of people and inform about deviations from the established indicators, control the load on athletes during training, carry out remote monitoring and control of the functioning of certain objects, carry out automatic checking the condition of a wide range of devices, sensors that can be used in smart homes and cars, when managing the city and the state as a whole. IoT technology can be used individually and collectively.

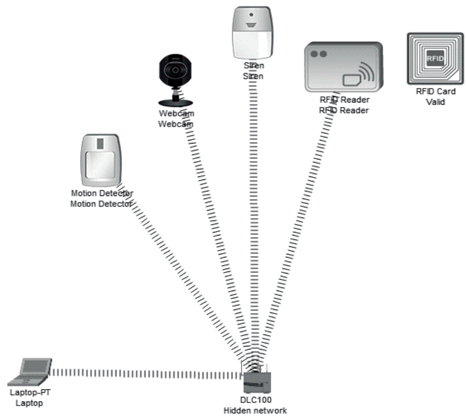

Fig. 7.16 – Protection zone cluster

The introduction of such technologies can solve the problems of improving the living conditions and quality of life of the elderly and people with special needs (management of climate control systems, lighting, food purchases, food, health monitoring, medication reminders, use of real-time sensors, transfer data to relatives or persons caring for such people).

This technology is widely used in industry and commercial activities. The use of a wide range of sensors makes it possible to control and manage a wide range of technological equipment used in the industry and municipal services of the city (management of water bodies, technological lines, machines, engines, pumps, switching of traffic lights depending on road congestion, notification of the presence free places in parking lots near supermarkets). Another direction is the use of farms to monitor the availability of water and food for animals.

The use of IoT has reached such a scale that today the issue of Internet bandwidth for transferring large amounts of information, connecting, and monitoring a large number of sensors arises. It is necessary to state the transition of humanity to the use of INDUSTRY 4.0.

In the work [7], the author testifies that at the beginning of the introduction of IoT, sensors sent data to the cloud, where they were processed, analyzed, and stored, and management decisions were made. With the exponential increase in the number of devices, the load on both data transmission channels and the volume of the cloud for storage (trillions of gigabytes) has increased, so the use of edge computing has become a necessity, not a wish. The author notes that the use of edge computing and cloud technologies together is possible, and in some cases necessary, especially in industry. Edge computing is the most important component of IoT, which helps to reduce latency and increase the reliability of deployed systems [7]. In [21], models of IoT architecture are presented, the need for IoT protection is determined, the results of research on the construction of an information protection system for IoT devices, in particular, separated and centralized, and simulation modeling of the load depending on the number of devices is carried out.

The issue of security is quite relevant and is aimed at the comprehensive protection of information. For example, work [11] focuses on the complexity of IoT protection and provides eight key security technologies: network security, authentication, encryption, attack on the security side, security analytics and threat prediction, interface protection, and delivery mechanisms.

Prospects of implementation and threats facing IoT systems are presented in [1; 5–6; 17; 19; 22]. The analysis of these works confirms the relevance of security issues, directions of protection, and basic conceptual approaches to the implementation of security. High-profile cyberattacks have occurred more than once, and the number of hacker attacks is increasing [2; 8; 16]. The relevance of the problem is emphasized by incidents, the capital losses from which are measured in billions of dollars.

The largest number of attacks falls on portable devices, the use of wireless communication technologies between system elements creates the prerequisites for a cyber attack on the system. According to [1; 5–6; 17; 19; 22], NSD is most often carried out by hackers through entry (access) points to the corporate network or is used to launch a DDoS attack. Considering the large number of sensors connected to the system, the use of wireless networks, cloud services, etc. does not allow to ensure a reliable cyber protection perimeter of the object. Another direction is the theft of confidential data of users (companies). Machine learning technologies and the use of artificial intelligence systems have a powerful potential for cyber threats due to their dual purpose (the algorithms used can both counter cyber attacks and create them). New technologies create new cyber threats that can only be countered with the use of new information technologies.

Modeling of systems made it possible to determine that the main areas requiring attention from the side of cyber protection are [13–15]:

– communication security;

– protection of the devices themselves;

– control over the operation of devices;

– control of interaction in the network.

As a result of the research and analysis of the most likely attacks on simulated systems, the following classification of attacks is proposed (Fig. 7.17):

Denial-of-Service (DoS) (D):

1) physical level (H):

– attack of setting an obstacle (H_1);

– attack of intervention in the IoT system (H_2);

2) channel level (C):

– collision attack (C_1);

3) attacks on routing protocols (R):

– “Black hole” attack (R_1);

– selective forwarding attack (R_2);

– attack “Rapid Onslaught” (R_3);

– “Funnel” attack (R_4);

– “Sybil” attack (R_5);

– “Wormhole” attack (R_6);

– flood attack ((R_7));

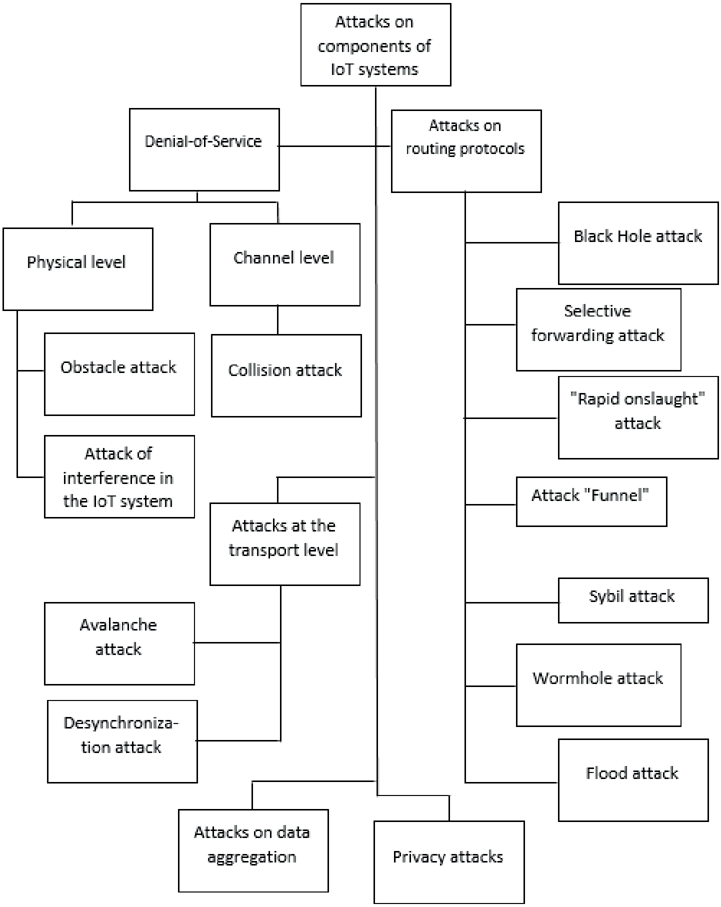

Fig. 7.17 – Attacks on IoT system components

4) attacks at the transport level (T):

– avalanche mailing attack (T_1);

– desynchronization attack (T_2);

– data aggregation attacks (G);

– privacy attacks (P).

Attacks can be presented in the form of open classification groups:

$D = H \cup C$ – multiple attacks leading to a denial of service, it includes combining multiple physical and channel layer attacks. The set of attacks leading to denials of service at the physical level (formula 7.7):

$$H = \bigcup_{i=1}^{n} H_i. \tag{7.7}$$

The set of attacks leading to denials of service at the channel level (formula 7.8):

$$C = \bigcup_{k=1}^{z} C_k. \tag{7.8}$$

A set of attacks on routing protocols (formula 7.9):

$$R = \bigcup_{v=1}^{s} R_v. \tag{7.9}$$

The open classification grouping of transport-level attacks is presented in the form of a set (formula 7.10):

$$T = \bigcup_{\alpha=1}^{l} T_\alpha \tag{7.10}$$

The set of attacks on data aggregation is represented by the following form (formula 7.11):

$$G = \bigcup_{j=1}^{m} G_j. \tag{7.11}$$

Multiple privacy attacks (formula 7.12):

$$P = \bigcup_{\gamma=1}^{\delta} P_\gamma. \tag{7.12}$$

In general, attacks can be represented as a combination of all classification groups (formula 7.13):

$$A = D \cup R \cup T \cup G \cup P. \tag{7.13}$$

We will analyze each attack included in the classification group.

DoS attack at the physical level. A DoS attack is characterized by an adversary's attempt to stop the operation of a network or destroy a network security service. In the IoT system, a DoS attack can occur at different levels of the protocol stack, can affect several levels at the same time, and use the interaction between them. A DoS attack at the physical level can be carried out by interfering with the radio frequencies on which the system operates. With such an attack, one attacking node can disable the entire network or some part of it (for example, blocking data transmission).

The attack of interfering with the operation of the IoT system when detecting a sensor (in our case, a sensor / camera on the perimeter of the security object) and trying to gain physical access to it is of critical importance for our system. In this case, an attacker can destroy the device, try to change data, gain access to confidential information (in particular, cryptographic keys), and use the device to enter the network.

Channel-level DoS attack. DoS attack of collisions at the channel level is directed, as a rule, to exhaustion of node resources. This attack affects the packet transmission process by causing exponential delay and packet retransmission procedures in some MAC protocols. Thus, when a large number of bits in a packet are damaged, the node will try to use error correction codes to restore the damaged bits, thereby wasting limited energy resources. Another example of such an attack is a "collision" at the end of a frame, which causes the entire packet to be retransmitted. Another variant of attacks inherent in the IEEE 802.11 protocols can be the generation of an RTS message to the base station or a neighboring node, which will lead to the processing of this message and the generation of a CTS message, then waiting for the reception of the signal, and all other nodes stop transmitting data to the receivers node for the time specified in the RTS message. Flowering methods can also be implemented.

We will analyze attacks on routing protocols. The well-known Black Hole attack is aimed at using a routing protocol to redirect packets going from or to a target node through a specific node. This attack can be used for packet dropping or "man-in-the-middle" (a method of compromising a communication channel, in which an attacker, after joining a channel between counterparties, interferes with the transmission protocol by deleting or changing information). Another type of attack is the selective forwarding attack, which is similar to the Black Hole attack, but in this attack, packets that meet certain criteria will be dropped, not all.

When implementing the “Swift Onslaught” attack, the route opening procedure is used at the request of routing protocols. A malicious node generates and broadcasts a route request to its neighbors, and as a result, the node has an increased probability of being part of the chosen route between the source and the destination.

A “Funnel” attack is characterized by the fact that the attacker tries to place a compromised node or his own in the path of as many networks flows as possible, and then begins to act as a funnel – collecting all the traffic of the sensor network. In protocols using broadcast broadcasting, the attacker listens to the channel and informs the neighbors that he “knows” the shortest route to the base station. Once he managed to get between the broadcasting sensor node and the base station, he can do whatever he wants with the data packets coming to him.

The “Sybil” attack is characterized by the fact that the attacker tries to compromise an operating node, or connect his own using several pseudo-identifiers and thus pretending to be several nodes at the same time. In this way, neighboring nodes can perceive it as “theirs”. This kind of attack is used to break the distributed storage mechanism, routing mechanisms, data aggregation mechanisms, and voting mechanisms in the network.

A wormhole attack poses a serious threat to the security of sensor networks because it does not require the compromise of a sensor node. So, for example, an attacker listens to a channel and receives a broadcast of a route request message from a base station and forwards it to the nearest neighbor. The node that received this message will consider it as its parent, that is, the one that is closest to it, although this is not the case at all. The action of the attack is based on creating a special path between two or more network nodes for the transmission of intercepted packets, and the nodes will think that they are transmitting packets via the shortest path.

One type of attack is a flood attack (HELLO flood attack). The peculiarity of this attack is an attempt to transmit a mass of optional messages to the network, which will deprive the network of various resources (computing power, channel capacity, energy resources). Having a high-frequency radio transmitter with sufficient computing power, the attacker sends Hello packets to many sensor network nodes. After receiving this message, the nodes perceive the compromised node as a neighbor and include the received address of the sender in the mailing. In this way, the attacker gains access to the data sent from the nodes.

The functions of the transport layer include the delivery of packets (TCP) and datagrams (UDP) from the sender to the recipient. Attacks at the transport level are aimed at analyzing traffic regularity and sending parallel duplicate messages on other paths used at this level. Given the fact that most transport protocols support sensitive information and are therefore vulnerable to memory exhaustion, an avalanche attack (the attacker makes new connection requests each time increasing the amount of sensitive information in the attacking node, gradually leading to the fact that the node becomes faulty (rejection of the node from further connections) due to resource exhaustion) and exploits this flaw.

Another characteristic attack of this level is a desynchronization attack, as a result of which an attacker tries to destroy the connection between two working nodes in the network by repeatedly forging messages to them. In particular, transport layer protocols can use sequence numbers to track successfully received packets, identify packet loss, and detect duplicates. Attacker-generated packets can use these sequence numbers to convince a node that packets have been lost and trigger retransmissions, which can have the already known consequences of resource exhaustion and channel congestion when valid information does not arrive at the base or does arrive late.

Attacks on data aggregation are aimed at changing network behavior. Data aggregation and fusion procedures are used in networks where the placement of typical sensors is close to each other. Such procedures are used to combine multiple data to eliminate redundant information. Save resources, is positive, but it is dangerous from the point of view of cyber security. Thus, the calculation of simple mathematical functions (minimum, maximum, average value, sum) used during aggregation in the case of the presence of one malicious node or replacement of real data from sensors can change the behavior of the network partially or as a whole.

Attacks on privacy are aimed at capturing information collected by sensors and can be implemented through network eavesdropping, traffic analysis, and/or node hijacking. This is especially relevant for those networks that do not use data encryption.

Recommendations for countering attacks on IoT system components. Defense against physical level DoS attacks. Using IEEE 802.11 (broadband) standards use frequency hopping. In this case, the interference transmitter must "know" the sequence of hopping motion or create interference of a larger frequency band. It is suggested to use spread spectrum technology to protect against such attacks. The transmission of such a signal will be similar to noise, which will reduce the risks of intentional interference with the information signal.

In addition, when the signal disappears from any part of the network or node, or network element, the DSS (Decision Support System) must generate an alarm for the unit. Nodes that detect an interference attack must transmit a short message to their "neighbors" and the base station about the attack on the network. In this case, if the message "does not reach" the base station from the attacked node, there is a possibility of receiving an emergency message from the node that was not attacked.

To counter attacks of interference in the operation of the IoT system, each sensor used in the system must be equipped with a tamper (a miniature button on the board of the device that is pressed when the case is opened or it is disconnected from the attachment point). When the tamper is triggered, the hub sends all users of the security system push messages and SMS (if such types of messages are available in the devices that will be used), as well as transmission of the message to the base station. In addition, it is desirable to provide programmatically that when the tamper is triggered during “arming”, all data stored on the device will be destroyed automatically. To avoid detection of sensors, they should be placed in hidden places, but suitable for their installation, and materials resistant to external influences should be used. Sensors and cameras have their range, so when placing such devices, this indicator should be taken into account and installed with an overlap to avoid a zone of insensitivity. If installed correctly, the sensor will detect the danger and send an alarm signal to the base station before the attacker gets close to it.

To counter a link-level DoS attack, there is authentication to verify that the node generating the message is authorized on the network in combination with encryption. In our case, we use the WPA2-PSK authentication standard with the AES encryption type. Considering the limit of energy resources, the use of asymmetric encryption becomes impossible in such systems. The main disadvantage of using symmetric encryption is the problem of key distribution. When using a symmetric cryptographic scheme, shared cryptographic keys must be reliably and securely established between two nodes before they can exchange data. Key installation and management techniques must be suitable for use with hundreds and thousands of nodes.

Another way to improve protection is to install an RFID tag on all network devices and carry out a combined (two-factor) node authentication procedure.

It is proposed to use blockchain technology to protect against interference in the program code and changes in sensor indicators. This technology is a distributed database that is potentially accessible to everyone. Thanks to the use of blockchain technology, it is possible to combat fraud, manage the identification, and transactions, verify the status of elements of various systems, and ensure data integrity. Combining blockchain and Internet of Things technologies can solve some security problems, namely: tracking sensor data measurements and preventing duplication by any other malicious data; authentication, and secure data transfer.

The use of cryptography is suggested to meet the needs for protection against eavesdropping, injection, and packet modification. To counter aggregation attacks, it is proposed to use methods of delaying aggregation and authentication. To prevent routing attacks, we use channel-level encryption and authentication using a global public key. Sybil attacks can be prevented by verifying the identity of sensor nodes (using a shared symmetric key from a trusted base station) and limiting the number of neighbors a node can have. Thus, a compromised node will be able to communicate only with verified neighbors. The “Funnel” attack can be countered by using a geographic routing protocol, in which traffic “naturally” directed to the physical location of the base station is difficult to redirect to create a funnel.

Edge computing in information protection systems can be used to counter several considered attacks and is the subject of further research. The use of clusters of protection systems, IoT clusters in combination with edge computing creates new approaches to technologies for building protected IoT with decentralized data processing.

In the economic direction, many Internet of Things systems will depend on microtransactions between digital objects and this will require a machine-to-machine (M2M) economy connection that will ensure the exchange of money between non-human devices. In this case, there is a need for an IoT-compatible currency, that is, the use of cryptocurrencies can be a solution. Many blockchain projects are working on scaling to provide adequate transaction-per-second performance, such as Bitcoin Lightning Network and Ethereum Plasma.

Over time, IoT will undoubtedly improve our daily lives and increase the efficiency of management and control, and automation in various industries. The combination of cryptocurrency and IoT will create the prerequisites for the digital economy of states, cryptocurrency will become digital money for microtransactions and the M2M economy.

Questions for self-control:

1. What is included in the IoT system?
2. Name the areas of use of IoT.
3. What are the prospects for the implementation and threats of IoT systems?
4. Name the attacks inherent in IoT systems.
5. List the methods and measures to counter attacks on the IoT system.
6. How can channel layer attacks be countered?
7. How to prevent eavesdropping?
8. What is a microtransaction?

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UDC 004.330.1

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Chapter 8
DESIGN THINKING FOR DIGITAL TRANSFORMATION

Content

8.1. The concept of design thinking: principles, process, empathy: understanding human needs and shortcomings

In user experience design, it's crucial to develop and refine skills to understand and address rapid changes in users' environments and behaviors. The world has become increasingly interconnected and complex since cognitive scientist and Nobel Prize laureate Herbert A. Simon first mentioned design thinking in his 1969 book, The Sciences of the Artificial, and then contributed many ideas to its principles. Professionals from a variety of fields, including architecture and engineering, subsequently advanced this highly creative process to address human needs in the modern age. Twenty-first-century organizations from a wide range of industries find design thinking a valuable means to problem-solve for the users of their products and services. Design teams use design thinking to tackle ill-defined/unknown problems (aka wicked problems) because they can reframe these in human-centric ways and focus on what's most important for users. Of all design processes, design thinking is almost certainly the best for "thinking outside the box". With it, teams can do better user experience research, prototyping and usability testing to uncover new ways to meet users' needs.

Design thinking's value as a world-improving, driving force in business (global heavyweights such as Google, Apple and Airbnb have wielded it to notable effect) matches its status as a popular subject at leading international universities. With design thinking, teams have the freedom to generate ground-breaking solutions. Using it, your team can get behind hard-to-access insights and apply a collection of hands-on methods to help find innovative answers.

In essence, design thinking:

1. Revolves around a deep interest to understand the people for whom we design products and services.

2. Helps us observe and develop empathy with the target users.

3. Enhances our ability to question: in design thinking you question the problem, the assumptions and the implications.

4. Proves extremely useful when you tackle problems that are ill-defined or unknown.

5. Involves ongoing experimentation through sketches, prototypes, testing and trials of new concepts and ideas.

Large enterprises and corporations, representatives of private small and medium-sized businesses, academic and government institutions and organizations are faced with the need to create innovative products and services to satisfy existing stakeholders in the relevant field of activity. The key to the successful implementation of innovations is a high-quality justification of the chosen strategy and an effective system of monitoring its implementation.

At the core of the design-thinking methodology are interdisciplinary approaches to stimulating innovative processes aimed at improving existing products, services and processes. According to scientist Michael Luchs, design thinking is a systematized method of collective work to identify and creatively solve a problem.

A comprehensive approach to design thinking as a tool for finding ways to satisfy stakeholders based on involvement allows you to expand the possibilities of applying tactics used in the fields of art, architecture, engineering and technology, which are characterized by the use of design methods. Design Thinking Theory and Practice has been gaining popularity and has been increasingly used in management and business administration academia over the past few decades.

The goal of design thinking is to solve the most complex, multifaceted and unresolved problems with systemic impact (Roberts, 2000; Churchman, 1967; Rittel & Webber, 1973).

Organizations in this section act as social units or a collective of individuals, which was created purposefully to achieve specific goals, with the aim of solving a problem by creating a new product or service (Etzioni, 1964, p. 3).

Design thinking is seen as the use of methods and research practices to solve problems outside the boundaries of architecture or engineering. **Design thinking** is a method of developing products, services, and services oriented to the consumer (user), which is based, first of all, on consumer demand, and secondly, on the possibilities of technical implementation and economic possibilities.

Characteristic features of design thinking are:

– immersion in the consumer experience;

– detached approach to defining the problem;

– focusing on personal scenarios of behavior and actions.

In order to solve the problem and determine an effective solution, it is necessary to conduct research, focus on the "pain points" of stakeholders, generate an alternative set of ideas, choose the best alternative, create a prototype and test it. The constructive-thinking method describes the tactics of performing these stages and the tools necessary for each of them.

Hasso Plattner and David M. Kelley, who are the founders of the Hasso Plattner Institute of Design (a design school that combines management and business practices with traditional engineering techniques), systematized the methods of design thinking. They investigated the stages of the creative process, the center of which is the consumer, and substantiated the approaches to using design thinking in business.

In 1969, Herbert A. Simon in his book "Sciences of the Artificial" defined design thinking as the process of transforming existing conditions into desired ones. Thus, design thinking is a process that is always focused on creating a better future and finding new tools for solving complex problems in a variety of areas, focused on the target group of users.

Since the 1990s, thousands of people have studied design thinking individually and in groups. Among the notable initiators of this trend are the design and consulting firm IDEO and the Hasso Plattner Institute for Design Thinking at Stanford University. Design thinking was depicted in various schemes: as an open spiral, a curved loop, a double rhombus or a series of rings. Regardless of which diagram to draw this process, in design thinking methodologies we constantly come across two central ideas or principles.

There was a certain development of the theory and practice of design thinking, given in the form of a chronology in the Table 8.1.

***Table 8.1* – The development chronology of the design thinking theory and practice**

Period	Characteristic
1	*2*
By the 1960s	The origins of design thinking lie in part in the process of creative techniques of the 1950s.

1	2
1960s	The first known books on the methods of creativity were published by William J.J. Gordon (1961) and Alex Faickney Osborn (1963). The 1962 conference on systematic and intuitive methods in mechanical engineering, industrial production, architecture and communications, London, Great Britain, aroused interest in the study of design processes and the development of new design methods. Books on methods and theories of design in various fields are published by Maurice Asimou (1962) (engineering), Christopher Alexander (1964) (architecture), L. Bruce Archer (1965) (industrial design) and John Chris Jones (1970) (product and system design).
1970s	Don Koberg and Jim Bagnall, in their book The Universal Traveler, were the first to develop "soft systems" to solve the problems of "everyday life". Horst W.J. Rittel and Melvin M. Webber publishes "Dilemmas in a General Theory of Planning", which show that the problems of design and planning are evil problems, in contrast to the "manual", individual disciplinary problems of science. L. Bruce Archer expands the study of design ways of knowing, arguing: "There is a constructive way of thinking and communicating that is different from scientific and scientific methods of thinking and communication and is as powerful as scientific and scientific research methods when applied to his own types of problems".
1980s	The development of design, human-centered, and the growth of design-oriented business management. Donald Shen publishes a "reflective practitioner", in which he seeks to establish the epistemology of practice embedded in the artistic, intuitive processes that [design and other] practices bring to situations of uncertainty, instability, uniqueness and conflict of values.
1990s	The first symposium on research in the field of design thinking is held at Delft University, the Netherlands, in 1991. IDEO consulting agency for design thinking is formed by combining three industrial designs of the company. They are one of the first design companies to demonstrate their design process based on design methods and design thinking.
2000s	Beginning of the 21st century, brings a significant increase in interest in design thinking, as the term becomes popular in the business press. Books on how to create a more design-oriented workplace where innovation can thrive have been written for the business sector, including Richard Florida (2002), Daniel Susan (2006), Roger Martin (2007), Tim Brown (2009), Thomas Lockwood (2010), Vijay Kumar (2012). The design approach is also expanding and adapting to solve service design problems, marking the beginning of the service design movement. In 2005, Stanford University's School of D. School began teaching design thinking as a universal approach to technical and social innovation.
2010s	2018 – In Harvard Business Review, Jan Lidtke argues that "design thinking works" in business.

Design thinking has certain characteristics. First, design thinking is human-centered. First of all, it takes into account the needs and desires of people, not the proposals of companies or artistic ideas. Human-centered design thinking involves observation, conversation, research, and collaboration.

Secondly, design thinking is based on a creative worldview, openly exploring certain issues, rather than looking for a specific path to these results. During this creative process, you need to ask questions, visualize ideas, create material prototypes and tell stories about people, ideas and results.

These key principles are people-centeredness and creative worldview and support a lively and changing process of design thinking.

For each stage of the process, design and thinking is characterized by the passage of two phases:

– divergent comprehension;

– convergent processing.

The divergent phase (from the Latin divergere – diverge) consists in finding a set of solutions to the same problem.

The convergent phase (from the Latin convergere – converge) consists in the exact use of instructions for solving the problem.

Characteristics of the design thinking process and the main stages

Innovation is seen as the embodiment of the process to be updated in the organization and designed to create new products and services (Bessant, Lamming, Noke, & Phillips, 2005), is a mechanism for solving key problems. To effectively innovate, strengthen competitiveness, organizations in recent decades have increasingly turned to the use of design thinking as a product development process (Lockwood, 2010; Johansson-Sköldberg et al., 2013). Design problem solving is a powerful method of creating innovative products and services that can solve existing problems of various industries.

Sydney A. Gregory, in The Design Method (1966), states that design thinking is "a method of designing a model of behavior used to create things that do not yet exist. The science is analytical, and the design science is constructive". In this context, design is used as an engine of a product, system, creation of services that meets the needs and challenges of the client or end user.

The idea of the fundamental, practice-oriented method of design thinking is the ability to adapt the existing experience of solving the problem, taking into account the achievements of socio-scientific research, various groups of the population and existing trends.

Tim Brown defines the process of design thinking based on three elements that are not consistent, but intersect: inspiration, idea and realization. He noted this position in the work “Change by Design” (2009). This definition of design thinking is based on the work of Lawson (1980), Rowe (1987), Archer (1979) and Cross (1991, 2001). This design approach notes three **key elements** that can be repeated, may overlap, and may not be consistent (Brown & Wyatt, 2010):

– inspiration;

– idea;

– implementation.

The first key element is the creation of ideas with participation and empathy on the part of designers for relevant stakeholders. This empathic process can find out which stakeholders are relevant, which are not mentioned, and what system dynamics are in question. In addition, interaction with stakeholders (whether they are the end user) leads to more innovative results (Holmlid, 2009). This element aims to define a need (Faste, 1987), in which the designer studies the explicit and implicit desires and requests of the client, creates a user solution that meets these requests. A search exercise file is required throughout the design process; however, in terms of the inspiration of the IDEO process (Brown, 2009; IDEO, 2011), is a central function that allows you to create ideas, solutions and approaches to solving a client’s problem.

The second key element is one form or another of prototyping, iteration and verification. This can be described as a period of quick, gradual testing of ideas that can be quickly tested and analyzed. This element can be described as reasoning (Brown, 2009), with a clear emphasis on the transformation of ideas into specific products, services or systems. The stage of an idea in design thinking can be repeated endlessly since ideas are repeatedly comprehended and transformed by the physical in different forms to verify and evaluate their compliance with the desired goal.

The third element is implementation, which is also reflective and repetitive, which consists of studying each idea, testing and affirming the success or failure of an idea in order to continue and create better, more sophisticated goods or services. This process consists of experience-based learning can be described as reflective (Schön, 1988) and serves as a driver of the process of design thinking. Reflective practice (Schön, 1988, 1983) links elements of inspiration, ideas and implementation (Brown, 2009) design thinking in the context of stakeholder needs, with an emphasis on reflection, improvement and empathy.

Theoretically, the design process is split into three main phases, but in practice you can start with any and move as you like.

Step one is to observe. You need to look, listen, ask questions and collect data. Observation requires patience, care, and humility. Conversations with users develop empathy and give insights. Workshops push to develop design together with stakeholders whose views may diverge. Researching the lifestyle of a particular community deepens knowledge about it. The foundation of these methods are the values of human-centered design.

The next step is to imagine. At this stage, it is necessary to generate many ideas, sort them into groups, look for connections and analogies and decide how to move on. In this way, human-centered research is combined with creative thinking, opening our perception to unexpected concepts.

The third step is to create. Here creative action comes to the fore. Creation is a direct and physical process. Through prototypes, you can show how the product will work. Storyboards (storyboards) give users an idea of how they will be able to interact with the device. Role-playing embodies a service or process in social and physical aspects. Each creative method begins with the question: how a design solution or insight can help real people. Each prototype or narrative serves as a tool to communicate with users and stakeholders.

At the heart of design thinking is the search for ideas. Creative methods in design play the role of a set of defined actions that the team performs to search for an idea.

The Stanford School of Design divided the process of design thinking into several stages (Fig. 8.1):

1. *Empathy* – immersion in the problem issue and user experience.

2. *Focusing* – the formulation of a specific, significant task that can be solved.

3. *Idea generation* – generating ideas and choosing a solution.

4. *Prototyping* – creating a model for testing certain solutions.

5. *Testing* – receiving feedback and determining the best solution.

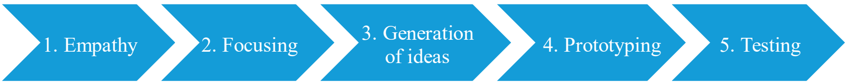

Fig. 8.1 – Algorithm design thinking

The presented method of design thinking consists of five stages, each of which refers to a divergent or convergent phase. Divergence consists in expanding the angle of view, collecting all the finds and ideas. Convergence involves narrowing the focus and choosing a priority idea to be tested, worked out in the following stages.

The process of design thinking is iterative, that is, the developed idea is immediately subject to verification, the result obtained is used as an experience to find the best solution.

As a result, we note that the term design and related words are used in the text with the meaning – design, engineering, development and reproduction. The reorientation of cognitive processes in professional activity from analytical methods to a creative approach faces various kinds of problems, the main of which is cognitive distortions of human consciousness.

Questions for self-control:

1. Explain what the essence of design thinking is?
2. Describe the main goal of applying design thinking.
3. What are the key features inherent in design thinking?
4. What is the essence of the divergent phase of design thinking?
5. What is the essence of the convergent phase of design thinking?
6. How are elements such as inspiration, idea, realization related?
7. What stages of the design thinking process are selected by experts?
8. What is the essence of empathy in the process of design thinking?
9. What is the purpose of creating empathy maps?
10. Explain what the essence of empathy is?

8.2. Cognitive distortions and their effects of human activity

The effect of cognitive distortions on human consciousness

Design thinking is a creative process of a person's professional activity, because of any process of information processing, he encounters certain features of consciousness. Most often these are cognitive distortions.

Cognitive (the process of information processing by our consciousness) distortions are understood as systematic errors in thinking or pattern deviations that arise on the basis of dysfunctional (incorrect) beliefs embedded in cognitive schemes and are easily detected when analyzing automatic thoughts. The existence of most cognitive distortions has been described by scientists, and many have been proven in psychological experiments. Cognitive distortions are an example of evolutionarily formed behavior. Some of them perform an adaptive function since they contribute to more effective actions or faster decision-making. Others apparently come from a lack of appropriate thinking skills or from the inappropriate application of skills that have been adaptive in other settings.

Cognitive distortions can occur due to various causes, in particular:

– “failures” in the processing of information (heuristics – a scientific branch that studies the specifics of creative activity);

– “mental noise” – talking to oneself;

– limited brain ability to process information;

– emotional and moral reasons;

– social impact.

Distortions associated with behavior and decision-making unnecessary concern for success.

Amplification – investing more effort in achieving the goal than necessary, an attempt to “kill a fly with a sledgehammer”. Option – excessively detailed planning in the absence of sufficient source data and the presence of strongly influencing the result of uncertain or random factors.

Acceleration – performing work at a speed greater than necessary or even acceptable. In the latter embodiment, literally and figuratively: running through a minefield.

Advancement is an unreasonably early start of action to achieve the goal. Bias towards the search for information is the tendency to look for information even when it does not affect the actions or the result.

Exaggeration of the probability of individual cases.

Generalization of individual cases – groundless transfer of characteristics of private or even isolated cases to their large sets. There are many types of this cognitive distortion, the classic version is a conspiracy theory.

The effect of contrast is the amplification or underestimation of the value of one object when it is compared with the contrast object just discovered. For example, a person is happy that he bought something inexpensively in a store, but ceases to rejoice after he discovers another, little-known store in which the same thing is 2 times cheaper.

The Baader-Meinhof phenomenon or the illusion of frequency – newly recognized information that appears again after a short period of time, is perceived as extremely often repeated.

Reassessment of the significance of individual cases.

Deviations in the direction of the result – the tendency to judge decisions by their results, instead of assessing the quality of decisions by the circumstances of the moment in time when they were made ("winners are not judged" by the "judgment of the survivor").

Reassessment of influence – the tendency of people to transfer the duration or intensity of the impact of an event on their future experiences.

The focusing effect is an error in predictions that occurs when people pay too much attention to any one aspect of a phenomenon; causes errors in the correct prediction of the usefulness of the future result. For example, focusing on who is to blame for a possible nuclear war distracts attention from the fact that everything in it will suffer.

Reassessment of their capabilities.

The effect over confidence is the tendency to overestimate their own abilities. The illusion of control is the tendency of people to believe that they can control or at least influence the outcome of events that they cannot really influence [4].

The advantage of zero risk is the advantage of a controlled, but potentially more harmful (due to its more frequent occurrence) situation over the opposite due to the reassessment of the possibility of control. That is, the person, for his part, believes that he completely gets rid of the risk (in fact, without having full control), while on the part of statistics this is a reduction of only one, not the greatest risk to zero. For example, most people would prefer to reduce the likelihood of terrorist acts to zero instead of reducing accidents on the roads, even if the second effect gave more saved lives [5]. Another common example is iatrophobia: many people are more afraid of complications of medical interventions than diseases and deaths because of these diseases arising from lack of treatment (for example, anti-vaccination).

The Dunning-Kruger effect – people who have a low level of qualification, draw erroneous conclusions, make unsuccessful decisions and at the same time are not able to realize their mistakes due to the low level of their qualifications. In the mid-1990s, in the city of Pittsburgh, a well-dressed man in the middle of the day and without hiding his face robbed a bank. When he was caught (and it only took one day to do so), he couldn't hide his surprise. "How was I identified?" – Asked. "After all, I generously smeared my face with citrine!" although it looks like a joke, it is true: two friends of that mister, whose name was Wheeler, assured him that citrine would help hide his facial features, making him invisible. To prove that it is, they smeared it with lemon juice, then took a photo of him, erased his features from it – and that Wheeler calmly went to business, thinking that no one would recognize him.

The news then received wide publicity and served to ensure that Cornell University social psychology professors David Dunning and Justin Kruger became interested in the case and asked themselves the following question: is it possible that a person's incompetence does not allow him to see that he is incompetent? Professors Dunning and Kruger conducted an experiment in which they asked several volunteers to assess their level of competence in the following areas: grammar, argumentation, logic and humor. So, they found that the stupider a person was, the less aware they were of their gaps. And vice versa: competent people tended to underestimate themselves very much. Dunning and Kruger also noticed that there is a connection between incompetence and quackery, and proved that fools rate themselves so highly that they always consider themselves surprisingly intelligent. Something similar happens with knowledge.

The more ignorant a person is, the more it seems to her that he knows everything, and with a lot more strongly opposed to learning something new. This is what some call the "arrogance of ignorance". Or, as popular wisdom says, the fool of the sea is knee-deep. So, when wisdom is prudence, restraint, and doubt, ignorance is the insolence of antonyms: it is reckless, reckless, intolerant. When I was young, I was often confused by the fact that that fools are absolutely certain of themselves. For the chronically insecure person who your submissive servant is, the one to whom everything was clear was synonymous with the leader. And the big problem is that in fact it is. Many fools are born leaders, you just need to give a look at the world of politics: individuals with astonishing self-confidence and the same arrogance utter insubstantial nonsense. And since aplomb is very often confused with intelligence, it turns out that many people follow them.

The most interesting thing about this phenomenon is that a significant part of these people are by no means fools. They only think that if so many people follow this Gamel pied piper, then there is some reason for that. In addition, when a pied piper manages to convince a certain number of people, there is a cumulative effect – no one thinks anymore, everyone goes into no matter what abyss. And we hardly noticed that in this way, it seems, the realm of fools was established. Many of us ask ourselves how it is possible that people succumb to such incredible nonsense that we see every day: profess delusional conspiracy theories, create all sorts of internet-inspired silliness: from selfies in the mouth of a volcano to the belief that the earth is flat; and they also issue and maintain crazy laws that are contrary to basic common sense... There is not one explanation, there are many phenomena that contribute to the fact that folly is rotten among us (moreover, reinforced by the multiple and distorting mirror that it is social networks). I don't know what Dunning and Kruger will say now about the consequences of the effect named after them almost thirty years ago. If then they were surprised that the man, relying on his own folly, robbed the bank, smearing his face with lemon juice, now they would be dumbfounded, making sure that this effect, according to which "a person's incompetence does not allow him to see that he is incompetent", is no longer a hilarious exception to that Wheeler, but stands in the way of becoming the norm.

It is necessary to recognize that we are all carriers of cognitive distortions *and to use it correctly. Anyone who will avoid this recognition will lie to himself and make the same mistakes repeatedly.*

Reassessment of the significance of one's own opinion / position / choice.

Distortion in the perception of the choice made – excessive perseverance, attachment to one's choice, perception of it as more correct than it really is, followed by its justification. For example, attempts to find implicit advantages in the purchase and thereby justify it in the presence of another, more suitable product that for some reason was not purchased.

The effect of acquaintance with the object is the tendency of people to express unreasonable sympathy for an object only because they are familiar with it (patriotism, the effect of involvement in the creation of the object).

Irrational escalation – the tendency to remember your choice as more correct than it really was.

Blindspot on distortions – easier detection of deficiencies in other people than in yourself. In this case, a person is inclined to protect his thoughts. Methods of protecting one's opinion in such distortions are usually:

– selection or adjustment of the hypothesis to the measurement results;

– the tendency to seek or interpret information in such a way as to confirm previous concepts;

– unconscious manipulation of the course of research to identify the expected result;

– considering only those facts that are consistent with expectations.

– the tendency to assert oneself in one's rightness contrary to testimony, which is contrary to a person's initial stable beliefs. Because of this effect, which has acquired the name of the *opposite result*, it can be difficult to convince the interlocutor of the dispute, even if you provide him with strong evidence that refutes his position.

Other types of cognitive distortions.

The effect of authority is the tendency to attribute a higher appreciation to the opinion of an authoritative figure and to a greater extent depend on this opinion. *Man is used to relying on the truth of authority than the authority of truth.*

Decorating the past – the tendency to evaluate past events more positively than they were perceived now when they actually happened.

The "curse of knowledge" is the difficulty for more informed people when trying to view any problem from the point of view of people less informed.

Professional deformation is a psychological disorientation of the individual during professional activity. The tendency to look at things according to the rules generally accepted for one's profession, rejecting a more general point of view.

The effect of ownership is the overestimation of the value of the purchase immediately after its acquisition. Its consequence – the rejection of loss – the negative utility that is associated with the loss of an object turns out to be more than the utility associated with acquiring it. People, knowing the benefits of the thing due to them, are more upset about its loss than they would rejoice at its finding, to which they did not think about this thing and, accordingly, did not consider its benefits.

The need to complete and the advantage of holistic subjects – the need to achieve completion in an important question, get an answer and avoid feelings of doubt and uncertainty.

Regulation is the trap of continuous orders for oneself to do something, instead of sometimes acting impulsively, spontaneously, when it is more acceptable, when looking for something new, for example, during vacation, rest.

The status quo is the tendency of people to want things to stay about the same.

Procrastination – systematic unjustified postponement, delaying the beginning of inevitable work.

Time-saving bias – human tendency to erroneously estimate the time, which can be saved (or lost) because of an increase (or decrease) in speed.

Planning error – the tendency to underestimate the time of execution of tasks, the cost and duration of the implementation of projects, especially new, complex, large, unique. *A special case of a planning error found expression in Murphy's law: "Any job requires more time than you think"*.

Socially conditioned distortions. A large group of distortions associated with behavior and decision making. For example, distortion in their own favor:

1. *Distortion in favor of one's group* is the tendency of people to give preference to those they consider to be members of their own group.

2. *Selfish error* is the tendency to recognize greater responsibility for successes than for defeats.

3. *Fundamental attribution error* – the tendency of people to explain the behavior of other people with their personal qualities, underestimating situational factors, and at the same time overestimating the role and strength of situational influences on their own behavior, underestimating the personal aspect.

Distortions associated with probabilities and stereotypes. Many of these cognitive distortions are often studied in relation to how they affect business and how they affect experimental research. Common mistakes due to misunderstanding of the essence of accidents, for example:

1. *The primacy effect* is the tendency to overestimate initial events more than subsequent events.

2. *The recency effect (proximity aberration)* – the tendency to value recent events more than earlier events.

3. *The Hawthorne effect* is a phenomenon in which people observed in a study temporarily change their behavior or performance. Example: increasing labor productivity in a factory when a committee comes to study labor productivity in this factory.

Distortions related to memory errors, for example:

1. *The self-reference effect* is a phenomenon in which memories encoded with reference to the self are better recalled than similar information without reference to the self.

2. *Egocentric distortions* – remembering the past in a self-aggrandizing manner, for example, remembering exam grades better than they were, and the fish caught – bigger.

3. *False memory* is a memory disorder expressed in false memories.

4. *The disinformation effect* occurs when the reproduction of episodic memories becomes less accurate due to post factum information.

Hindsight bias

Regarding the importance of influencing professional decisions in the field of financial and economic activity in the conditions of digital transformation, among cognitive distortions there is an effect after knowledge or hindsight error.

Effect after knowledge, Hindsight bias – a cognitive distortion, a tendency to perceive events that have already happened or facts that have already been established as obvious and predictable, despite the lack of sufficient primary information for their prediction. An error after knowledge can lead to distortion of memory processes, in particular, processes of restoration and reproduction of past experience, leading to false theoretical conclusions. Thus, this effect can cause serious methodological problems at the stages of analysis and interpretation of the results of experimental studies. The after-knowledge effect is dangerous in forensics – it can influence the expert's conclusions along with other cognitive distortions. Other names: "I knew it from the beginning", "I knew it like that", "So I knew it!", "English I-knew-it-all-along", hindsight, retrospective determinism, retrospective distortion.

According to Hartmut Blank and his colleagues, all hindsight errors existing in the literature can be reduced to three independent processes: the effect of inevitability, the effect of predictability, and memory distortions. All three phenomena are different possible manifestations of the hindsight error, which can occur both separately and together.

The first phenomenon – the effect of inevitability – reflects a retrospective increase in the subjective probability, or perceived inevitability, of a particular outcome. In other words, when a person learns about how the event ended, this outcome begins to seem more likely or inevitable to him than before he acquired this knowledge.

The second phenomenon is the effect of predictability: people tend to believe that they knew everything in advance or were able to predict how this or that event would end. B. Fischhoff called this effect “I-knew-it-all-along”.

Finally, the third phenomenon is memory distortion. After receiving an answer to any question (for example, “What is the length of the Danube River?”) or after receiving information about the outcome of an event, the knowledge in memory is distorted, adapting to the received information about the correct answer.

In the literature, the hindsight phenomenon is most often associated with the effect of predictability, followed by the effect of inevitability and processes of memory distortion. H. Blank notes that these phenomena do not reflect the same phenomenon, since, first of all, different psychological processes are at the basis of each of them. Thus, at the basis of the effect of inevitability are the processes of creation and modification of cause-and-effect models of the event. In hindsight, people construct and add new cause-and-effect relationships in such a way that the outcome seems predetermined.

The effect of predictability, in turn, is associated with processes such as a person’s perception of the extent to which he was able to predict a certain outcome. For example, drunk drivers may recognize in retrospect that after six glasses of whiskey the probability of getting into a car accident is very high, but they will also be convinced that they were unable to foresee such a possibility when they were drunk. Finally, memory distortions are governed by various memory processes, especially such as binding (“fitting”) memories to the actual outcome of the event and restructuring initial assumptions. Moreover, the inevitability effect may also help to cope with the disappointment of undesirable consequences (“I had no chance”). The effect of predictability, in turn, serves the function of self-affirmation (for example, promotes the perception of oneself as an informed person, including in the eyes of others). In addition, subjective predictability (or unpredictability) performs the function of self-protection (maintenance of positive personal identity) in case of perception of a negative result for which a person can be responsible. For example, owners of stocks that have crashed in price believe that they were not able to foresee the failure in advance. Memory distortions, according to some authors, can be considered as a byproduct of knowledge updating processes and thus can indirectly affect the function of knowledge updating.

The hindsight bias is based on the same limitation of cognition. This limitation is manifested in a person's dependence on current knowledge when trying to recall or reason about available information, regardless of whether it is about one's own state or about another person's state. This is the key limitation underlying the hindsight fallacy.

The hindsight bias has similarities to other memory distortion phenomena, such as the misinformation effect and false memories in autobiographical memory. All three variants of memory distortion are the result of a three-stage process. The specifics of each process for the three cases may differ, but they all end with one or another psychological manipulation or alteration of memories.

The first stage is different for the three phenomena, but in all three cases there is some kind of event present in the first stage: the event that happened (misinformation effect); an event that did not happen (false autobiographical memories); a statement made by a person about an event he remembers (hindsight fallacy).

The second stage consists in increasing the information that a person receives after the event has occurred. In the case of a hindsight error, the new information is reliable and clearly presented to the person, while the additional information in other cases of memory distortion is false and presented to the person in an ambiguous and possibly manipulative form.

The third stage includes restoration in memory (“remembering”) of primary information. A person prone to the hindsight error or misinformation effect must recall the original information, while a person with false autobiographical memories will create memories of events that did not actually occur.

Research shows that a person tends to make the hindsight error even when he is aware of the existence of this effect and has a desire to overcome it. It is impossible to completely overcome the hindsight effect, but there are ways to weaken it. One of them is consideration of possible alternative explanations of the event and openness to different points of view. The only way to reduce the effect of hindsight in experimental conditions is to force yourself to think about alternative explanations that may be correct.

Prevention of the impact of cognitive distortions

Thinking is a useful activity, necessary for solving problems, analyzing, comparing, studying, planning, etc. But very often the mind wanders where it wants, occupying attention with trivial and unimportant questions and useless thinking that wastes your time and energy. Critical thinking is an integral part of design thinking, its component.

Indeed, there is no consensus on any known definition of intelligence. The reason, perhaps, is that this word is associated with different qualities. In history, there are many examples of people unanimously recognized as intelligent in such diverse fields as science, technology, art or philosophy.

Defining intelligence as “he ability to reflect, plan, solve problems, think abstractly, grasp complex concepts, remember quickly, use accumulated experience”, scientists conducted an analysis of research and concluded that people endowed with high intelligence have more chances to protect themselves from various kinds of prejudices.

To reveal a high level of intelligence, one should remember the ability of some people to abandon the established patterns of their era and act in a new way, not being satisfied with what seems obvious. Galileo, Darwin, Einstein, as well as

Kant and Descartes were such dissenters. They questioned the prevailing ideas and simplified interpretations of the world order. Intelligence in that case was accompanied by critical thinking, the ability to intellectually oppose the dominant system of concepts, an attempt at ideological processing and, in general, any form of dogmatism.

Critical thinking is often confused with intelligence, but it is not the same. Critical thinking is a set of cognitive qualities that allow us to think rationally, considering a certain goal and the readiness to apply these qualities at the right time. Critical thinkers have flexible thinking and look for evidence that supports their beliefs and recognize attempts to mislead them. Critical thinking means the ability to overcome any cognitive biases (e.g. hindsight bias, confirmation bias).

Man by his nature is irrational and this in certain aspects hinders us, creates obstacles on the path of life. Not all beliefs are stupid, absurd, or dangerous. Some of them can be constructive, such as *believing in yourself, in your abilities, in your worth, in life and in other people*.

The risk of falling under the influence of dangerous beliefs is connected with the need to find the meaning of life at any cost. If someone gives us an explanation that fits our worldview or frees us from independent search, it is easier for us to accept it. But the greatest danger of irrational beliefs is that they tend to align with our intuitive expectations. Since ancient times, people have believed in strange things, and many have tried to fight them.

Despite all his intelligence, education and critical thinking, no human being is immune to stupid prejudices – mainly because people have a hard time believing in randomness. To look for *fate, fatality, intrigue, conspiracy, good or evil intention in random events* is a universal mistake.

If it is not possible to particularly increase the level of your intelligence, you can learn to develop critical thinking.

Informing people about cognitive distortions and biases and encouraging them to avoid them is not enough to get rid of them. To avoid them, it is very important to understand how an alternative result could have been obtained. We need confirmation – evidence, and this is achieved through obtaining information – knowledge. On the way to critical thinking, the first thing a person needs are to realize his nature and accumulate knowledge and experience.

Acquiring knowledge (acquiring experience) is a physically difficult process for our brain, so in approximately 80–85 % of people it (the brain) will resist this process. The solution is to constantly train yourself, as a person, and the brain as its main part. The first stage will be planning your day.

Questions for self-control:

1. What methods of analyzing consumer behavior are used at the stage of empathy in design thinking?
2. Expand the content of the concept of consumer profile
3. What are cognitive distortions?
4. What are the types of cognitive distortions?
5. What are the main techniques for counteracting cognitive distortions?
6. What is critical thinking?
7. Define intelligence

8.3. Idea generation: techniques and tools for conceptualizing solutions

Goal setting and motivation as elements of critical thinking

In order to achieve the set goals, tasks, or increase one's efficiency in general, a person first of all needs to understand how the brain works.

So: modern neuropsychology and psychoanalysis claim that 2 systems are responsible for the thinking process in our brain – the subconscious (unconscious state) and consciousness. They are marked by system 1 – unconsciousness and system 2 – consciousness. System 2 is our conscious thoughts, the voice in our head, in fact it is the person we consider ourselves to be. This is a system that can carry out instructions and a sequence of actions (for example, multiply 7 by 14). System 2 is very hard to start (actually lazy) it is slow but attentive and can find a bug.

System 1 is our unconscious part (subconscious mind), an incredibly fast system that processes a huge amount of data that enters our brain, it selects the most important of them and discards the extra, and most of it. It works automatically (in the background) without us, that's why it was called the subconscious. We do not even understand the scope of her work. For example, when you see some text, it reads it even before you try to read it. It automatically adds information for completeness of perception. This is the library of our memory, and system 2 is a short-term memory that can simultaneously hold 4–5 new concepts.

Learning is essentially the formation and grouping of new information into known designations, that is, the transfer of work from system 2 to system 1. That is, in fact, it is a system of repetition.

Frequent, conscious repetition leads to the accumulation of databases of system 1. It was Sigmund Freud who popularized the idea of the unconscious. He formulated the statement that: the perception that behind our ideas, thoughts and actions there are unconscious motives beyond the control of our will. Further, Carl Gustav Jung developed this statement and concluded that people are very strongly influenced by things that are not controlled by their consciousness. This is how our brain has evolved to use our resources in a better way. For repetitive tasks, we have developed an automatic system for their execution to save the limited capabilities of system 2 for those things that really need our full attention.

How to train your mind to achieve efficiency

No one can live without a routine, if you don't have one, you can't maintain your psychological health! For example, you can choose a time to get up in the morning, any, but one thing and be sure to stick to it, it will have a positive effect on your mood.

Setting a goal for oneself is a problem when a person sets a task for himself and does not fulfill it. Again and again he formulates the task and postpones it for later, formulates it again and postpones it again. How to solve such a problem?

First, you must agree with yourself what you want and what you will get for it. Such work must become part of your routine, otherwise it will not work, because you are not your own servant, you must negotiate with yourself. This is motivation. You have to motivate yourself to do the work through incentives. You need to start by determining the number of hours during the day wasted on meaningless activities. Make a schedule for yourself and stick to it. But consider that the main rule of the schedule is not a prison. Ask yourself about the ratio of responsibility to reward and move on. You need to make a schedule so that you get the best possible day for yourself and you are satisfied with it, and the most important thing is that you are not in a worse position compared to the beginning of the day based on the results of your work. And even if you did everything as you wanted, you will be able to fulfill your plan by no more than 50–70 %, but this is already significantly more than 0. And even if these percentages will be smaller, you should try to achieve positive growth dynamics in the following periods. This will make you efficient and you will see your own results and be amazed at your achievement.

Second, start writing. Writing is thinking, if you have an idea, put it on paper, and the first thing you will see is some flaws in the formation of the idea itself. Ideas expressed in writing allow a person to learn to think and clearly convey his thoughts. Advanced thinking allows you to be more effective.

Identifying the problem and assimilating input information

To achieve goals, a person needs 2 things – diligence and intelligence. Two complex elements that are difficult to measure and even more difficult to determine their impact on achieving results. Modern science does not provide an answer to the question of how to increase intelligence and diligence. These complex questions lie in the plane of a person's personality. Take IQ as an example, any attempts to develop exercises to increase it have failed. Indeed, many techniques, methods and principles of solving complex problems were developed, and people used them very effectively, but changing the problem and the situation brought everything back to the beginning. Accordingly, humanity has not achieved progress in increasing human intelligence. Therefore, each person works on the balance of these elements within the framework of his personality or personalities, which actually creates a successful adaptation of a person to the surrounding environment. It can be characterized in such a way that a person will look for such a field of activity where his specific features of perception, temperament and behavior will meet the requirements of this field (self-realization).

In any field, self-realization is the process of solving certain problems, or choosing the optimal solution or direction. The only way to choose the optimal way to solve the problem is to determine the content of the problem. After creating an empathy map, focusing is carried out – this is a transitional stage that involves processing all the collected information. An empathy map is a graphic diagram in the center of which is the consumer, surrounded by various information blocks depending on the task. The main task of creating an empathy map is to create a detailed portrait of the ideal consumer of a particular product. At the same time, the center of the empathy map can be not only the consumer, but also an idea, task or problem to be solved.

Focusing is the next stage of the design thinking process. At this stage, a clear concept of the project is revealed. All that was heard and seen is gathered together, a complete picture is formed from the received information, in which the most important is determined. At the focus stage, conclusions are drawn based on the information gathered in empathy mode, and a concept is created that will be implemented in the project.

The content of focusing consists in formulating a question that should be related to the problem. This is a statement that focuses on the conclusions made in the process of observation, an image that is formed based on certain characteristics of various objects. The focusing mode is also called "point-of-view" (POV). The main problem of this stage is to avoid cognitive distortions of "points of view" (Fig. 8.2).

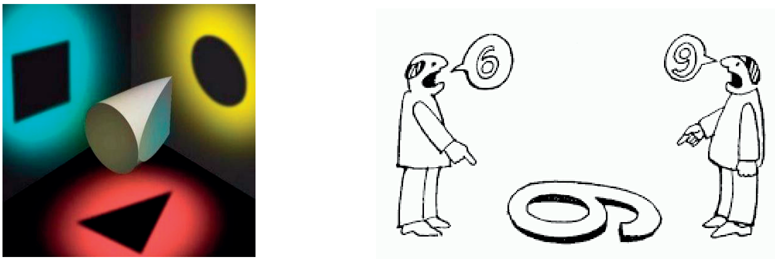

Fig. 8.2. The problem of information perception through "point of view"

Focusing is a deep understanding of what was collected in the process of observation. Focusing is critical and allows for an explicit expression of the problem that needs to be solved based on the information collected about people's lives.

The information with which we work, the samples that are available to us, do not reflect the whole picture, but only what we received and perceived. Accordingly, you need to be able to go beyond this framework, keep in mind that the data that is available is always incomplete, and this inevitably leads to various kinds of distortions.

The process of finding new ideas

The next stage is the ***generation of ideas***. At this stage, the search for a solution to the problem, which was defined earlier, is carried out. At this stage, it is important to generate the whole range of possibilities, there is no place for one correct idea. Idea generation is the development or development of new ideas that contribute to the possibility of creating new ideas. There are many ways to organize a constant search for ideas. The main components of the search for new products are the analysis of sources and the application of creative methods of obtaining ideas.

The process of generating ideas should be aimed at expanding the possibilities of solving the problem and looks like branching into all possible concepts and results that can be applied as an alternative solution to the problem. The basis for creating a prototype and an innovative solution is the representation of participants in the design thinking process.

The use of different methods of generating ideas allows you to avoid potential complications and get benefits, namely:

– avoid obvious solutions and increase the innovative potential of the idea;

– use the collective representation and strengths of the team;

– to open entire areas that were previously left out;

– provide flow (quantity) and flexibility (diversity) of innovative solutions.

In order to generate ideas, prototyping or creating a layout based on bodystorming is used – this is a variant of “brainstorming” with an emphasis on generating ideas and creating unexpected inventions through physical research and interaction, creating intellectual maps, sketches, etc.

The creation of an idea occurs through a combination of rational thoughts and emotions based on established limits, the presentation of context and the consideration of unrelated ideas.

The search for new ideas begins with the method of “silent brainstorming”. After that, ideas are discussed and developed. All formulated ideas are subject to verification of their viability by applying evaluation criteria and using filters.

Procedure for selection, sorting and structuring of basic ideas:

1. Formulation of selection criteria. If there are several criteria, then each of them must have a certain weight. The criteria allow you to preserve the innovative potential accumulated in the mode of generating ideas.

2. Selection of an idea by voting (the danger of voting may be that if the majority supports the idea, then the enthusiasm of the rest of the team may fade).

3. Prototyping and testing its functionality. To search for ideas, it is

appropriate to use brainstorming sessions, sketches, drawing up intellectual maps or building a layout. Any way is good, the main thing to remember is that the generation of ideas should be clearly separated from their evaluation. Under this condition, the presentation can be limitless.

As an effective tool for finding new ideas is Boyd's "ooda loop" or killing speed. U.S. General Charles Krulak characterized John Boyd as a high intelligence officer. A specialist who made an unsurpassed contribution to American martial art and was one of the central architects of military thought reform. It is this model of behavior that competitive decision-making on the battlefield – time compression, and its use as its ally "OODA Loop" began to be applied in civilian life due to its effectiveness and highly competitive environment.

A military mental model known as the "OODA Loop". It is also called the "Boyd Loop". It is a practical concept of rational thinking of military leaders to function effectively in confusing or chaotic situations. It helps to quickly make the right decisions in a combat situation. The abbreviation "OODA" stands for simply. Observe is to observe. Orient is to navigate, decide is to solve. Act is to act.

The word "loop" involves repeating these steps repeatedly until the situation is resolved or ended. Each repetition of one stage provides more information for the next, turning it into a feedback process.

Observe. Information alone is not enough. The observation stage requires the transformation of information into a general context. A particularly important leadership skill is the ability to determine which information is just noise and irrelevant to the decision at hand. If you want to make good decisions, you need to master the art of observing what's around you.

Orient. To navigate, it is necessary to recognize any obstacles that may interfere with other parts of the "Boyd loop" cycle. What does orientation do in this context? First, it allows to associate oneself with reality: to see the world as it really is. As free as possible from the influence of cognitive biases and simplifications. Without unnecessary details, but not primitive either. To his colleagues, John Boyd recommended the use of the process of “deductive destruction”. Pay attention to your own assumptions and biases. Then find fundamental mental models to replace them. In this way, you always learn from the mistakes made and do not continue to repeat them.

Decide. The previous two steps provide the foundation needed to make an informed decision. If there are several options at hand, you will have to use your observation and orientation to choose one. The best possible.

Act. There is a difference between making decisions and implementing them. Once you decide that it’s time to act, it’s worth checking your decision. The results and consequences will indicate whether your decision was correct or not. Having received information about this, you will return to the first part of the “loop” and begin to observe anew.

In sports, there is a proverb that extends quite well to war: “Speed kills”. If you know how to be agile, adequately assess an ever-changing environment, and adapt quickly to it, you will always have an advantage over any adversary. Even faster than lightning.

Suppose you need to work fast. What then? You can learn something from fighter pilots. For them, any seconds of undue hesitation can cost lives. Pilots have many solutions and processes that they can juggle when they are in air battles. They move at high speed and must avoid enemies by tracking them. And also to maintain contextual knowledge of goals, terrain, fuel and other key variables.

Start applying the “Boyd loop” in your everyday decisions. Just watch what’s going on! Believe me, you will notice things that you did not pay attention to before. Before you draw a conclusion from the information received – stop. Pause for a short break. Consider your mental biases, get more information, and be sure to think about the consequences.

Like any practical action, if you do something right, the more you do it – the better you will succeed later. After a certain time, you will begin to make the best (high-quality and correct) decisions in full. You will see faster progress. And as Colonel John Boyd would say, you're going to start something "better to do in your life, not just be someone".

Like all good mental models, this knowledge works in other areas, even outside the military: it is actively used by special services, lawyers, doctors, businessmen, politicians, law enforcement agencies, marketers, coaches, etc.

Methods for generating new ideas

The method of associating ideas is based on the use of the capabilities of the senses of a person (hearing, sight, touch) and his mental abilities to form the desired ideas. Observing, listening or feeling a particular real object, a person is able to move away from his image and imagine another that has a certain similarity, but is fundamentally different from it. The associated original and valuable idea is captured and used for further study. During the observation and formation of the idea, the properties of the real and imaginary object are analyzed. Based on logical reflections and direct comparison of these properties, the necessary decisions are made. It is clear that this process involves the availability of accurate answers to a number of specific questions. It turns out, in particular, the advantages and disadvantages of the design of the product, the possibility of its use under new conditions or the implementation of a large-scale (increased, reduced) modification of the product. The possibilities of changing the external design, layout or principles of the product, replacement of materials, etc. are also studied. Answers to these questions allow you to create an image of the future object.

The method of generating ideas is based on the systematization of data on the development of a certain type of product in the past and on the logical analysis of these data to determine possible directions for product development in the future. Common means of generating are diagrams and matrices of ideas, the so-called brainstorming (brainstorming method), heuristic methods.

The method of generating with the help of a diagram of ideas involves the use of appropriate graphic material that synthesizes the past experience of the formation and development of the type of product in question. The method of generating using a matrix of ideas is associated with penetration into the morphology (composition and structure) of the product. It is considered more productive because it allows you to get more combinations of ideas, including alternative ones. The latter contributes to finding fundamentally new solutions. Morphological analysis is based on the construction of a matrix of characteristics of the object of forecasting and their possible values, followed by sorting out and evaluating the variants of combinations of these values. It is implemented based on the construction of the so-called morphological block, which was proposed by the Swiss scientist F. Zwicky in the late 50s.

The procedure of morphological analysis is a sequential sorting of possible combinations of different characteristics (in our example, physical principles and technical solutions).

The sequence of stages of morphological analysis is as follows:

– the problem is described as a whole (no solutions are offered);

– the problem is decomposed into several components (for example, the parameters of the object are determined – shape, packaging material, contents);

– for each parameter, several possible options are offered (known and those that have not yet been used in the goods on the market). In this case, a matrix is compiled, the so-called morphological box, in the first column of which all the parameters are listed, and on the right in the same row are alternative solutions;

– parameters and alternative solutions are combined (each solution consists of a set that requires one option from each parameter); the optimal solution, from the point of view of the company, is selected and implemented.

The method of morphological analysis is very useful for the design of new products, as well as for determining the possibility of patenting the main parameters in order to “block” inventions that may appear in the future, and block competitors' path to imitation of innovation.

The brainstorming method proposed by A. Osborne in the late 30s and as a method is very simple. It assumes the following stages: preparatory; idea generation; analysis and evaluation of ideas.

There are several methods of brainstorming and its modifications:

– classic brainstorming;

– anonymous brainstorming;

– didactic brainstorming;

– destructive and constructive brainstorming;

– technique of creative cooperation.

Anonymous brainstorming. Directly brainstorming is carried out before the meeting. Participants are asked to formulate and write down all ideas related to the problem on a piece of paper and give them to the presenter. The presenter presents ideas consistently, without naming the authors, and the group develops and improves these ideas.

Didactic brainstorming (Litt technique). Before the meeting, the formulation of the problem is known only to the presenter, who leads the participants to the problem gradually during, as a rule, a series of meetings: at first they are introduced only to the general aspects of the problem, then additional information is displayed consistently, as a result of which the problem is solved completely.

Destructive and constructive brainstorming. Brainstorming is carried out in two stages. At the first stage, all the shortcomings of the existing solution to the problem are highlighted, and at the second, a search for new, better ideas is underway.

Technique of creative cooperation. With this method, group work is changed to individual. First, a group brainstorming session is held for 10–15 minutes. Then the participants individually (5–10 minutes) think about the problem, write down new ideas. Improve the proposals made during the discussion.

The conference of ideas is a modification of the brainstorming method, which is characterized by a higher pace of meeting and involves benevolent criticism in the form of remarks and comments. All ideas are recorded in the protocol, but the authors are not indicated. A variation of this method is the Hilde Ideas Conference, Discussion 66, Method 635. *Hilde Ideas Conference*. Both employees who are aware of the problem and newcomers who are able to put forward new fresh ideas are attracted to the conference of ideas, since traditional approaches to solving it do not gravitate over them. Skeptics or specialists who believe that they know everything better than others should not be invited to a conference. The chairman, whose status during the conference is equal to others, should maintain a relaxed atmosphere, steadily moving towards the goal.

Discussion 66 (a series of buzzing voices). Participants are divided into groups of six people, each independently of the others prepares his own solution to the problem or works out a position on a specific issue. In each group, the presenter, protocolist, speaker is determined. Group work lasts approximately 6 minutes. After that, all groups gather for a plenary session, at which a new view of the problem can be selected, which is again discussed separately for a short time.

Method 635. The group, which consists of 6 participants, analyzes and clearly formulates the problem. After that, each of the participants within 5 minutes enters into the form 3 proposals for solving the problem and passes the form to his neighbor, who takes into account the proposals of the predecessor and notes three more of his own proposals. They can arise as a result of certain associations with recorded decisions or be completely new. After all participants have processed the forms, the process ends. The time given to ponder in the last phases can be extended.

The next method of generating ideas is synectics. This is a really effective method of finding ideas proposed by V. Gordon.

Synectics – search for ideas of new products based on the use of analogies from other areas of life. The basis of synectics is brainstorming, in which specialists in various fields of activity are invited to participate. A group from one assault to another accumulates experience in solving the problem. The main techniques used in the synectic assault are based on analogy:

– direct (how tasks similar to data are solved);

– personal (try to enter the image of the object given in the task and express yourself from this position);

– symbolic (give a figurative definition of the essence of the task);

– fantastic (how this task would be solved by fairy-tale characters).

The method of control questions. This method is implemented using a list of questions developed by A. Osborne, T. Eiloar, D. Pearson, G.L. Bush and others. The list proposed by A. Osborne includes 9 groups of questions:

1. What new application can be offered for the object?
2. What another object is similar to this and what can be copied?
3. What modifications can be obtained by rotating, bending, twisting, turning, changing functions, color, shape, contour?
4. What in a technical object can be increased (size, strength, number of elements, etc.)?
5. What in a technical object can be reduced (compacted, compressed, accelerated, narrowed, crushed)?
6. What can be replaced in a technical object (element, material, drive, etc.)?
7. What can be reworked in the object (scheme, layout, order of work, etc.)?
8. What in the object can be done the other way around?
9. What new combinations of elements are possible?

The method of verbal associations. When we are looking for needs that can be met, or working to improve an existing product, form of service, ideas can suggest words. The method of verbal associations consists in methodical compilation and re-reading of a list of words and concepts until a word suggests a new idea. The source of verbal associations can be dictionaries, journals on trade problems, technical literature.

Heuristic methods are based on associative abilities, intuitive thinking and the ability of a person to control it. These methods include various rules and recommendations that help solve problems without first evaluating the results. The most common heuristic methods include methods of analogy and inversion.

Methods of analogy reflect the natural desire of a person to imitate, that is, to reproduce in the elections the characteristics of objects, processes and phenomena of the environment, as well as mental abilities and physical properties of his own organism. The desire to establish the identity and divergence of objects of wildlife and the tools created by man accompanies the individual at all stages of creative activity. They are still looking for analogies between an airplane and a bird, a manipulator and a human hand, a cybernetic device and a human brain. Taking in general, generalized heuristic methods of analogy, depending on the specifics of the object of imitation, are divided into two classes: methods of imitating objects of inanimate nature, methods of imitating objects of wildlife (man and other biological beings).

In modern practice, the *method of precedent* is widely used. It involves the use in the new product of an original and effective functional principle that was applied in previous models. For example, vending machines, cash registers.

The *method of constructive similarity (the principle of the matrix)* is the basis for the design of goods, which is a geometric (linear, plane or volumetric) analogy of existing ones. For example, a few cars built on a common structural basis, a series of electrical household products.

The *method of reintegration (the method of "Ariadne's thread")* is also used in creative activity, which contributes to the creation of a new complex product by analogy with a relatively simple one. It is known that the rocket engine of F. Bandera was developed by analogy with a blowtorch. For the development of consumer goods, the pseudomorphization method is very often used. According to this method, products are created that are similar in shape to existing ones, but have a different functional purpose. The purpose of such a product is to create a misconception about its true function. For example, a pen in the form of a lighter-gun, a lighter-gun, a radio-wallet.

Methods related to the imitation of wildlife objects are widely used to generate ideas. For example, the paleobionics method takes the silhouettes of fossil animals (walking excavator) as prototypes for new products.

The method of biomechanics is based on the reproduction in the developed goods of the principles of the mechanics of the movement of creatures (helicopter).

The bioarchitecture method uses for new products the shapes and proportions inherent in wildlife objects (for example, heating radiators, fences and other structures). When designing products that artificially reproduce the functions inherent in man, they use the method of biocybernetics. Recently, in research practice, the methods of bionics have been widely used – a science that studies the laws and principles of the functioning of a living organism to create artificial technical systems. Automated self-learning systems, robotically technical devices, devices for pattern recognition – this is not a complete list of applications of bionic algorithms.

The logistical also includes methods of alternative search, based on the integrated use in the process of searching for ideas of new products of such techniques that form alternative pairs in the form of "reception – antireception". For example, magnification-decrease, hyperbolization-miniaturization, macroidealization-microidealization.

The method of inversion (from the Latin rearrangement) also plays an important role in finding ideas for new products. It involves the search for solutions in directions opposite to those generally recognized for similar objects. For example, the method of inversion of working materials and substances involves the replacement of their traditional types with non-traditional ones. This provides the ability for the product to perform new functions or increases its usefulness. The method of inversion of the shape of the object involves a change in the operational properties of the product due to deviations from traditional solutions. For example, an airplane with folding wings, a hydrofoil boat. If it is necessary to take into account the contradictory requirements for structural materials at the same time, the inversion method is also used.

Gamestorming is a set of practices to facilitate innovation in the business world. The presenter directs the group towards a specific goal through play, a structured activity that allows you to think freely, even playfully. The word "gamestorming" is a neologism about the use of games for brainstorming. Games can be seen as an alternative to a standard business meeting. Most games involve 3 to 20 people and last from 15 minutes to an hour and a half. The game pauses some of the usual life protocols and replaces them with a new set of interaction rules. Games may require multiple props, such as sticky notes, poster, markers, random shots from magazines, or thoughts of provoking objects. The game's skills include asking questions (discovery, managing, experimenting, closing), structuring large diagrams, sketching ideas, merging words and drawings into visual language, and most importantly, improvising to select and conduct a suitable game or invent a new one. Gamestorming is used to explore user experience, social media marketing, innovation, product development.

Questions for self-control:

1. What is the significance of the day map element?
2. What is goal achievement analysis in the day map?
3. How motivation is realized in the critical thinking system?
4. What are the basic techniques for creating solution concepts?
5. What is the focus content?
6. What are the methods for generating new ideas?
7. What is Boyd's Loop?
8. What is the purpose of dobistorming as a prototyping tool?

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UDC 334:007:65.012:35.07

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Chapter 9
CONTEMPORARY RESTRUCTURING (RE-ENGINEERING) OF BUSINESS PROCESSES AT TRANSITION TO ELECTRONIC SERVICES RENDERING

Content

9.1. E-services in the restructuring of digital economy business processes

Electronic services provision is first of all connected with the state, therefore, while characterizing them we will focus special attention on services in the field of public administration. With the development of new technologies, a rethinking of approaches to governance and responsibility begins, relations between players change: between service providers and manufacturers; between public, private and third sectors and between authorities and citizens. New forms of governance are emerging, reflecting the change of organizational and economic relationships, with profound implications for use by citizens and businesses.

It was digital economy development that caused the need to build online communications between business, citizens and the state. Widespread ICT and Internet enabled the emergence of electronic services.

E-services concept is quite young, it has only been used for 20 years, but there are already many definitions of it. In a general sense, an electronic service can be understood as a service provided through the Internet using ICT. Separate interpretations of "electronic services" concept are given in Table 9.1.

Table 9.1 **– The views of scientists and practitioners regarding the content of "electronic service" concept**

Author	Definition of the term "electronic service"
Beznaziuk O.	An electronic administrative service is an administrative service provided in whole or in part through online services
Borysov I.V.	Electronic services are services provided through the informational telecommunication system and do not constitute a separate type in the system of contracts for the services provision.
Kovalskyi V.	Electronic services are services provided via the Internet, automatically, with the help of information technologies and mainly without human intervention, including by installing a special application on smartphones, tablets, television receivers or other digital devices.
Matviichuk R.M., Kandziuba S.P.	An electronic service is a service created to meet the user's information needs, which has an electronic form of provision.
Tyshchenkova I.O.	Electronic services in the activity of public administration should be understood as legal relations that arise thanks to ICT regarding the subjective rights realization of a natural or legal person, mainly at their request in the process of public administration's public-authority activity.

Source: complied by the author.

Therefore, a peculiarity of electronic public services is the use of ICT and the Internet in their provision. As a type of public service, electronic services have certain characteristics:

1) legal regulation;

2) mandatory recognition and provision;

3) direct participation of public authorities and public institutions in the services' provision;

4) service continuity and its availability for everybody.

Among the main features of services in the conditions of digital technologies development, scientists single out the following:

1) the service is always expressed through the active actions of the legal relations participants;

2) the service provided by the contractor is able to satisfy the needs of the customer;

3) lack of material nature;

4) synchronicity of providing and receiving services (are consumed in the process of their provision);

5) the service must meet the requirements specified in the contract or regulatory act;

6) the possibility of remote services provision – the use of ICT in the services provision.

In Ukraine, the concept of electronic service is defined at the legislative level. The normative definition of the term "electronic services" is presented in Table 9.2.

***Table 9.2* – Normative definition of "electronic services" concept**

Legislative and normative acts	**Definition of the term "electronic service"**
1	*2*
Law of Ukraine "About electronic confidential services"	An electronic service is any service provided through an information and communication system.
Law of Ukraine "On e-commerce"	Electronic information services – paid or free services related to information processing and storage, provided remotely using information and communication systems at the individual request of their recipient.
Law of Ukraine "On the peculiarities of public (electronic public) services provision"	Electronic public service – a service provided by state authorities, local self-government bodies, enterprises, institutions, organizations that are under their management, including an administrative service (including automatic mode), which is provided using information and telecommunication systems on the basis of an application (appeal, request) submitted in electronic form using information and telecommunication systems (including using the website of the Unified State Electronic Services Portal), or without submitting such an application (appeal, request).

Continuation of Table 9.2

1	*2*
Tax Code of Ukraine	Electronic services are services provided via the Internet, automatically, with the help of information technologies and mainly without human intervention, including by installing a special application on smartphones, tablets, television receivers or other digital devices.
The Concept of Development of the a-Services System in Ukraine	Electronic service – administrative and other public service provided to the subject of the appeal in electronic form using the means of information, telecommunications, information and telecommunications systems.

Source: complied by the author.

In fact, the state established the essence of electronic services (e-services) as those provided to the consumer in electronic form with the help of ICT. The question arose: "What exactly should be considered electronic services?". The Tax Code of Ukraine defines the list of transactions that belong to electronic services and those that are not classified as such (Appendix A).

The concept of e-services includes not only administrative services provided in electronic form, but also other services that do not belong to administrative. In particular, such other e-services can be online registration in the e-queue for kindergarten or for a doctor's appointment, registration in the queue for vaccination against COVID-19, etc.

Here are generalized approaches to the electronic services classification [1]:

1) by the content of electronic services provision (informing, one-way interaction, two-way interaction, conducting transactions);

2) by the field of activity: informational services; consulting services;

3) services related to interaction between public administration subjects; assistance and support services;

4) by subject of provision: those provided by central executive authorities, regional representatives of the government, local self-government bodies and subjects of delegated powers;

5) by the place of receipt: "single window"; the official web portal of the authority;

6) by the form of receipt: fully automated and partially automated;

7) by the result they can both provide for the execution of an administrative act and not provide for its execution;

8) by consumers: electronic services for public authorities, citizens and business organizations B2B (Business-to-Business); B2C (Business-to-Citizens); G2B (Government-to-Business); G2C (Government-to-Citizens); G2G (Government-to-Government); C2C (Citizens-to-Citizens).

Scientists recognize that the goal of providing e-services is the creation of simpler conditions and more effective relations for citizens and public institutions regarding:

– information exchange (requests of citizens about the activity and work of public institutions, conducting a population census, etc);

– public services provision (at individual requests of citizens or through information systems);

– the control or introduction of restrictions, usually initiated by the state and involving the introduction of restrictions on certain behavior (for example, the imposition of penalties, the collection of taxes).

Today, the concept of "electronic services" is gradually being replaced by the term "digital services". At the same time, the very interpretation of these services is expanding, because if "electronic services" are concentrated in the field of public administration, then "digital services" cover all online services. The development of digital services and digital markets is defined as a priority of the European Union. In April 2022, the European Parliament agreed and approved the draft Digital Services Act (DSA), which will enter into force on January 1, 2024 and is aimed at establishing fundamentally new rules of the game in the online space.

The law interprets "digital services" much more broadly than "electronic services", as the DSA rules will apply to four main categories of online space participants: companies providing online intermediary services; companies providing hosting services; online platforms; very large or super large online platforms. The main tasks of DSA, as defined by the European Commission: to improve the defense mechanism of users' rights on the Internet; to protect against unsolicited advertising; to reduce the amount of illegal content on the Internet; to expand digital services for online market participants in the EU; to prevent the abuse of "Internet power" by super large platforms that cover an audience of more than 10 % of the EU population; to contribute to the growth and expansion of competition in the online market [2].

That is, digital services include the ability to receive any service on the Internet through social networks; search engines; online market (marketplaces).

It should be noted that the Ministry of Digital Transformation of Ukraine announces the development of digital services in our country as well. The perspective development of digital Ukraine – the digitalization of the service sector is outlined in conceptual and strategic documents, in particular in the Concept of the Digital Economy Development and Society of Ukraine for 2018–2020, which provided for the introduction of measures to implement incentives for the socio-economic processes digitalization, digital competences acquisition by citizens. Currently, the main strategic document is the National Economic Strategy 2030, in which one of the strategic courses of the economic policy until 2030 is the "Digital Economy" direction.

The directions of Ukraine's regions digital transformation are defined in the State Strategy of Regional Development 2021–2027 (2019). Among the main priorities of regional development, the following are highlighted: improving the quality and ensuring the availability of administrative services for the population, developing infrastructure and digital transformation of regions. At the regional level, there is a practice of approving Digital Development Programs. Thus, the Digital Development Program 2021–2025 was approved in Khmelnytskyi at the end of 2020. The program is aimed at implementing the policy of informatization, digitization, digital development, digital innovations, e-government, e-democracy, creation of effective management mechanisms using modern ICT.

You need to have certain knowledge and skills to effectively provide and use digital services. Back in 2013, the European Commission launched a scientific project on the development of a digital competence system for citizens DigComp (DigComp – The Digital Competence Framework for Citizen). In 2016, the Digital Competence Framework for Citizen DigComp 2.0 was published, and in 2017 its format was updated – DigComp 2.1. In addition to the European Digital Competence Framework for Citizens DigComp 2.1, were adopted pan-European Digital Competence Framework: for teachers (DigCompEdu, 2017) and higher education institutions (DigCompOrg, 2015). In 2021, the Ukrainian government adopted the national Concept for the digital competences development, the main purpose of which is to define priority directions and tasks for the digital skills development and digital competences of various employees' categories, graduates of educational institutions, and citizens. Ukrainian experts adapted the DigComp 2.1 conceptual reference model of digital competences to the peculiarities of Ukraine, taking into account the recommendations of European and international institutions, and in 2021 a description of the Digital Competence Framework for Ukrainian citizens was published.

The development of electronic and digital services is greatly facilitated by the formation and deployment of digital platforms. The European Commission has defined a digital platform as an enterprise that operates in bilateral and multilateral markets and that uses the Internet to enable interaction between two or more individual, interdependent groups of users [3]. A European Parliament study proposed a broader definition, according to which a digital platform provides a technological basis for the provision or aggregation of services (content) from service providers (content) to end-users [4]. The tasks of the platforms are defined as creating value for all users of the platform, maintaining connections between its users and facilitating the exchange of information, values, products, services, works.

Four main types of platform participants are: platform owners, providers (managers), developers and independent end-users (consumers, suppliers) [5, p. 444].

The following models of digital platforms monetization in relation to the consumer are distinguished [6, p. 59]:

1. **Free platform** – provides free services. It is worth highlighting two models of financing the operation of the platform:

1) for state platforms – at the expense of the state budget, various funds, grants, donor organizations (DIIA);

2) for commercial platforms – monetization can occur by delivering advertising content to users (Facebook).

2**. Shareware platform** – provides free services in the basic version, the user pays for the advanced format (Spotify).

3. **Charge of commission** – receiving a commission on each transaction (eBay, Uber).

4. **Access fee** – payment of information on the platform (Science Direct, paid electronic mass media).

5. **Differentiated access fee** – only a part of users who are more interested in platform services pay for access (dating sites).

The diversity of areas in which platforms arise allows you to receive an electronic or digital service of any nature: educational services (Buki, Coursera), logistic services (Lardi Trans), sale and purchase of goods (Amazon, OLX, Prom, Rozetka), courier services, performance of various tasks and services provision (kabanchik.ua), finance services (purchase of insurance through Privat24), state services (Prozorro, Diia).

Economically, a digital platform is the implementation of a multi-marketplace model, where supply and demand are coordinated, transaction costs are optimized, and a transition from unification to total aggregation of all possible goods and services is performed. There are several models of digital platforms communication (Table 9.3).

Table 9.3 – **Basic communication models for the digital platform's formation**

Subject (Manufacturer of goods and services)	Object (Consumers of goods and services)		
	Business	**Consumers (households)**	**Government**
Business	Business to business model (B2B). Electronic commercial services	Business to consumer model (B2C). Online stores (e.g.: Alibaba, Amazon)	Business to Government model (B2G). Electronic public procurements
Consumers (households)	Customer to business model (C2B). Contextual business advertising and electronic labor exchanges (e.g.: Google AdSense; Work.ua.)	Customer to Customer model (C2C). Digital platforms for joint consumption (e.g.: blablacar; Airbnb; eBay).	Customer to Government model (C2G). Digital platforms for submitting petitions
Government	Government-to Business model (G2B). Government services for business.	Government to Consumer model (G2C), State services for citizens.	Government to Government model (G2G). E-Government.

Source: [7].

Thus, platforms may have different functionality, but most of them have similar features:

1) multilateralism – the ability to coordinate different groups of users, for example, buyers and sellers;

2) the presence of network effects, which consist in increasing the value of the platform for a group of participants as its number increases;

3) the presence of a unique ecosystem (combination of companies that develop the platform);

5) the presence of applications that are the main software;

6) limited resources provision consisting of software and regulators that facilitate close cooperation of users;

7) degree of openness and availability of software interfaces and development tools [8, p. 60].

Depending on the subjects and their role in the creation and regulation of the platform, the latter are divided into public (state) – platforms created and regulated by state bodies, the users of which can also be commercial participants; private (commercial) – founded by a private business, providing services to both private and public participants.

State (public) digital platforms, unlike private ones, are established by the state represented by state bodies. The functioning of such a platform is determined by a state regulatory legal act of the appropriate level, which establishes the order of activity and management, defines the participants of the platform, the purpose and tasks. The digital platform is managed by an authorized state body (platform operator). The activity of state digital platforms is limited by the territory of the state.

The state digital platform, unlike private ones, does not aim to make a profit, because it is created by the state with the aim of increasing the efficiency of the public services provision through the digitization of interaction processes with their consumers.

Questions for self-control:

1. Define the content of the electronic services.
2. What are the main characteristics of electronic services?
3. Characterize the Ukrainian legislative base of the regulation of electronic services.
4. Generalize approaches to the electronic services classification.
5. What is the difference between the terms "electronic services" and "digital services"?
6. Distinguish the models of digital platforms monetization concerning the consumer.
7. Describe the basic communication models for the digital platform's formation.

9.2. World experience in the introduction of e-services

Let's consider several case studies on the introduction of e-services and features of digital business processes development in different countries.

Case 1. One of the leading places in the world and the EU in the provision of electronic business services is occupied by *Estonia*. It has invested heavily in its own developers and gained significant experience that can already be capitalized. Currently, Estonia is a powerful digital state with high GDP per capita.

The country has succeeded in introducing e-government and citizens receiving individual ID cards in 2002, which provide an opportunity to use state-administrative, medical, financial, educational services, public transport and libraries, get insurance, travel and vote online. Due to the ID card, Estonia saves 2 % of GDP and allows providing services in a convenient format for citizens. Currently, Estonians use the Mobile-ID identity card (personal identification through a SIM card).

The most important event in the development of electronic interaction in Estonia was the X-Road program, which manages requests between unrelated computing environments and is an integrated data exchange system [9]. Due to it, almost all administrative services are provided online in Estonia. As of 2022, almost 67 % of Estonian citizens use an ID card regularly, also 99 % of administrative services are presented online and 2,773 services are subject to the X-Road system.

There is also an eTaxBoard system in Estonia, which helps citizens fill a tax return, refund VAT and monitor its return [10]. In 2014, the Estonian government launched the e-residency digital project, due to which every EU citizen residing outside Estonia can open a company in this country. Since every digital transaction is taxed, the government has revenue from it.

Estonia became the first European country to hold electronic parliamentary elections in 2007 ("eGovernment Award" Best Practice Label) [11].

Unemployed citizens can search for vacancies through national and regional employment services remotely. Social benefits and vehicles are made and registered online as well (Estonian Motor Vehicle Registration Centre).

One of the results of electronic business effective provision services was the formation of a startup ecosystem. There is a Startup Estonia platform, which continuously reboots the startup ecosystem. The country has the largest number of "unicorns" per capita in Europe: Pipedrive.com, Zego.com, ID.me, Skype.com, Playtech.com, Wise.com, Bolt. Let's consider the basis, factors, goals of the formation and provision of electronic services in Estonia (Fig. 9.1).

The goals of improving the electronic services provision:
1. Transference of electronic services to private cloud infrastructure with subsequent security testing.
2. Development of business event services with reduction of administrative burden on business.
3. Automatic provision of such services as creation of an enterprise.
4. Creation of a national platform of virtual assistants within the framework of #Bürokratt programs.
5. Creation of a Center of Excellence in Data Management and Open Data.

Basic electronic services for improving business processes:
1. Electronic taxation (eTaxBoard system).
2. Filling of vacancies.
3. Formation of the startup ecosystem.
4. Opening of a company by EU citizens in Estonia (e-residency project).

Disadvantages of providing electronic services affecting business processes:
1. Lag in provision of commercial 5G services.
2. Lack of electronic services cloud infrastructure.
3. Low share of training of ICT workers.

The basis for the electronic services provision:
– individual ID-cards (2002), Mobile-ID;
– X-Road program

Fig. 9.1 – Peculiarities of electronic services provision in Estonia

Source: [10].

Estonia's new digital strategy until 2030 has been adopted. It is based on large-scale goals in the field of digital services, connectivity and cyber security.

The state plans to train an additional 7,000 specialists in the field of ICT, by 2027. To date, Estonia lags behind in the provision of commercial 5G services, but there is a goal to cover large cities by 2023, and to create transport corridors by 2025. 47 % of all actions to support digital transformation in the Strategy will be aimed at further digitalization of public services (budget of 97,43 million euros) [12].

Case 2. The formation of the electronic service provision system in *Sweden* began at the end of the 20th century, when the Swedish government launched the Government eLink project, which consisted in the secure information exchange between government institutions and customers of their services [13].

Later, the State Administration Modernization Strategy was presented. Later, the State Administration Modernization Strategy was presented. Its essence lies in a greater focus on the needs of citizens and defines information and communication technologies as the most important tool for improving public services. At the same time, the "Information Society for All" initiative was adopted, which consisted in strengthening Sweden's position as one of the leading countries in the information society and using the potential of information and communication technologies to stimulate growth, employment, regional development, democracy, fair treatment, quality of life, equality and effective public administration, which was a significant contribution to the development of Sweden's information society [14].

In 2000, the report "Agency 24/7 – Criteria for 24/7 agencies in public administration network" was published and Sweden became the first country in Europe to introduce round-the-clock provision of administrative services.

Among the principles of providing electronic services in Sweden, the following can be distinguished: confidentiality and security of information; ease of use and transparency; providing services 24/7.

Since 2017, the Swedish government has launched a new Digital Strategy, which is still in effect (Fig. 9.2). The strategy established a number of goals: digital literacy, digital security, digital innovations, digital leadership, digital infrastructure.

The goals of improving the electronic services provision:
1. Creation of optimal infrastructure for the digital economy.
2. Creation of a national big data strategy.
3. Increasing incentives for learning for individuals and companies to improve ICT skills.
4. Promotion of digital innovations, in particular the IPv6 protocol.
Increasing digital security.

Basic electronic services for improving business processes:
1. Round-the-clock administrative services provision (24/7 Agency).
2. Promotion of regional development ("Information Society for All" initiative).
3. Discussion of strategies and electronic services development ("Public e-Forum" (VERVA).

Disadvantages of electronic services provision affecting business processes:
1. Insufficient coverage and use of digital technologies by firms.
2. Digital gender gap.
3. Insufficient "reliability" of optical fiber networks.
4. Improving communication in sparsely populated areas.

The basis for the electronic services provision:
1. Government eLink project (late 20th century).
2. State administration modernization strategy.
3. The "Information Society for All" initiative.

Fig. 9.2 – Peculiarities of electronic services provision in Sweden

Source: [14–15].

The coverage and use of digital technologies can be further increased by: promoting ICT courses in education; coordination of retraining activities with social partners; promoting additional investment across sectors and companies; developing complementary skills in a comprehensive digital skills strategy.

The National Cybersecurity Strategy 2017 marks a turning point towards a more holistic approach to digital security in Sweden.

Digitalization actively affects the improvement of business processes in Sweden. For example, Swedish forestry companies today are actively investing in digital technologies to improve production quality management and optimize supply chains. The application of analytics, artificial intelligence and IT process management are becoming strategically important tools affecting sustainable forest exploitation and timber trade.

Case 3. *Singapore* is the founder and chair of the Global Governance Group, an informal bloc of 30 small and medium-sized countries that seeks to strengthen engagement between the G-20 and the rest of the world to support multilateral cooperation and collaboration. The G-20 community is promoting e-government as part of the UN's Sustainable Development Goals: "industry, innovation and infrastructure". In 2017, the leaders of the bloc have committed to reduce the gap in the development of digital infrastructure between countries with more technological resources and low-income countries by 2025, as well as to promote international digitalization standards in accordance with the principles of openness, transparency and consensus.

In the case of Singapore, the government began to promote the computerization of the civil service in the early 1980s. The government's understanding of IT's primary role in modern world led to the creation of strategic program:

1. The program of the state civil service computerization (1981).
2. National plan for information technologies (1986).
3. IT plan 2000 (Intelligent Island) (1991).
4. Creation of a nationwide broadband network for the provision of multimedia interactive services Singapore ONE (One Network for Everyone) – "One Network for Everyone" (1996).
5. "Basic ICT plan 21" (2001).
6. The first national IT-literacy program (2001).

Accelerated construction of advanced information infrastructure has reduced time of services provision and ensured secure virtual access in times of crisis such as the COVID-19 pandemic [16].

In 2007, the government launched the Singapore Government Enterprise Architecture (SGEA) program. The Singapore Government Enterprise Architecture was developed by the Ministry of Finance and the Infocomm

Development Authority (IDA):

– Business Reference Model (BRM);

– Data Reference Model (DRM);

– Technical Reference Model (TRM);

– Solutions Reference Model (SRM).

Singapore's electronic networks are used by enterprise to improve business processes. This is the trade network TradeNet (the process ofdocuments passing takes 3 minutes), marine network – MarineNet, port network – PortNet and the electronic system for judicial documents accounting – Electronic Filling System.

For business entities, the e-Citizen portal provides access to electronic forms of tax and other payments, to the system of electronic public procurement. Here you can register a trademark or a patent, get information about various government programs for business support and development, preferential credit schemes, consulting and training, especially those related to small and medium-sized enterprises. Such a unified approach significantly increases the efficiency of business processes. In the field of trade, the government has already created the legal system and regulatory mechanisms necessary for e-commerce.

Singapore was the first in the world to implement the idea of a government portal [17] – the "Electronic Government" program operates on a single government website *(http://www.egov.gov.sg/)*. The server supports several sections:

– business;

– defense;

– education;

– employment;

– health;

– law and order, etc.

Public e-help centers have been created; e-lifestyle is being formed: e-learning, e-entertainment, e-communication, e-interaction (Fig. 9.3).

The goals of improving the electronic services provision:
1. Knowledge-based work environment, ICT education.
2. Digitization of Malaysian and Philippine immigration services to facilitate entry and exit for their citizens.
3. Technological experiments in the field of electronic services provision.
4. Improving the operational efficiency of computer equipment.
5. Adaptive yet solid IT infrastructure.

Basic electronic services for improving business processes:
1. E-services package (e-Citizen).
2. TradeNet, MarineNet, PortNet electronic systems.
3. E-commerce legal system.
4. Program for business: access to state business grants.
5. "OneMap" application (SG-SPACE).
6. Business access to licenses (OBLS).

Disadvantages of electronic services provision affecting business processes:
1. Necessity of trading e-system constant modernization.
2. Risk of unsuccessful IT experiments.
3. Dependence on government officials' high qualification and e-literacy.

The basis for the electronic services provision:
State program "Singapore's e-government" (2000).
Electronic Government program "e-Citizen".
Single portal for government services provision.
Singapore Government Enterprise Architecture (SGEA).

Fig. 9.3. Peculiarities of electronic services provision in Singapore

Source: [18].

Therefore, the large-scale implementation of the general service technological architecture allowed to improve the electronic services provision according to the following steps (Fig. 9.4):

1. Standardized technologies → 2. Transaction → 3. Transformation → 4. Increasing opportunities and synergies in government

Fig. 9.4 – Steps to implementation of the general service technological architecture of electronic services provision in Singapore

Source: [16].

Since 2015, the government has not developed official strategic plans for the development of eGov, considering there are already built-in stabilizers in the digitalization policy and electronic services provision. At the same time, IDA (Infocomm Development Authority of Singapore) is the senior technology and information assistant of the Singapore government [18].

Case 4. *The United States of America* launched a digital services program in the 1990s. In 2003–2010, according to the Electronic Government Development Index, the country was among the top ten in the world. In 2000–2008, the share of US government websites providing electronic services increased from 22 % to 89 %. At the same time, Internet penetration doubled.

In the USA, the E-government Act was signed in 2002, the Open Government Directive was signed in 2009, and the initiative "Creating electronic government of the 21st century" was introduced in 2012. Digital services were planned to be improved by using data more efficiently, so the US Digital Service (USDS) was formed. In 2021, a second decree was signed to improve service to electronic services users – "Improving Federal Customer Service and Service Delivery to Restore Trust in Government" [19].

The US is a federal democracy, so digital transformation is happening simultaneously at the federal, local and state levels. The US are innovating with respect to specific digital services. There is an extensive system of agencies and institutions that facilitate electronic services provision. In the USA, the following institutions are engaged in the creation and provision of electronic services:

– US Digital Service (USDS);

– Technology transformation service;

– 18F;

– Presidential Innovation Society;

– Centers of excellence in IT modernization;

– Office of scientific and technical policy.

It is advisable to delegate most of the functions to a centralized body to define a digital transformation strategy that would contribute to a more effective restructuring of business processes (Fig. 9.5).

The goals of improving the electronic services provision:
1. Avoiding duplication of interagency digital transformation efforts.
2. Coordination of digital operations.
3. IT system modernization.
4. Improving of electronic services provision.
5. Increasing user's of electronic services trust in the government.
6. Introduction of a personal ID at the federal level.

Basic electronic services for improving business processes:
1. Confidence in state institutions (DATA.GOV).
2. Fair and available services.
3. User-centric government.
4. Single sign-on service in USA (SSO, LOGIN.GOV).
5. E-commerce support.

Disadvantages of electronic services provision affecting business processes:
1. Privacy and security.
2. Digital divide in rural areas.
3. Duration of receiving electronic service.
4. Duplication of functions by numerous institutions is possible.

The basis for the electronic services provision:
1. «Improving Federal Customer Service and Service Delivery to Restore Trust in Government» decree, the US Digital Service is formed (USDS).
2. The USDS #Procuremenati service is designed to help acquire electronic services in various sectors of the economy.

Fig. 9.5 – Peculiarities of electronic services provision in the USA

Source: [20].

During the vaccination fixation period of citizens against COVID-19, the United States did not introduce digital IDs at the federal level. At the same time, the leadership of the United States became more active. 30 states plan to introduce digital driver's licenses, and 6 states are already offering them.

The modernization of electronic services provision in the USA is aimed mainly at migration policy, social services and e-commerce between government organizations and ministries.

The main difference of modern economy models and the traditional (industrial) ones is the mechanism of interaction between subjects of economic activity. Its formation was preceded by the process of technological business processes transformation, both within companies and between them. Digital technologies were designed to reduce production costs. Nowadays, this opportunity is increasing in the conditions of well-coordinated mechanism for electronic services provision and digital automation of production.

Taking into account the experience of other countries on the way to digitization will help Ukraine to avoid typical mistakes and use the most successful cases in its own practice. State authorities and enterprises need established two-way communication, obtaining the necessary information, conducting consultations on the e-services provision for the effective restructuring of business processes.

Questions for self-control:

1. Describe Estonia's case study on the introduction of e-services and features of digital business process development.
2. Define the peculiarities of electronic services provision in Estonia.
3. Describe the electronic service provision system in Sweden.
4. What are the peculiarities of electronic services provision in Sweden?
5. Characterize Singapore's case study on the introduction of e-services and features of digital business process development.
6. What are the peculiarities of electronic services provision in Singapore?
7. What are the steps to implementation of the general service technological architecture of electronic services provision in Singapore?
8. Describe the peculiarities of electronic services provided in the USA.

9.3. Applied aspects of e-services in Ukraine

A key condition for building a digital society and a digital economy for the development of state, business and citizen communications online is the legislative regulation of such processes. Today Ukrainian regulatory legal issues regarding the digital format of the participants activities in economic relations are defined in a number of such legislative acts as: Commercial, Civil, Tax Codes of Ukraine; laws of Ukraine: "On Information", "About the National Program of Informatization", "On Telecommunications", "On Electronic Documents and Electronic Document Circulation", "On State Registration of Legal Entities, Natural persons – Enterprises and Public Organizations", "On Access to Public Information", "On the protection of personal data", "On the permit system in the field of business activity", "On electronic commerce", "On public procurement", "On administrative services", "On the protection of information in information and telecommunication systems". Special attention should be paid to the Laws of Ukraine adopted during 2021–2022: "On electronic confidential services", "On stimulating the development of the digital economy in Ukraine", "On public electronic registers". The above-mentioned standards regulate and standardize the financial and economic activities of business entities and their cooperation with public authorities in a digital format.

The main body in the system of central executive bodies that ensures the formation and implementation of digital transformations state policy in Ukraine is the Ministry of Digital Transformation of Ukraine, which was created in September 2019. The Ministry ensures the formation and implementation of state policy: in the fields of digitization, digital development, digital economy, digital innovations, e-government and e-democracy, information society development, informatization; in the field of citizens' digital skills and digital rights development; in the fields of open data, development of national electronic information resources and interoperability, development of infrastructure for broadband access to the Internet and telecommunications, e-commerce and business; in the field of providing electronic and administrative services; in the fields of electronic trust services and electronic identification; in the field of the IT industry development, in the field of development and functioning of Diia City legal regime. The Ministry of Digital Transformation is actively developing projects related to the digitalization of the economy and society in general, it is engaged in the automation of processes for the administrative services provision, and is creating a comprehensive system of electronic services in Ukraine – "A State in a Smartphone".

Recently, there have been many positive changes regarding the introduction of electronic services in Ukraine: various web portals and online services for the digital services provision have been created; the network of Centers for Administrative service (CASs) is developing, the list of digital services is continuously expanding, the number of web services is growing, etc.

In 2020, the Unified state web portal of electronic services was implemented – "Government services online" (https://diia.gov.ua) (Fig. 9.4), which concentrates public services that were previously placed on various portals of government bodies.

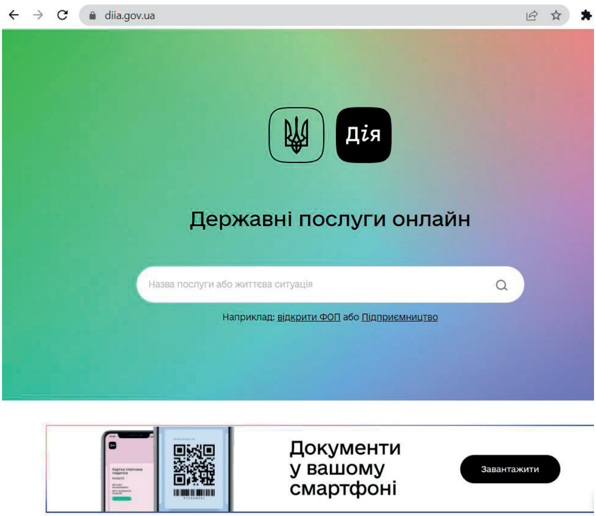


Fig. 9.4 – "Government Services Online" platform

The introduction of this project was implemented in order to ensure the rights of citizens and businesses to access digital services, information about electronic and administrative services; obtaining information from national electronic information resources, that is necessary for providing services; appeal to public state authorities of Ukraine. The Unified state web portal of electronic services was put into exploitation by the Ministry of Digital Transformation of Ukraine without state budget funding. The Diia portal was created with the support of the USAID/UK aid project "Transparency and Accountability in Public Administration and Services / TAPAS" and the EGAP Program, which are financed by the Swiss Agency for Development and Cooperation; the USAID project "VzayemoDiia!" (SACCI) and the EGOV4UKRAINE project.

The Unified state web portal of electronic services «Diia Portal».

The "Government Services Online" portal presents services in certain areas for two categories:

1) citizens (references and extracts, transport, environment; land, construction, real estate; security and public order; licenses and permits; family; health; entrepreneurship; pensions, benefits and assistance);

2) business (land, construction, real estate; medicine and pharmaceuticals; licenses and permits; extracts and certificates; transport; business creation; Diia.City).

The full list of available electronic services can be found at *https://diia.gov.ua/services* and in Appendix B. Among the most popular public services are those related to cars, obtaining passports, pension provision, private entrepreneurship, taxation and obtaining information from public registers.

The list of services on the Diia platform is constantly growing, and existing services are being improved. In 2021, the Ministry of Digital Transformation introduced new services, such as: signing a document using an electronic signature, launching Covid-certificates, assigning and recalculating pensions, applying for subsidies. One of the main goals of the Ministry is to digitize 100 % of public services by 2024.

Communications of digital relations subjects (state authorities, local self-government bodies; legal entities and natural persons – entrepreneurs; citizens) begin with electronic identification. The Diia platform operates an integrated electronic identification system ID.GOV.UA *(https://id.gov.ua)* for e-identification and user authentication using electronic signatures, Diia.Signature and BankID of the NBU. According to Ukrainian legislation, an electronic signature has the same legal force as a document signed personally. An electronic signature can be obtained through accredited key certification centers. The list of qualified providers of electronic trust services is posted on https://czo.gov.ua/ca-registry.

The relevant normative acts of Ukraine establish the right of citizens to use digital documents, which have the same legal force as plastic ones. The following digital documents are available in the mobile application:

– Ukrainian identity card;

– biometric foreign passport;

– taxpayer ID number (identification code);

– driver's license;

– vehicle registration certificate;

– vehicle insurance policy;

– birth certificate of the child;

– student card;

– Certificate of displaced person (IDP's certificate).

The following projects are implemented on the Diia platform:

1**. Diia. Digital education** *(https://osvita.diia.gov.ua/)* – a national digital literacy online platform that hosts over 80 educational series. Educational series on digital literacy developed by the EdEra online education studio with the support of the following companies: Google Ukraine, Microsoft Ukraine, DTEK Academy, UNDP Ukraine's Accelerator Lab, CISCO, CFC Consulting, Osvitoria, Global Teacher Prize. The project was implemented with the support of the Swiss-Ukrainian EGAP Program, financed by the Swiss Agency for Development and Cooperation and implemented by the Eastern Europe Foundation and the

Innovabridge Foundation.

The courses were developed taking into account European standards for teaching and assessing digital competence for such categories as: active citizens, civil servants, businesses and startups, entrepreneurs, schoolchildren, medical workers, military personnel, coaches, parents, beginners, etc. From September 1, 2022, all courses on Diia.Digital education provide for the accrual of 0,1–0,2 ECTS credits as part of self-education.

2**. Diia.Center** *(https://center.diia.gov.ua/)* – public service platform where:

1) citizens can receive administrative services; consultations on the organization and conduct of business, digital services; maps of Diia.Centers and information about Administrative Services Centres (ASC);

2) employees of the center (ASC) have access to the distance learning module, the library of materials and templates and sample documents.

3. **Diia.Business** *(https://business.diia.gov.ua/)* – an online platform for entrepreneurs, which contains information about starting your own business and its development. The business development and export project Diia.Business, which is a sub-brand of the Diia ecosystem, was launched by the Ministry of Digital Transformation of Ukraine in cooperation with the office for entrepreneurship and export development in 2020. Business representatives have access to: a guide for an entrepreneur, 150+ business ideas, templates of necessary legal documents for starting a business, services and support programs for business, cases of Ukrainian entrepreneurs, current news, free online and offline consultations, National online school for entrepreneurs, online exhibitions, the Diia.Business virtual center, the Diia.Business export direction, a marketplace of financial opportunities for business, an analysis of Ukrainian business' state, a platform for attracting impact investing and other initiatives.

4. **Diia City** *(https://city.diia.gov.ua)* – IT hub with a special legal and tax space for Ukrainian IT companies, where comfortable tax conditions have been created:

1) low tax rates: labor taxes: personal income tax (PIT) – 5 % (as standard in Ukraine, the rate is on the income of natural persons – 18 %), military tax – 1,5 %, unified social tax (UST) – 22 % with the minimum wage; tax on withdrawn capital: 10 % while withdrawing dividend (instead of income tax);

2) to stimulate investment: an alternative model of employment, a new form of cooperation using the GIG contract.

5. **E-Entrepreneur** – a comprehensive electronic public service, which is posted on the Diia portal with the aim of simplifying the conditions of registration and conducting business activities. Phased implementation of this experimental project is planned for 2021–2022. Through the "e-Entrepreneur" system, the following services will be provided:

– state registration of business entities of various forms of ownership;

– registration of a single tax payer, value added tax;

– issue of licenses for: the right to wholesale alcohol trade, retail trade of tobacco, fuel storage, retail trade of liquids used in electronic cigarettes;

– registration of settlement operations registrar and settlement operations software registrar, state registration of food market operators' capacities;

– registration of the declaration of the material and technical base conformity with the requirements of the legislation on labor protection;

– issuing a permit for the beginning of high-risk works and the beginning of operation (use) of machines, mechanisms, and high-risk equipment;

– opening a bank account [21].

6. **Diia. Open data** *(https://diia.data.gov.ua)* – the portal is designed to provide access to public information in the form of open data and provides access to authorities information with the possibility of its subsequent use.

Open data help to improve state services and create new digital services, monitor the work of public authorities. These data are very valuable and much of it should be available and open to businesses, startups, government officials, journalists, the public. The leader of data disclosure among state bodies is the

State Tax Service, the Antimonopoly Committee, the State Customs Service, the Office of the Prosecutor General, the Ministry of Education and Science.

In recent years, positive changes in the Ukrainian society, economy and its spheres are confirmed by the rise of Ukraine in the world rankings regarding its digital development. Leading international institutions and organizations are engaged in researching digitalization problems on a global scale: United Nations, World Bank, World Economic Forum, European Union and others.

Since 2014, the European Commission has been publishing materials on assessing progress in achieving the goals of the digital economy in the European Union and monitoring the state of digital development in individual member states, using the results of Eurostat surveys. Every year, the European Commission analyzes 34 indicators from 5 main categories (communication; human capital; use of Internet services; digital technologies integration; digital public services) and publishes a report on the progress of digital transformation in the EU, based on them. I-DESI (International Digital Economy and Society Index) was developed for comparison with countries outside the European Union.

Ukraine is not a member of the EU so its DESI index is not officially determined, also one of the reasons is the lack of relevant information (reporting), which, for its part, does not allow assessing digitalization level of the country and the possibilities of its development and competitiveness.

To assess the development of digital services, we will analyze the level of e-government development using two key indices: The UN Global E-Government Development Index (EGDI) and E-Participation Index (EPI). The E-Government Development Index is calculated by the UN Department of Economic and Social Affairs once every two years and is formed taking into account three indices: Online Service Index (OSI), Telecommunication Infrastructure Index (TII) and Human Capital Index (HCI).

According to UN 2020 data, Ukraine took 69th place in the ranking of countries with the most developed e-government, which is 13 positions higher than in 2018. According to the data of E-Government Survey 2020, Ukraine has entered the group of countries with a high level of e-government development and became one of the 12 countries that moved to a very high level according to the E-Participation Index. The indicator of E-Government Development Index 2020 is 0,7119 [22, p. 11]. The leaders of this rating are Denmark, Korea, and Estonia (Table 9.4).

Table 9.4 **– E-Government Development Index (2014–2020)**

Country	**2020**		**2018**		**2016**		**2014**	
	Place in the rating	E-Government Development Index	Place in the rating	E-Government Development Index	Place in the rating	E-Government Development Index	Place in the rating	E-Government Development Index
Denmark	1	0,9758	1	0,9150	9	0.8510	16	0,8162
Korea	2	0,956	3	0,9010	3	0,8915	1	0,9462
Estonia	3	0,9473	16	0,8486	13	0,8334	15	0,8180
Finland	4	0,9452	6	0,8815	5	0,8817	10	0,8449
Australia	5	0,9432	2	0,9053	2	0,9143	2	0,9103
Sweden	6	0,9365	5	0,8882	6	0.8704	14	0,8225
Great Britain	7	0,9358	4	0,8999	1	0,9193	8	0,8695
New Zealand	8	0,9339	8	0,8806	8	0,8653	9	0,8644
…								
Lithuania	20	0,8665	40	0,7534	23	0,7747	29	0,7271
Kazakhstan	29	0,8375	39	0,7597	33	0,7283	28	0,7283
Russia	36	0,8244	32	0,7969	35	0,7215	27	0,7296
Belarus	40	0,8084	38	0,7641	49	0,6625	55	0,6053
….								
Ukraine	69	0,7119	82	0,6165	62	0,6076	87	0,5032
….								
Somalia	191	0,1293	193	0,0566	193	0,0270	193	0,0139

Source: [23].

Estonia deserves special attention, since in recent years, according to the UN, it has been among the twenty world leaders in terms of EGDI, and according to the 2020 indicator, it is in the top three of the e-Government Development Index rating.

A certain lagging behind the world leaders of countries with developing economic systems indicates the need for measures of effective institutional support by the state regarding the development of this direction.

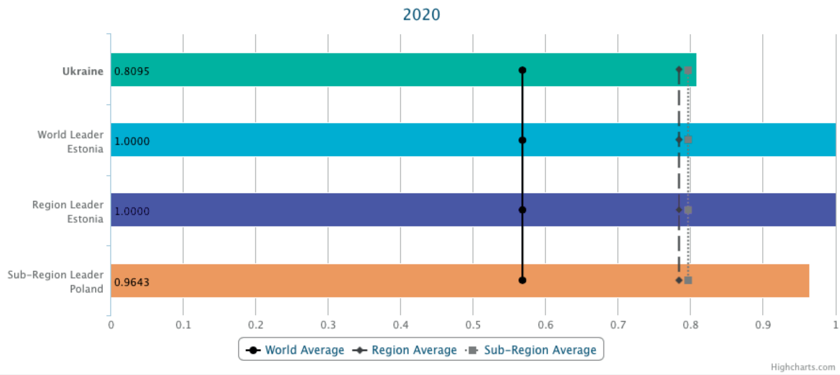
The key indicator for measuring e-government is E-Participation Index (EPI), which is evaluated by analyzing the level of national e-government portals (government platforms) development regarding information interaction with citizens. The UN E-Participation Rating measures e-Participation by indicators:

1) the use of interactive services for providing information by governments to citizens;

2) interaction and consultations with citizens;

3) citizen participation.

In the 2020 UN E-Participation rating, Ukraine took 46th place among 193 countries of the world, rising 29 positions compared to 2018. The leaders of this rating are Estonia, South Korea, the USA, Japan and New Zealand (Fig. 9.5).



E-Participation Index	2020	2018	2016	2014	2012	2010	2008	2005	2004	2003
Ukraine (Rank)	46	75	32	77	83	48	14	28	24	24
Ukraine (Value)	0.80950	0.68540	0.74576	0.43137	0.15790	0.25714	0.56818	0.36507	0.34426	0.39660

Fig. 9.5 – E-Participation Index of Ukrainian citizens [24]

In recent years, digital tools for the interaction of citizens and businesses with public authorities have been successfully implemented in Ukraine. Citizens and business representatives gained access to such services: e-appeal; e-consultations; e-petitions to the Verkhovna Rada of Ukraine, the President of Ukraine and to the Cabinet of Ministers of Ukraine, central and local executive bodies and local self-government bodies; e-contests of projects and programs of civil society institutions, e-elections of public councils members under executive authorities, e-registration of an entrepreneur, e-payment of taxes, e-licenses.

In 2020, Ukraine for the first time participated in the Open Data Maturity Report 2020 – European open data rating, and it took 17th place among European countries in the open data maturity rating. In the Open Data Maturity 2021 rating, Ukraine rose to 6th place, the level of open data maturity was 94 % (Fig. 9.6).

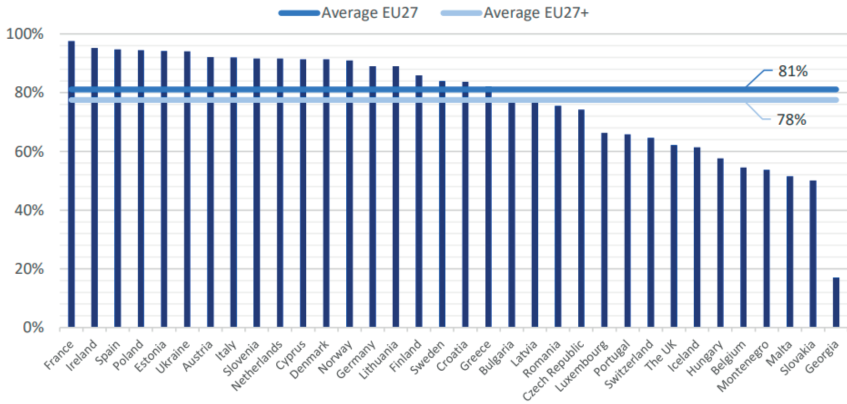


Fig. 9.6 – Overall Open Data Maturity Indicators 2021 [25, p. 5]

Fig. 9.6 illustrates the overall open data maturity indicators for all 34 European participating countries in 2021. It is obvious that Ukraine occupies a much higher position in the rating than the 21 EU countries. France has the best indicator among countries (97,5 %), it has been leading in this rating for recent years. The top five include Ireland, Spain, Poland, and Estonia (Table 9.5, Fig. 9.7).

Table 9.5 **– Open Data Maturity Development Indicator in Ukraine 2020–2021**

Open Data Maturity Development Indicator, %				
	Ukraine		The average indicator of the European Union countries	
	2020	2021	2020	2021
Overall, including:	84	94 (+10)	78	81 (+3)
Open Data policy	85	98 (+13)	85	87 (+2)
Web-portal of Open Data	88	94 (+6)	79	83 (+4)
Open Data impact	85	95 (+10)	72	77 (+5)
Open Data quality	78	89 (+11)	76	77 (+1)

Such positive dynamics are present in all points of Open Data Maturity Development assessment, where Ukraine will demonstrate a trend towards stable positive dynamics and one of the highest growth rates in Europe.

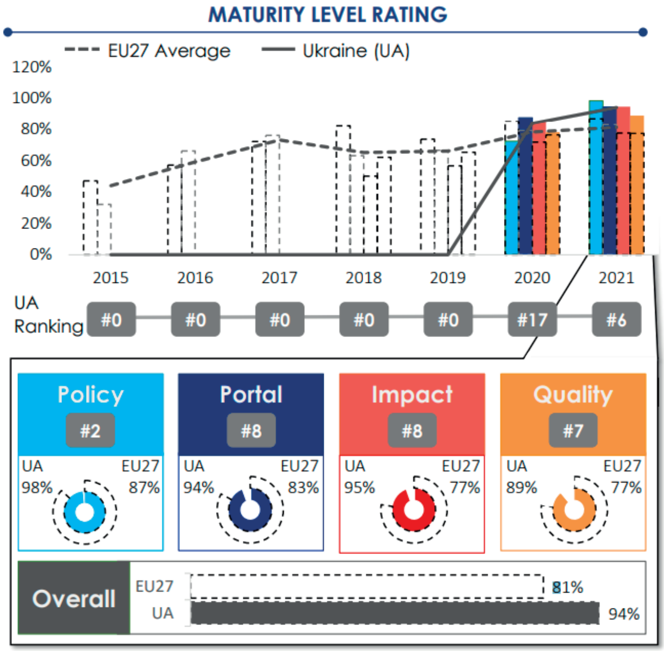


Fig. 9.7 – Open Data State of Ukraine 2021 [26]

According to all indicators, Ukraine had demonstrated higher results than the average one in Europe. The presence of Ukraine's positive dynamics in the above-mentioned world rankings in recent years reflects the gradual digitalization of society and the country's economy.

Questions for self-control:

1. Describe the areas and categories of the "Government Services Online" portal («Diia Portal»).
2. What digital documents are available in the Diia mobile application?

3. Characterize the projects, which are implemented on the Diia platform. Define their features.
4. Analyze Ukraine's position in the E-Government Development Index Ranking (2014–2020).
5. Analyze Ukraine's position in the E-Participation Index Ranking.
6. Which are Ukraine's positions in the Open Data Maturity ratings 2021–2022? Describe and analyze the indicators.

9.4. Transformation of business processes in digital economy

The digital approach is a new business philosophy that involves the presence and constant development of feedback between the entities of business relations regarding the development of economy, which is driven by innovative technologies. Paradoxically, however, digitalization does not consist in the total implementation of IT technologies, but in the deep transformation of business strategy. This is a complete renewal of the current business model, and therefore a rethinking of the mission of the activity, processes, tools and means.

In digital economy, competition is increasingly becoming a competition not of resources, but of strategies, when organizations' investments are more and more often focused on building core competencies and securing their dynamic capabilities. Innovative potential, the ability to form more effective strategies and constantly develop organizations, updating their structure and key business processes in response to the challenges of the external environment, play even greater role.

Business can choose any direction of development, guided by the mission and available tools for influencing processes. However, it is digital transformation that has the greatest potential. It is a new prototype of the reconstruction of society and economy, which is realized by implementing a flexible modular complex of models and tools that are fully available for adaptation in traditional business models (Fig. 9.8).

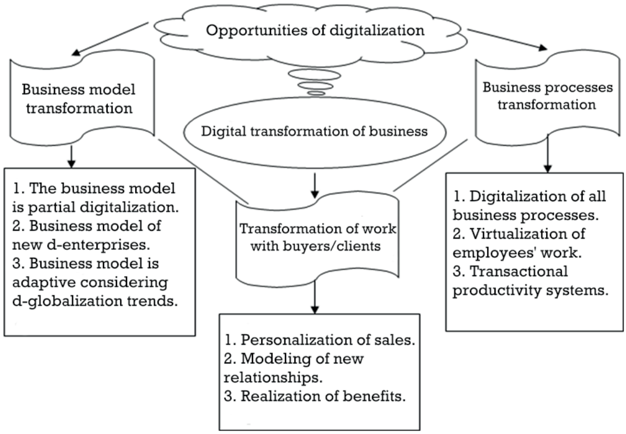


Fig. 9.8 – Model of digital business transformation

Source: [27, p. 146–148].

It is obvious that business digitalization process covers three main directions:

1) transformation of business models;

2) transformation of relations with buyers and/or clients;

3) transformation of business processes.

Let us consider the essence of mentioned directions.

Business model is a broad term used to describe the method (positions in the value chain, customer choice, products, pricing) of doing business [28]. A revenue generation model describes the process by which a business makes money and defines exactly how the firm is going to price its products and services.

Today, when defining the essence of the "business model" concept, 2 approaches are distinguished:

1) business process/role-oriented (an approach aimed at inside the enterprise);

2) value/customer-oriented (an approach aimed at the external environment of the enterprise).

The first approach is related to the consideration of the enterprise's activities from the point of view of business processes and technologies (the focus of attention is directed inside the company). The second approach, on the contrary, involves focusing on the value that an enterprise creates for external customers, as well as on the results of activities. In fact, the business model allows you to get an answer to the question: what and how should be done to achieve the desired result.

The key business model elements of any enterprise that determine its content are:

– the value for external customers that an enterprise offers based on its products and services;

– the system for creating that value, including suppliers and target customers, as well as value chains;

– assets that an enterprise uses to create value;

– the financial model of the enterprise, which determines both the structure of its costs and the methods of profit-making.

The business model turns innovations into economic value for the business (Fig. 9.9). It describes in detail how a company makes money by clearly defining its place in the value chain. A business model is built of various business components, which include entrepreneurship, strategy, economics, finance, operations, competitive strategies, marketing and sustainable growth strategies.

Fig. 9.9 – The sequence of value creation by business model [29]

The business model structure can be presented in the form of three main components:

– functional model – business processes and events that initiate these business processes, output results;

– organizational model – organizational structure of the enterprise and the roles that departments perform in the enterprise's management system;

– information model – a scheme of information flows in the control loop, built on the basis of a functional model.

The business model is necessary to form a holistic view of the following essential characteristics of the enterprise: what value and in what way is it created for the consumer; to whom and how it is provided; how resources and capabilities are used to create sustainable competitive advantage and make profit.

Comparison of business models in the conditions of classical and digital economy are presented in Table 9.6.

***Table 9.6* – Comparison of business models in the conditions of classical and digital economy**

Criteria	*Classic business model*	*Digital business model*
Strategic planning and data analysis	Finding and analysing trends	Identifying trends based on Big Data and machine learning
Production	Manufacturing products	Production optimization in accordance with customer requests
Storage	Storage of finished products	Optimizing remains in real time
Transport and logistics	Planning, delivery and control for efficient logistics	Real-time delivery control and process forecasting
Sale	Distribution of products through sales points	Direct sales to consumers

Source: [28; 30].

The introduction of digital technologies led to the formation and development of such business models categories as:

– digital platforms that provide direct interaction of participants;

– service business models based on the use of resources instead of owning them (including Software-as-a-Service (SaaS), Infrastructure-as-a-Service (IaaS), etc.);

– business models whose pricing is based on the achievement of results (outcome based models) and effect for the client, including those on the basis of complex products and services consumption;

– crowdsourcing models based on the involvement of external resources for the implementation of business processes;

– business models based on the monetization of clients' personal data, when free services to users sell their data at other consumer segments.

Digital transformation consists in the use of modern (disruptive) technologies to increase enterprise's productivity and value in today's conditions. The main results of such transformation can be: cost reduction, improvement of services and products quality, as well as increase productivity. KPMG research shows that in 61 % of companies, digital technologies have contributed to growth of competition in their business from new employees.

The second direction of digitalization impact on business is the *transformation of relations with buyers and/or clients*.

The most important reason why people buy a certain product is not the quality or price, but rather the feeling they get after the purchase. Due to Customer Relationship Management (CRM), companies work methodically to exceed their customers' expectations, meet their needs, and delight them. It is digitalization that significantly helps to solve this task due to:

1. A deeper understanding of clients – is realized due to the company's use of social networks in order to study client's requirements and preferences, promoting the brand, providing support to clients during the purchase and use of products, etc.

2. Revenue growth from the company's existing clients – statistical data on the purchases of its own customers are used for organization of personalized sales and full customer service, development of individual packages of proposals.

3. The search for new touchpoints with clients is implemented by creating opportunities for own customers for self-service with the help of digital technologies, or multi-channel ways of access to customers.

4. Building a successful client experience – effective implementation of the initiative turns into customer satisfaction and loyalty.

5. The possibility to use customer data to further improve their experience, satisfy their preferences, understand pain points and obtain a complete customer profile.

6. Fast, effective response and resolution of customer issues in real time.

7. Much of the digital transformation power lies in its ability to enhance level of interaction with customers. For example, promptness in responding and fulfilling customer requests increases their engagement. Moreover, digitalization allows customers to access functions, make transactions and initiate communication anytime and anywhere, which increases the convenience and speed of request execution.

8. Providing a higher level of customer service, increasing opportunities to build relationships with each customer.

An important component of digital transformation of enterprises is *digitalization of their business processes*. It should be noted that under this term, domestic scientists consider both the automation of basic and auxiliary (supporting) business processes, as well as management processes, which are carried out in order to optimize and ensure the efficiency of the enterprise and industry activity in general [30, p. 20].

According to the results of research conducted by Ernst & Young, digitalization has the greatest impact on such components of business processes as: interaction with customers, value proposition and internal infrastructure management [31].

Business processes digitalization of enterprises through the introduction of digital technologies contributes to the formation of more perfect business processes, which in turn leads to the improvement of their efficiency, flexibility, adaptability to external environment changes and formation of competitive advantages. Business processes digitalization of enterprises involves consistent implementation of several stages:

– collection of complete information about each business process, its modelling and identification;

– identification of places of origin, further processing and consumption of information;

– information business processes modelling;

– information system modification considering the digitalization model; automated information system creation (due to the use of hardware and software);

– all business processes controlling (fixation of individual business processes parameters in the information system, drawing up plans, creating reports, etc.).

It should be noted that the methodology of business processes digitalization of enterprise is based on the supporting concepts of information systems, which in their development evolved as follows: MRP I (Material Requirements Planning) – MRP II (Manufacturing Resource Planning) – Enterprise ERP systems (Enterprise Requirements Planning) – CSRP (Customer Synchronized Resource Planning). Modern ERP system is a complex of interdependent modules (appendices) that ensure the operation of a single integrated information environment due to the automation of all business processes of the enterprise. Currently, such a domestic software product as the ERP system of IT-Enterprise corporation “Information Technologies” is becoming common among enterprises in Ukraine. This system has complex “Industry 4.0” implementation projects at industrial (metallurgy, machine-building, food, chemical, cable) and agricultural enterprises, including the introduction of production management systems, controlling, logistics, budgeting, etc.

All IT-Enterprise system modules are conventionally grouped into management circuits of such components as: production and technical re-equipment of production; implementation of projects; basic production means; business processes; document flow; personnel; logistics; budgeting and controlling. Business processes digitalization of the enterprise includes a number of elements, a brief characteristics of the main ones is given in Table 9.7.

Table 9.7 – **Characteristics of the components of business processes digitalization of the enterprise**

№ p/p	Component	Brief characteristics
1.	Realization	Ensuring the successful realization of the company's strategy requires thorough market and competitors analysis.
2.	Result	The conclusion of this stage will be an informed decision on whether to move to digital transformation or not.
3.	Analysis	A thorough analysis of what enterprises can do better with existing business processes and which business processes require immediate implementation of the latest technologies should be conducted.
4.	Recognition	Enterprises need to identify changes they can introduce to business processes to improve them. For this, it is necessary to perform many actions, in particular, the following: study current business processes; involve key stakeholders; study the latest innovative technologies; choose technologies and technical products that can be implemented in the activity of the enterprise; view and improve products, service offerings and even business models.
5.	Prioritization	Enterprises must first rethink detected changes, analyse expenses and benefits, assess possibilities, resources, budgets, etc., and then prioritize based on this.
6.	Implementation	Implementation of changes. Includes obtaining the necessary budgets, identifying responsible groups, redesigning of processes and implementation using identified technologies and technical products.
7.	Deployment	It consists in making the new system available for use. Includes developing a clear deployment plan with clearly defined functions, responsibilities and timelines.

Source: [32].

Business processes digitalization (English: digital work) involves the use of digital tools when carrying out business organization activities, and not only the digitalization of data array. First of all, there is a need for preliminary assessment of the existing information system of the enterprise, to determine the procedures and processes that need to be automated or digitized. It is also equally important to determine the interaction between business processes at the level of their implementation and consider the hierarchical structure of business processes of economic entities.

Improved business processes, in turn, change priorities in the distribution of enterprise resources. The main functional areas of the enterprise, including marketing, finance, production and personnel, are determined by the available information systems capabilities that ensure the implementation of production and organizational activities. The decision-making process is mainly focused on the use of an integrated information base, which is formed at lower management levels, and on data flows from structures external to the enterprise, obtained with the help of new telecommunication means and services based on them. Information technologies implementation in the organization of business processes is based on electronic document flow and the transformation of information resources (data) into a means of achieving commercial goals.

The goal of digital transformation is to create the right foundation for digital business. This means creating an organization that can continue to evolve as needed to keep up with changes in technology and customer expectations. Digital strategy must be transparent enough to help the company survive the changes in the digital economy, so that it continues to deliver digital advantage to the business [33].

Therefore, business processes digitalization is aimed at optimizing the existing resource potential, working time expenditure and improving the efficiency of economic activity.

Questions for self-control:

1. What are the features of competition in conditions of digital transformations?
2. What is the digital transformation of business? Outline its main directions.
3. What is the essence of the business model?
4. What new types of business models have appeared in conditions of digitalization?
5. What are the features of the business model in digital economy?
6. Explain how digitalization affects the transformation of relations with buyers and/or clients.

7. What advantages do buyers and clients receive during digitalization implementation?
8. Describe the components of business processes digitalization of the enterprise.
9. What are the consequences of business processes digitalization for the enterprise?
10. Outline the stages of business processes digitalization.

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UDC 004.330.1

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Chapter 10

USE OF MULTIMEDIA METHODS TO VISUALIZE DATA ON THE EDUCATIONAL NEEDS OF THE PEOPLE WITH SPECIAL EDUCATIONAL NEEDS

Content

10.1. Use of “Theory of multiple intelligences” in the inclusive education

Universal Design of Education is design of the objects, environment, educational programs and services, which ensures their maximum suitability for use by all persons without the necessary adaptation or special design [4].

Structure of the universal design [1]:

– using the various methods for presenting information, easy perception and understanding of information,

– providing students with the alternative ways to act and demonstrate what they know,

– using interests of the students, offering a choice of the educational content and ways to motivate them, offering the different levels of complexity.

The main goal of the *universal design* in education is to remove barriers for gaining and acquisition of the knowledge. All barriers can be united into three groups: physical – lack of ramps, unequipped toilets, and high thresholds, etc.; informational – lack of subtitles or sign language translator, small print, etc.; mental – our prejudices and attitudes.

"Theory of Multiple Intelligences" (by Howard Gardner) contradicts the generally accepted definition of the intelligence by the standardized IQ tests. His approach is based on the individual approach to each person with the establishment of the intellectual capabilities based on his/her type of intelligence. That is why the use of "Theory of Multiple Intelligences" is becoming relevant today in building the effective inclusive design in education.

Intelligence is the ability to process information due to the biological and psychological factors, which can be activated in the certain cultural environment for solving problems or creating products (H. Gardner) [3].

Types of intelligence (or centers of competence) of the author of "Theory of Multiple Intelligences" are graphically shown in Fig. 10.1.

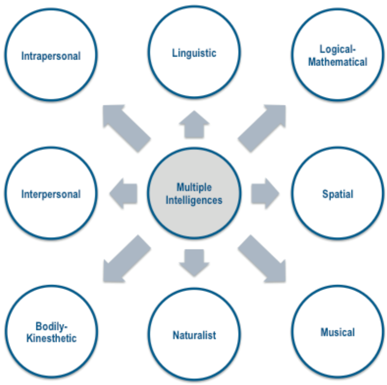

Fig. 10.1 – Types of intelligence by H. Gardner [3]

H. Gardner gives the following definitions to each of these types of the intelligences:

– *visual-spatial* – the ability to accurately perceive the visual-spatial world and change the previous images or manipulate them;

– *kinesthetic* – the ability to control the movements of one's own body and skillfully operate with the physical objects;

– *musical* – the ability to create and perceive the rhythm, pitch and timbre, as well as distinguish the forms of musical expression;

– *interpersonal* – the ability to recognize the moods, temperaments, motivations and intentions of others and respond appropriately to them;

– *intrapersonal* – the knowledge of one's own feelings, strengths and weaknesses, intentions and the ability to be guided by this knowledge to determine the own behavior;

– *logical-mathematical* – the ability to distinguish between the logical or numerical models and to understand and build the long chains of inferences;

– *verbal-linguistic* – sensitivity to the sounds, rhythms and meanings of the words; the ability to recognize different functions of language;

– *naturalistic (natural)* – the ability to distinguish between the plants, animals, stones and other phenomena of the world [3].

A person learns through what he/she feels, hears, smells, does, sees, tastes. Based on the capabilities and characteristics of each person, it is also necessary to choose the individual learning style.

Dominant learning styles [3]:

1. Kinesthetic-tactile (haptic) – it is used by people who learn better when they move, are engaged in the practical activities, explore new things, experiment, i.e. learn by touch.

2. Visual (optic) – it is used by people who learn better through drawings, diagrams, charts related to the topic of study; a smaller percentage of them prefer the printed text (i.e. learn through reading).

3. Auditory (acoustic) – it is used by people who learn better, perceiving information by ear, through conversation, lecture, often with background music.

Janet Voss proposes to use the following technique of determining a person's learning style [3].

1. According to the eye movement:

– *Visual style* – a student, grasping information, sits quietly and looks ahead, or periodically raises his/her eyes. Usually such children speak quickly;

– *Audial style* – a student, grasping information, leads the eyes in the horizontal plane (one who has an active right hand – to the left, and one who has an active left hand – to the right). Periodically, these children look down. These children speak rhythmically;

– *Kinesthetic style* – a mobile student, by grasping information, looks right and down, speaks slowly. When such a student asks questions, his/her glance slides up.

2. According to the body language:

– *Visual style* – a student sits straight and watches the person who communicates information.

– *Audial style* – a student sometimes whispers the words spoken by the teacher, nods his/her head, his/her glance is distant.

– *Kinesthetic style (tactile)* – perceiving information, a student sits freely at the desk. Listening, he/she can play with a pen, move objects on the desk, and twist a small object in the hands.

Questions for self-control:

1. Why do we use the universal design?
2. Define the "Theory of Multiple Intelligence"
3. Describe the main learning styles.

10.2. Digitalization as a part of the inclusive education

Digital Economy is the economy based on the digital computer technologies. The digital economy is sometimes called the Internet economy, new economy, or web economy. Increasingly frequently, the "digital economy" is infused with the traditional economy, making the clear demarcation more difficult. The digital economy is understood as the production, sales and supply of the products through the computer networks [7].

Digitalization of the economy leads to the effective results for business and population:

1. There are the following results for business:

– simplification of the basic business processes (calculations, logistics, reporting, etc.);

– reduction of the load on the specialists (replacement of the mechanical functions of a specialist by the machine work, elimination of the professional skills in the direction of creativity and development);

– reduction of the operating costs;

– promotion of the goods/services through the Internet platforms (expansion of the market outlets).

2. There are the following results for the population:

– improving the quality and availability of the public services;

– simplification of the everyday household tasks (payment for utilities and other services, purchase of the goods on-line, etc.);

– expanding access to the services (medical, legal, consulting, etc.);

– improving the quality of education.

Digitalization in the education, and especially in the inclusive education, is becoming a separate part. The effectiveness of the educational strategy can be assessed by the following algorithm (Fig. 10.2).

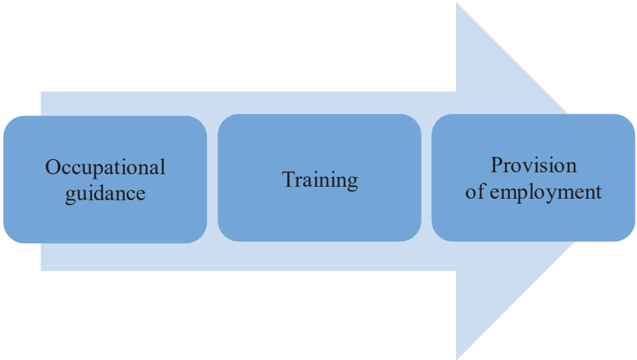

Fig. 10.2 – Algorithm for building the effective educational strategy

The sequence of execution of the algorithm shown in Fig. 10.2 reflects the effectiveness of the educational strategy. Failure to comply with one or another stage leads to the general decrease in the effectiveness of the educational strategy, the reasons for not achieving the goals of the educational strategy may include:

– lack of understanding of the basic requirements and competencies of the profession;

– inconsistency of the acquired knowledge and skills of the chosen profession;

– low applied nature of training;

– lack of communication habits;

– lack of information on the labor market;

– inability to "sell" the own knowledge and skills in the labor market.

Today we can identify the main stages in the development of education: computerization of learning, distance learning, digitalization of the society. At each stage there were certain changes in education:

1. Computerization of education:

– advanced training of the pedagogical staff;

– digitization of the data;

– increasing the amount of the information;

– acceleration of the learning process;

– increasing the level of access to education.

2. Distance learning:

– advanced training of the pedagogical staff;

– learning new Internet platforms;

– expanding the geography of education;

– cost reduction (transport, accommodation, meals);

– increasing the level of access to education.

3. Digitalization of the society:

– advanced training of the pedagogical staff;

– use of the modern learning tools;

– use of the digitalization products in the learning process;

– increasing the level of access to education.

With respect to the rapid development of the society, digitalization is becoming an integral part of the inclusive education. That is why the educational process requires the development of the additional tools and multimedia methods to visualize data on the educational needs of the people with special educational needs.

Questions for self-control:

1. Name the main results of economy digitalization.
2. Describe the algorithm for building an effective educational strategy.
3. Name and describe the main stages of education development.

10.3. Use of the modern visual teaching methods in the inclusive education

The rapid penetration of the information and communication technologies into the human life and the overload by the information flows require that the new technologies, changes of the teaching methods, ways of presenting educational information and introduction of the new learning technologies that would be effective in the today's conditions be adopted by the modern education. The information richness of the modern world requires special preparation and some adaptation of the educational material before presenting it to the students in order to provide the students with the basic or necessary information in the visually accessible form that will be understandable, easily accessible and easily assimilated. The expediency of using visualization of the educational information is due to the need to take into account the cognitive characteristics of the current generation of the students, as well as the need for compact presentation of the educational material in the form, which is the most convenient for its perception, understanding, assimilation and memorization [1].

At the present stage of development of education, the following visual teaching methods are used [1]:

– scribing;
– book trailer;
– gifs and social networks;
– mind maps;
– interactive books and textbooks;
– interactive timelines;
– internet memes;
– lapbooks;
– clouds of words, etc.

Scribing is the latest presentation technique, the speaker's language is illustrated "on the fly" with felt-tip pen drawings on a white board (or sheet of paper), it turns out like a "parallel tracking effect" when we hear and see about the same thing, at the same time the graphic series is fixed at the key points. A specialist in this field is called scriber, and the presentation created by him/her – a scribe [6].

Types of scribing:

– “manual” scribing (example of the manual scribing – *https://www.youtube.com/watch?v=1G3Kyu_UbjQ*);

– “computer” scribing (example of the computer scribing – *https://www.youtube.com/watch?v=1OexEa4Yeyk*).

You can use PowToon and VideoScribe to create the computer scribing.

Book trailer is a short video that reproduces the story of a certain book in any form. It is created by analogy with the movie trailers. Typically, this method of work is used to increase interest in reading books. Importantly, the trailer can be made by both the teacher and the students, depending on the purpose of the work. Its most interesting feature is the specific presentation of the intriguing information [1].

According to the method of visual embodiment of the text, they are divided into following groups [5]:

– game (mini film based on a book);

– non-game (a set of slides with quotes, illustrations, book covers, thematic drawings, photographs, etc.);

– animated (cartoon based on the book).

According to the content, they are divided into following groups:

– narrative (presenting the basis of the plot of the work);

– atmospheric (conveying the main mood of the book and the expected emotions of the reader);

– conceptual (conveying the key ideas and general semantic orientation of the text).

Gifs and social networks are the original means of modernizing the images of the classics of the world and Ukrainian literature. You can create a writer's profile on social media or imaginary online correspondence between the two artists, or even develop themed gifs and emoji. It is quite simple and at the same time very interesting. Conducting lessons in this format will allow students to use the convenient online tools while learning, as well as to discover their own creative abilities and make the outstanding personalities from the textbook a little closer [1].

Mind maps is a universal way of organizing information, adapted for the most productive perception of the brain. The technology teaches thinking in a new plane, involving both hemispheres of the brain in the active work. Opinions and conclusions are presented in the convenient format, with the arbitrary addition of the pictures and other supporting elements. The most popular scheme contains several components: keywords on the topic, graphics, arrows, combining different blocks. All this is designed to form the intuitive perception of information [1].

Programs for creating mind maps: MindMup, Simplemind, The Brain, Comapping.

Interactive books and textbooks imply modernization of the usual format of books, which has become possible thanks to the latest achievements in the field of IT. The text in the book is supplemented by 3D models, audio, video and thematic animations. Interestingly, in Ukraine such a format has existed for a long time, and is now gaining more and more popularity [1].

Interactive timelines is the dynamic way to study the chronological course of the events by visualizing it. The method does not lose its relevance in any of the subjects. Creating the timeline can be used to test knowledge and when learning a new topic [1].

Internet memes are any information presented succinctly and wittily to attract attention of the Internet users. This technique reproduces the certain attitude to the events or circumstances. The most popular are Internet memes in the image format with apt humorous textual explanation. For a long time it was believed that they are used online only for the entertainment purposes, but it has been proven that they are also quite effective in education [1].

Lapbook is a self-made interactive folder or notebook, where various informative materials on a certain topic under study are collected and brightly designed. The main advantage of the laptop is that it is created by hand and designed to the own liking – with the addition of various moving parts, pockets, envelopes, mini-books or other elements. This allows you to structure the information, actively participate in the learning process and identify the creative abilities of the students. Due to this, the process of cognition becomes really exciting [1].

Word clouds is the visual representation of a list of words, categories, or labels in a single shared image. With the help of the word clouds, it is possible to visualize terminology on the particular topic. This facilitates the rapid memorization of the information. The word cloud can be easily generated with the own hands using the special programs [1].

Questions for self-control:

1. Define the concept of "educational information visualization".
2. Name and describe the visual learning methods.

10.4. E-Accessibility tools in the Inclusive education

All e-accessibility tools in the inclusive education can be divided into the following groups: voice-to-text tools; text-to-voice tools; screen access programs; communication programs and spatial orientation programs. Let us look at each group of the tools in more detail.

1. Voice-to-text transformation. Examples of software: Live Transcribe, Write SMS with the help of voice PRO, Speechnotes, Notta, Audio file to text.

Main functions:

– automatic speech and sound recognition;

– possibility for people with hearing impairments to read audio texts from the screen (lectures, webinars, video lessons, etc.);

– telephone communication becomes more accessible;

– notification of indoor sounds;

– people with disabilities can send e-messages using voice.

2. Text-to-voice transformation. Examples of software: LINKa. Write, RHVoice Anatol, Voice Aloud Reader, KNFB Reader, FBReade, Voice Vocalizer, UkrVox.

Main functions:

– sounding of the entered text;

– making textual information available for the visually impaired;

– helping to establish communication with people with speech disorders;

– helping to orient in the institutions;

– reading information about the goods in stores (price, ingredients, shelf life, etc.).

3. Screen access programs. Examples of software: LINKa. Press, LINKa. Paper keyboard, JAWS, Fusion Downloads, MAGic, BIG Launcher, Blind Accessibility Keyboard, Google BrailleBack.

Main functions:

– helping to enter the text for people who can press only one button (using the suggested images);

– zooming on the screen of the device;

– reading aloud the information from the device screens.

4. Communication programs. Examples of software: Digital Inclusion, Autism: Communication, Understand Me Free, LINKa. Show, Card Talk, Leeloo AAC, AutiSpark.

Main functions:

– helping people with verbal dysfunction (speech, autism, some forms of cerebral palsy, after a stroke) to communicate with the surrounding people;

– giving the possibility to express the needs, emotions, desires with the help of the images;

– sounding the images helps to develop the language.

5. Spatial orientation. Examples of software: Dostupno, Sullivan, Be My Eyes, Envision, Cash Reader, LazarilloApp GPS, Aipoly Visio, Google Lens, LetSeeApp, MCT Money Reader, Wheelmap, izi.TRAVE.

Main functions:

– helping to navigate in cities, choose the barrier-free locations for low-mobility groups (cafe, hotel, shop, library, etc.);

– working as GPS navigator on a given route;

– recognition of the objects with the help of the camera;

– color recognition;

– recognition of the banknote denominations;

– performing the functions of a guide.

It is important to consider the practical application of the digital accessibility tools in the use of the popular products of digitalization of the society in terms of the problems and ways of their solving in each area of life of the population:

1. Public services

Problems in using:

– no version for visually impaired people;

– difficulties in entering the information for people with musculoskeletal disorders.

Solutions:

– using the screen access programs;

– using the text-to-voice programs.

2. Banking

Problems in using:

– problems of use for visually impaired people;

– difficulties in entering the information for people with musculoskeletal disorders;

– communication problems for people with hearing impairments in case of problem situations.

Solutions:

– using the screen access programs;

– using the text-to-voice programs;

– using the voice-to-text programs;

– using the banknote denomination recognition programs.

3. Medicine

Problems in using:

– problems of use for visually impaired people;

– problems in entering the information for people with musculoskeletal disorders;

– communication problems in the on-line consultations for people with hearing impairments.

Solutions:

– using the screen access programs;

– using the text-to-voice programs;

– using the voice-to-text programs;

– using the communication programs (for better consultations).

4. E-commerce and digitalization of the sales

Problems in using:

– problems of use for visually impaired people;

– problems in entering the information for people with musculoskeletal disorders;

– communication problems in on-line purchases/sales.

Solutions:

– using the screen access programs;

– using the text-to-voice programs;

– using the voice-to-text programs;

– using the communication programs.

5. On-line learning

Problems in using:

– problems of use for visually impaired people (presentations, texts);

– difficulties in entering the information for people with musculoskeletal disorders (taking tests, registration);

– problems of use for people with hearing impairment (lectures, webinars, workshops);

– communication problems (student assessments, feedback, evaluation of the learning outcomes).

Solutions:

– using the screen access programs;

– using the text-to-voice programs;

– using the voice-to-text programs;

– using the communication programs.

Questions for self-control:

1. Describe groups of electronic accessibility tools in inclusive education.
2. List the practical applications of the digital accessibility tools.

10.5. Advantages and disadvantages of visualization of learning in the inclusive educational environment

A number of the problems always accompanies modernization and development of any sphere of the society, and education is no exception. There are the following problems in the implementation of the inclusive education:

– lack of the proper training of the teachers;

– information on the benefits of inclusion did not reach the participants in the process or was unconvincing;

– lack of the resources;

– changes appeared to be very huge and therefore difficult to achieve in a short time;

– attempts to involve parents in cooperation with the university are formal or non-existent;

– established organization of the training sessions and functioning of the educational institution as a whole.

Use of the visualization tools in education of the people with special educational needs has many advantages in the learning process, but it is necessary to take into account the existing disadvantages of the learning visualization (Table 10.1).

Table 10.1

Advantages and disadvantages of the visualization of learning of the students with special educational needs

Advantages	Disadvantages
– improves the speed and quality of information assimilation; – allows to grasp large amounts of the information; – reduction of the information overload and retention of attention; – unambiguity and clarity of the derived data; availability for most nosologies; – aesthetic appeal.	– does not take into account all nosologies (visual impairment or blindness); – is a very labor-intensive process; – the need to process large amounts of information; – inconsistency of the images and essence of the data; – the need for special technical means.

Introduction of the digitalization in the educational process has many advantages, but like any progress, has a number of disadvantages:

Disadvantages of the digitalization of education are the following:

– complicates/overloads the educational process;

– outdated educational technologies;

– low quality of the digital infrastructure;

– the need to use the special equipment;

– processing of the large amounts of the information;

– constant updating of the educational materials.

Taking into account the above disadvantages in the further digitalization of education will allow enjoying all its advantages, which include the following:

– services/goods/information become more accessible;

– decreases the dependence of people with the functional disabilities on the surrounding people;

– preparing people with disabilities for future independent living;

– reduces the risk of fraud;

– always corresponds to the relevant information;

– increases the level of education of the citizens in general;

– gives a stimulus to the development of medium and small businesses;

– resets the load from the government agencies.

Questions for self-control:

1. What becomes an obstacle for modernization and development of education?
2. Describe the advantages and disadvantages of visualizing the study of students with special educational needs.
3. Name the disadvantages of digitalization of education.

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UDC 330.1:378.2:004

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Chapter 11
NEW APPROACHES OF ECONOMIC FIELD SPECIALISTS TRAINING UNDER CONDITIONS OF DIGITALIZATION ECONOMIC PROCESS

Content

11.1. Digital literacy: concepts, components and factors of digital competencies development

With the increasing pace of digital technologies development, as well as the introduction of innovative solutions in all spheres of public life there is a need to improve the quality of training of employees to create opportunities for modernization of the economy in accordance with modern requirements. The lack of conceptual foundations for the formation of state policy in the field of digital skills and digital competencies of citizens does not allow to ensure the development of all spheres of public life in accordance with modern requirements, processes of global digitalization of the economy, spheres of society which take place in most countries. Thus, there is a need to ensure the readiness of society for such processes, mastering key combinations of knowledge, abilities, skills, ways of thinking and other personal qualities in the field of information, communication and digital technologies (digital competence).

Digital competence is a dynamic combination of knowledge, abilities, skills, ways of thinking, views, other personal qualities in the field of information and communication as well as digital technologies, which determines a person's ability to successfully socialize, conduct professional and/or further educational activities using such technologies. The meaning and place of digital competence in the system of knowledge, abilities and skills of modern specialists and modern society citizens can be summarized in Table 11.1.

Table 11.1 **– The meaning and place of digital competence**

Document Title	Approach
The Law of Ukraine "On Education" [1]	information and communication competence is recognized as one of the key competencies necessary for every modern person to succeed in life
State Strategy for Regional Development for 2021–2027 [2]	a low level of digitalization of regions and digital awareness are identified among other national challenges hindering the development of regions and the state as a whole
The State Standard of Basic Secondary Education [3]	defines information and communication competence as one that provides confident, responsible use of digital technologies for their own development and communication; ability to safely use information and communication tools in learning and other life situations, adhering to the principles of academic integrity
The Concept of Digital Economy and Ukrainian Society Development for 2018–2020 [4]	the creation and implementation of a national curriculum for general and professional digital competencies and knowledge is identified as one of the priorities on the path to accelerated development of digital economy

The experience of European countries shows the significant impact of measures taken on digital competencies of the population on economic development and competitiveness of EU countries at the international level. Thus, on May 22, 2018, the European Parliament and the Council of the EU enacted the Framework Program on Updated Key Competences for Lifelong Learning

(2018/C 189/01), which recognizes digital competence as one of the eight key competences for full life and activities of EU citizens. Given the need to ensure the implementation of the strategic course of the state to gain full membership of Ukraine in the EU also requires further adaptation of Ukrainian legislation with EU law.

Today, a significant number of educational activities are aimed at developing digital skills, but they are not systemic, provide only individual skills and don't solve the issue of the low level of digital skills in society and awareness of citizens' digital rights. By order of the Cabinet of Ministers of Ukraine from March 3, 2021 № 167 – the Concept of digital competencies development and the action plan for its implementation were approved [5]. The implementation of this Concept is planned for the period up to 2025. The main problems in the development of digital competencies that need to be solved within the Concept of digital competencies [5] are shown in Fig. 11.1.

Main problems are the absence of

- the legal regulation of digital competencies;
- the system and description of digital competence (digital competence framework), as well as requirements for the levels of digital skills and digital competences of different categories of workers;
- common approaches to the definition of digital competencies in professional standards and common requirements for educational programs for the development of information and digital competence of various professionals;
- common requirements for digital competencies in the education system;
- requirements for digital competence in professional standards;
- system of indicators for monitoring the state of development of digital skills and digital competencies;
- coordination of actions at the level of executive bodies and local self-government bodies during the implementation of state policy in the field of development of digital skills and digital competencies;
- digital competence certification system

Fig. 11.1 – The main problems in the development of digital competencies

The main **purpose** of this Concept and its **objectives** are shown in Fig. 11.2.

Each of these main tasks has its own specific tools and algorithms for solving them, which need to be detailed.

In particular, the formation and development of digital skills and digital competencies in society is carried out by:

1) acquisition of digital education by a person with the use of information resources, new educational technologies and digital educational resources aimed at improving the level of digital skills and digital competencies;

2) ensuring the continuous development of professional digital competencies for specialists in the system of professional development in various fields of activity;

3) creation of the Unified state web portal of digital education "Diia. Digital Education";

4) development of measures for the introduction of digital means of conveying information (television, social networks, Internet broadcasting, etc.).

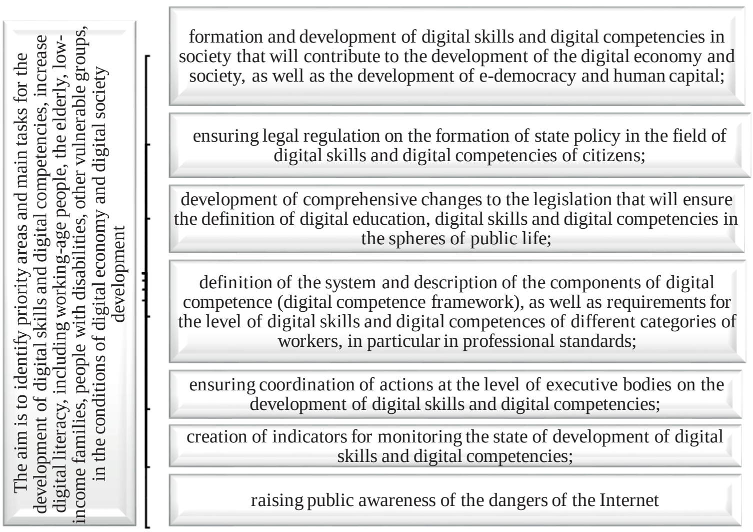

Fig. 11.2 – The main purpose of the Concept of digital competencies development and its tasks

Raising citizens' awareness of the dangers of the Internet is done by:

1) creation of social initiatives aimed at improving the level of digital skills and digital competencies for representatives of various target groups;

2) introduction of programs aimed at raising awareness of children and adolescents, digital competencies of parents and teachers on the dangers of the child in the digital environment, the formation of intolerance culture to violate the rights, freedoms and safety of children in the digital environment.

Ensuring legal regulation on the formation of state policy in the field of digital skills and digital competencies, as well as the development of comprehensive amendments to legislation that will define digital education, digital skills and digital competencies in public life, is carried out by:

1) legal regulation of digital skills development and digital competencies issues;

2) improvement of professional standards taking into account the approved framework of professional digital competencies;

3) introduction of digital skills certification;

4) development of training programs, retraining and advanced training of specialists in accordance with the professional framework of digital competencies.

Defining the system and description of the components of digital competence (digital competence framework) is carried out by:

1) development and approval of a digital competence description, which defines key concepts, structure of digital competence by areas, knowledge, skills and practical skills of citizens, levels of digital competence and can be used to recognize, plan, develop, and improve digital competence and employees of the main professional groups in various fields of economic activity (digital competence framework);

2) introduction of requirements to the levels of possession of professional digital competencies when hiring staff, during the performance of professional

and official duties, certification, etc.;

3) development of a professional digital competencies framework for the main professional groups in the fields of economic activity and methodological recommendations for their application.

Coordination of actions at the level of executive bodies on the development of digital skills and digital competencies is ensured by involving the Intersectoral Council on Digital Development, Digital Transformations and Digitalization, established in accordance with the Cabinet of Ministers of Ukraine dated July 8, 2020 № 595 Intersectoral Council on Digital Development, Digital Transformation and Digitalization” [6].

The creation of indicators for monitoring the state of development of digital skills and digital competencies is carried out by:

1) development of research methodology on the development of digital skills and digital competencies;

2) conducting research on the level of digital literacy of various population groups, in particular school graduates and students of educational institutions, teachers, civil servants;

3) forecasting the needs of employers in certain digital skills of employees of major professional groups.

The Digital Competence Framework is a tool that allows measuring the level of digital competences of Ukrainians.

It is based on the relevant EU Citizens’ Competence Framework (DigComp 2.1: The Digital Competence Framework for Citizens), which was adapted by Ukrainian experts. The framework contains 6 areas, 30 competencies and 6 levels of digital skills.

The development of the information society and the digital economy, the global processes of digital transformation that are actively taking place in many countries around the world, raise the issue of digital literacy of public servants and citizens of Ukraine on the government’s agenda. This is stated in the

Government's Program of Activities and the constant statements of top officials on "the state in the smartphone", "digitalization of the economy" and "digital transformations" in government.

The main goals of digital development of Ukraine and the information society are recognized primarily by the government, as evidenced by the tasks defined in such documents as the order of the Cabinet of Ministers of Ukraine from 20.09.2017 № 649-r "On approval of the Concept of e-government in Ukraine" [7], from 08.11.2017 № 797-r "On approval of the Concept of e-democracy in Ukraine and the action plan for its implementation" [8], from 17.01.2018 № 67-r "On approval of the Concept of digital economy and society of Ukraine for 2018–2020 and approval of the action plan for its implementation" [9], Resolutions of the Cabinet of Ministers of Ukraine of 30.01.2019 № 56 "Some issues of digital development" [10], of 08.07.2020 № 595 "On the establishment of the Intersectoral Council on Digital Development, digital transformations and digitalization" [6]. In addition, in recent years, experts have developed projects "Digital Agenda of Ukraine – 2020" [11], "Ukraine 2030E – a country with a developed digital economy" [12] and the bill "On the digital agenda of Ukraine", and the analytical report [13] revealed the essence and prerequisites for the formation of digital competencies, determined the state of their development and developed proposals to public authorities.

Today, the concept of "digital literacy" has been introduced to define and assess digital knowledge, competencies and skills. Digital literacy is the ability to use digital technology, communications and networks to search, evaluate, use and create information, and perform tasks effectively in the digital environment.

In any country, it is important to know the level of readiness of the population to live in the information society, which is determined by the level of digital literacy. For example, according to the "Survey: Digital Literacy of the Population", initiated by the Ministry of Digital Transformation in December 2019, 15,1 % of the population of Ukraine did not have digital skills at all, 37,9 %

of Ukrainians aged 18–70 have digital skills below average level, and according to the European Commission, this figure is even lower (53 %). Only 25,5 % of the population estimates their level of digital skills above average, while 52,6 % of the country's population considers learning digital skills irrelevant, 47,8 % of citizens need training [14].

Among the main reasons for this situation is primarily digital inequality: 51 % of families do not have a computer, 49,4 % – a laptop, 67,6 % – a tablet, 15,7 % – a smartphone etc. Only 22,4 % of residents in Ukraine interacted with the authorities via the Internet in 2019. That is why, in order to solve these problems, the Program of Activities of the Ukrainian Government for 2019–2020 has set a goal of covering 6 million Ukrainians with a digital skills development program.

Digital literacy rate was 82,1 % in the middle of 2020 in Kazakhstan. During the two years of implementation of the state program "Digital Kazakhstan" due to the introduction of digitalization 120 thousands of new jobs were created and attracted investments worth 37,8 billion tenge ($ 0,09 billion) in the innovation ecosystem.

One of the highest levels of digitalization among OECD countries is observed in Norway, where 87 % of the population aged from 9 to 89 use the Internet during the day. At the same time, young people (16–24 years old) make up 99 %; older generation (67–89 years) – 70 %. This country has an ambitious program to teach digital literacy to the entire population, regardless of gender, age, employment, education and place of residence.

Today, many countries pay close attention to educating the population and public servants on digital skills and competencies. For example, the report "Act or Lag: Digital Future of the UK" identifies the further development of education in six main areas:

– both higher and secondary education should focus on the transfer of skills, not knowledge;

– digital literacy in schools should be taught along with the ability to count as well as literacy;

– the Internet should not be seen as a service, but as an inalienable right of every citizen, so in cities it should be available everywhere and always;

– about 6 million people in the UK have never used the Internet. Better technical support for schools will help prevent this situation in the future, for which the state is ready to allocate 63 billion pounds a year from the budget;

– gender equality in IT-related professions and awareness of women's potential for economic development. At present, stereotypes ingrained in English society prevent girls from pursuing science and programming;

– about 35 % of jobs can be automated in the next 20 years, so we need to focus on training the most skilled workers, who are unlikely to be replaced by jobs and computers soon.

Italy, Spain, Portugal, Ireland, the United Kingdom and other countries adhere to the DIGCOMP Framework minimum literacy program, which covers the following areas of digital competence:

– work with information (data): the ability to identify, locate, classify, receive, store, organize and analyze digital information in terms of its relevance and purpose;

– communication: the ability to communicate in a digital environment, share resources through online tools, interact with communities and cross-cultural awareness networks;

– content creation: the ability to create and edit new content (from word processing to images and videos);

– security: ability to use personal data protection and digital identification;

– problem solving: the ability to identify digital needs and resources, make informed decisions and choose appropriate tools to implement conceptual tasks using digital tools.

To increase digital literacy, governments in many countries are actively creating and promoting specialized educational resources. In 2020 to eliminate digital illiteracy in Ukraine, the Ministry of Figures launched the national online digital literacy platform “Diia: Digital Education” (osvita.diia.gov.ua). Courses for it were developed by the online education studio EdEra (www.ed-era.com) with the support of Google, Microsoft, CISCO, Global Teacher Prize, DTEK Academy, UNDP, and the educational videos themselves are made in the form of educational and entertaining series. The project “Diia: Digital Education” is supported by the Swiss-Ukrainian EGAP program, funded by the Swiss Agency for Development and Cooperation and implemented by the Eastern Europe Foundation. Currently, the resource osvita.diia.gov.ua contains almost a hundred educational videos for more than 10 categories of users (civil servants, teachers, students, parents, novice businessmen, active citizens, etc.).

The movement towards digital education of the population in the regions of Ukraine is beginning. For example, in summer 2020, deputies of the Kharkiv City Council voted for the adoption of the “Concept for the development of digital literacy of Kharkiv residents”. During 2019, the Kirovohrad region implemented an educational project “Electronic Citizen of Kirovohrad Region” (center.kr-admin.gov.ua), aimed at teaching older people computer skills and using available online services in everyday life.

To determine the level of digital education on the portal osvita.diia.gov.ua in November 2020, the use of the national tool for digital literacy testing “Digital” was launched. During the first month of its operation, more than 34,000 Ukrainians passed their level of digital literacy.

It is important to note that today in the field of public administration in Ukraine there is an understanding of the need to develop such competencies as “digital literacy”, as evidenced by the introduction of CDTO positions in central executive bodies and regional state administrations [15] skills for “digital literacy” [16].

Questions for self-control:

1. What is digital competence?
2. Name the main problems in the development of digital competencies.
3. Describe the Concept of Digital Competence Development and action plan for its implementation.
4. Outline the purpose of the Concept of Digital Competence Development and its objectives.
5. How is the coordination of actions at the level of executive bodies on the development of digital skills and digital competencies ensured?
6. What is the framework of digital competencies?
7. How to determine the system and description of the components of digital competence (digital competence framework)?
8. How are indicators created to monitor the development of digital skills and digital competencies?
9. Give examples of the development of digital skills and digital competencies in Ukraine.

11.2. The influence of modern Fintech trends in the training of specialists in the economic field

The development of the financial market has undergone significant changes recently. On the one hand, the requirements for risk management have been strengthened. Thus, the standards KYC (Know Your Customer, which regulates the procedure of customer identification) and AML (Anti Money Laundering, which should help combat money laundering) were implemented. On the other hand, there has been a significant development of digital technologies and innovations. Thus, the Internet and social networks began to develop rapidly, the share of smartphones and tablets in the market of digital gadgets began to expand significantly, which required an increase in specialized mobile software [17]. All this required a significant number of proposals for digital products and services in the financial sector, which gave impetus to the development of Fintech.

Financial technologies (Fintech) are technologies aimed at improving and automating the provision of financial services. Their main task is to make it easier for large companies, business representatives and end users to work with their own finances. This is done using specialized software, both on computers and on various digital gadgets.

The term “Fintech” first appeared at the beginning of the XXI century, but then Fintech was mainly related to technologies used by large financial institutions. However, it soon became clear that their scope could be extended to ordinary consumers of various financial services. At present, financial technologies have penetrated most segments and sectors of the financial sector, as well as in education, retail, investment and a number of other areas of human activity [18]. With the advent of new technologies, the focus of banks on internal processes due to the crisis of 2008 and the desire of users to experiment with digital services have led to the emergence and growth of new Fintech companies. Such companies use the latest developments in the field of mobile payments, online lending, digital instant transfers and other advanced technologies. Organizations built on such models are at the forefront of the latest technology and usually offer their services mainly through the Internet.

The network model of this business allows to:

– obtain new sources of financing for small and medium-sized businesses and significantly reduce costs;

– increase the availability of financial products for all categories of the population;

– to meet the needs of the client with maximum completeness in the shortest possible time.

Savings make it possible to offer customers financial products on very favorable terms, in particular through special software that takes into account the individual preferences of the user. So, Fintech companies currently offer the following services:

– payment decisions and merchant services;

– Internet banking and P2P lending;

– international money transfers;

– investment management and private banking;

– processing and organization of large amounts of information – Big Data.

Companies engaged in this industry can be divided into startups that provide technical solutions for existing financial companies and that work directly with consumers of financial services. The categories of Fintech companies are divided into areas of activity: Personal Finance Management, Blockchain, Payments, Marketplaces (Lending), Investment Platforms, Collective Funding (Crowdfunding), Security, B2B Fintech, Money Transfers, Big Data Analysis, RegTech, InsureTech, Artificial Intelligence, Neobanks (Challenger Banks), Cryptocurrencies.

Banks have traditionally dictated rules and forced consumers to follow them, while new Fintech companies are willing and able to recognize the needs of consumers of financial services and try to meet them. Without constant changes in line with the latest Fintech trends, existing financial institutions are doomed to lose to new financial market players. Financial services in cyberspace are becoming their key tool. The division into traditional channels (bank branches, call centers, ATMs and terminals, shopping malls) and the Internet is dying out, as it is important to serve the customer where he will spend the most time [19, p. 124]. Declining margins in the banking business are forcing banks to cut costs and close branches. Remote channels remain the only tools to maintain the quality of service. The cheapest is online access to banking services and mobile banking. The bank is becoming not only a financial institution, but also a platform for cooperation.

Service organizations are the future. Banks will change under the influence of customers, and financially literate customers will force banks to change. If financial institutions have historically serviced money, now the industry that will be the first to learn how to serve customers better than others will benefit. Fintech, by changing the expectations and habits of financial services consumers, causes growth in their democratization and the spread of financial reach [20, p. 585]. There is growing competition for a secured client and a reliable borrower – and these are the most demanding customers who value their time, willing to pay for speed and convenience. To attract and retain such customers, you need to be able to offer quality and technological service. And this applies primarily to remote service channels.

The Fintech industry is changing not only the financial sector, but all related sectors (that is, virtually all), changing business models [21]. Thus, innovations in lending and payments, which are expressed in the emergence of alternative lending models, the use of unconventional data sources and powerful data analytics in risk assessment, accelerating credit processes with customer focus and reducing operating costs, open a new perspective on business startup services (for example, for the retail sector) and access to the international level.

Accordingly, the labor market is in demand for workers with fundamentally new knowledge and skills needed for Fintech. Namely, the profession of Fintech-specialist appears, bordering on the junction of both finance and technology [22, p. 274]. The future lies in such hybrid professions.

The profession of Fintech specialist can sometimes be confused with the profession of IT specialist, limiting its breadth to specific technologies (such as big data or blockchain), analysts and developers. In fact, financial technology companies need not only analysts and developers, but also IT architects, project managers, product scientists, information security experts, economists and lawyers, but with different functionalities.

They must be able to design, implement, maintain and promote projects, both in the field of Fintech and in the global digital environment. They need to have unique problem-solving skills, as well as understand how they can effectively implement digital change in their personal work and in the business of their employer as a whole [23]. Thus, a Fintech specialist combines the knowledge and skills of a Fintech programmer, digital marketer and product manager with experience in an Internet project or Fintech startup.

Fintech specialist must have a number of skills:

1. Multitasking. It is an opportunity to perform several processes simultaneously, smoothly switching from one task to another. Initially, the term was used exclusively in the programming environment, but gradually it migrated to the Fintech industry. Multitasking is a combination of analytical thinking, a solid systems approach and a high level of organization. Even if you do not consider these properties to be your innate traits, you can develop them through practice.

2. Communication. Continuous improvement and release of new products are the main features of financial business based on technology. Client managers in this field must be aware of all the trends, innovations and competitive solutions in the market, constantly learning new things.

This is not just about the technological skills needed for financial technology. In the past, personal VIP account managers in large banks were more like professional lobbyists and networkers. They have expanded their customer base with recommendations and connections, never missing a major industry exhibition or conference. The same skills have always been and will always be in demand among Fintech customer managers.

Today, conferences are not only a way to establish useful contacts, but also function as expert training. The customer service professional must be able to use all communication channels that are convenient for the customer, and constantly explore these channels for new opportunities. For example, in the United States and Western Europe, in addition to e-mail, the main channel of interaction in the

B2B sector has become social networks (in particular, LinkedIn). However, e-mail and personal communication remain the main ways for businesses to communicate with financial service providers [19, p. 125]. This means that a good customer service specialist at Fintech must not only be able to speak nicely and show empathy, but also to conduct business correspondence competently.

3. Business Management. The ultimate goal of every company is to work like a well-oiled machine, and the person responsible for this is called the business manager. They provide their employees with all the resources needed for daily work. So when a company has a good manager, there is someone to maintain the car. Business management includes a set of activities related to the planning, organization and management of business facilities. In order for any Fintech company to grow, it is necessary to properly coordinate the set of operations and their coordination, which is the task of business management for the development of any Fintech company.

4. Extended Expertise. All modern providers of financial services, payment solutions, insurance and capital management have grown from small startups, where quality customer service was and remains both part of the business model and competitive advantage. The payment platform is difficult to set up and maintain, and customers often need advice during this process. The manager should not only respond to any request as clearly and quickly as possible, but also know your product, understand the peculiarities of national legislation, be able to explain the acquisition of technology, algorithms to combat Internet fraud and more. A good specialist with clients is attentive to the little things and can easily talk about complex things. Fintech's customer manager must be personal for each customer. They know how to hear and listen, immediately delve into the client's problem, consider it from different angles and offer the best solution.

5. Programming Skills. Today, in the digital age, programming is becoming a full-fledged international language of a new format. Perhaps in the future it will be as natural for an educated person as the ability to write, read, and count.

Obviously, practical knowledge of information systems and technologies is a basic skill that is indispensable. Technical expertise allows you to objectively check the achievability of the desired project results and compare these results with organizational capabilities and constraints [18].

A specialist at a Fintech-company requires the ability to work in a specialized team development environment, as well as to understand the principles of distributed systems architecture, mathematical models and processes used for risk analysis. Also, such an employee must know the principles of automation and monitoring, technology and specifications, testing methods. The financial technology manager should be able to assess technical risks and competently answer questions from developers, programmers, analysts and engineers. All this is impossible without sufficient knowledge and experience in the IT field.

6. Data Analysis. The analyst's work involves the use of SQL, Python and other programming languages, creating dashboards and automating processes. But these are just tools to achieve two goals: make decisions more objectively on the basis of facts and evidence (as opposed to thought, intuition, and experience); look for growth points for both the product and the business. The analyst focuses on studying data, structuring complex financial systems, and understanding the processes that benefit business. Fintech-analytics product consists of answers to both asked and unanswered questions, creation of thinking models and frameworks, as well as recommendations based on them, which lead to increased business efficiency [18]. The best way to achieve this in most cases is to work with data, but this is not always the case.

Analytics help make decisions that lead to actions in the product and business. In some cases, you can make decisions without analyzing the data, simply formalizing all possible situations and solutions, and then rejecting most of the options, relying on what the team already knows. This is not about industrial programming. As a data analyst, you must be able to read documentation, quickly understand and use data manipulation tools, and automate your routine.

7. Knowledge of AI and ML. The stage of training artificial intelligence to solve artificial problems, such as chess gambits or analyze unnatural algorithms and events is almost over. A new stage in the introduction of neural networks in real aspects of human activity has begun, from modeling trends in the exchange and management of urban traffic, to genome analysis and drug development.

AI developers are actively working on the introduction of neural networks in the financial sector. AI will soon be a true helper for any trader, and in the future, when neural network training becomes a norm, AI will be able to trade for people just as users would trade, only more efficiently and 24 hours a day.

8. Cybersecurity and Blockchain. Nowadays, no industry can do without a proper knowledge of cybersecurity, especially Fintech. Both startups and large companies need to be confident in the security of their data. Information systems are expanding day by day in the financial sector, and this leads to the need for specialists with an understanding of cybersecurity basics. This has become especially popular with the rise of cybercrime. Hacking and virus launches have become commonplace in today's computer infrastructure.

The use of blockchains makes it possible to execute contracts and agreements without the involvement of lawyers and bureaucratic red tape, making investments secure through smart contracts for effective risk management. In addition, this technology is very convenient to confirm copyright, and indeed, blockchain technology can be used in a variety of areas, from trade to elections [17]. Thanks to blockchain technology, you can exclude the participation of third parties in financial transactions. You can also save and transfer funds without the participation of the bank, because, as we have said, blockchain systems have successfully implemented the ability to confirm identity, register transactions and perform contracts. Decentralized platforms can also be used to inventory and manage assets, manage transport and logistics processes, trade, track the origin of goods and materials, optimize supplier identification, sign procurement contracts, and audit and track transactions. Thus, this technology is used not only in the market of banking and financial services, but also in many other market sectors, making customers life easier and more comfortable. Therefore, no less important skill for a Fintech specialist is understanding the basics of blockchain.

9. Understanding of Finances. A financial technology manager needs to know how to calculate and analyze various financial transactions, tax, audit and accounting fundamentals, and capital management features to maximize profits. Also, the work can not be done without the ability to form a long-term perspective of the business as a whole, assess project prospects and competitiveness of various products and control the financial and economic operations of the company. The competence of such a specialist is also to analyze the advertising market. A financial technology specialist uses accounting and economic data to assess the financial condition of an organization and manage its financial flows. They are invited to understand the intricacies of both specialties.

10. Mathematics, Statistics and Probability. To work in the Fintech industry, you will also need knowledge of mathematics, statistics and probability theory. In fact, this knowledge is a system of necessary calculations of the profitability of financial, investment and trade transactions over time, taking into account inflation, exchange rates, interest and other legal and factual conditions of contracts. Financial mathematicians study payment schemes and interest rules, but this is not their main function. They also provide an objective answer to the legitimate question: "Which of the possible financial transactions is more profitable?" Few economic disciplines can boast of such specificity.

This is easy if the loan scheme or other operation is simple. But how to measure profitability in more complex cases, when the flow of costs and revenues is irregular? Not every economist will answer this question. Financial mathematics provides tools for analyzing and comparing the profitability of various operations. It can not only to show how profitability is calculated, but also to make practical proposals and analyze the economic meaning of the results.

Understanding all these processes will be a huge plus for a financial technology specialist. Thus, the profession of Fintech specialist, or in other words, financial technology manager requires knowledge and skills in various fields, such as accounting, finance, management, programming, data analysis, mathematics and more [24]. This knowledge will help the specialist to competently bring the product to market, maintain the efficiency of the team, as well as build trusting relationships with customers and partners.

Questions for self-control:

1. What is Fintech?
2. What services do Fintech companies offer?
3. What is the difference between the profession of Fintech-specialist from IT-specialist?
4. What skills should a Fintech specialist have?
5. How does the multitasking skill affect the Fintech specialist?
6. How do business management skills affect the work of a Fintech specialist?
7. What level of programming skills should a Fintech specialist have?
8. How did the development of artificial intelligence affect the development of Fintech technologies?
9. What is cybersecurity and what is its significance for Fintech?
10. At the junction of which sciences is formed Fintech?

11.3. The study of Big Data technologies as a basis for training in the digital economy

The digitalization of the economy is a challenge of the present era. It determines the digital transformation of both economy and society. It saves time, increases productivity through the process of automation, optimizes and improves communication, creates competitive advantages and access to a new level of service. The development of digitalization occurs due to the ability to collect, use and analyze huge amounts of digital data. Information is generated very quickly, so its processing and analysis play an important role, therefore, big data technologies are used to solve these problems [25].

The digital transformation of the economy necessitates the training of digital specialists: data scientists, data engineers, machine learning engineers, Internet marketers, web analysts, etc. [26, p. 40]. Professionals who have an understanding of the modern paradigm of data organization and management are able to find patterns in large data sets and conduct experiments to find useful information for business. Such specialists must "be fluent" in the language of business, know their field of application, understand its main problems and be able to find and make non-standard management decisions based on data.

The digital economy is transforming traditional economic activities, forming fundamentally new business models and constantly improving, introducing cloud technologies, artificial intelligence, new virtual reality, accumulates huge amounts of data (Big Data), which while reaching critical mass become the capital of digital economy [27].

A characteristic feature of the digitalization of the economy is the emergence of modern Big Data technologies. The term Big Data refers to a group of technologies and methods used to analyze and process a huge amount of data, both structured and unstructured, to obtain qualitatively new knowledge [28]. In summary, this is information that cannot be processed in classical ways due to its huge volume.

Big Data works on the principle: the more information we have, the more accurate forecast we can make. Also, the ability to compare certain data and the interconnections between them allows to find regularities that were hidden before. All this provides a deep understanding of the problems and, ultimately, allows you to find solutions or opportunities to manage the right processes.

Data Science is the science of data analysis. It is necessary to analyze the data in order to extract specific and useful information from a huge array of information: insights into consumer behavior, market trends, based on which you can make quality forecasts for the development of some sphere or separate industry. Data Science is related to Machine Learning, Cognitive Science, while Big Data is a division of Data Science.

Most often, processing large amounts of data involves building models and running simulations, during which key settings are constantly changing, while the system constantly monitors how these changes affect the possible outcome. This all happens automatically until a key point is found that will help solve the problem.

The history of Big Data begins much earlier. According to one of the authors of Forbes, the starting point can be considered 1944, when the American librarian Fremont Rider published "The Scholar and the Future of the Research Library". There he noted that the funds of university libraries in America are doubling every 16 years and by 2040 the Yale University Library will contain about 200 million books, which will require storage of almost 10 km of shelves. According to another view, the realization of the problem of too much data came earlier, back in 1880 again in America, when the processing of information and presentation of census data in the table took eight years. At the same time, according to forecasts, the processing of census data from 1890 would take even more time and the results would not be ready even for a new census. Then the problem was solved by a tab machine, invented by Herman Hollerith, founder of IBM, in 1881. The term Big Data was first introduced (according to the electronic library of the Association for Computing Machinery) in 1997 by Michael Cox and David Ellsworth at the Eighth IEEE Conference on visualization. They called the problem of big data the lack of capacity of main memory, local and remote media to perform virtualization. And in 1998, SGI's head of research John Mashey used the term Big Data in its current form at the USENIX conference [29].

And although the problem of storing large amounts of data has long been recognized and intensified since the advent of the Internet, the turning point was 2003, when more information was created than in all previous times. Around the same time, Google File System published a publication on MapReduce computing concepts, which formed the basis of Hadoop. Over this Doug Cutting worked on the Nutch project for several years, and in 2006 Cutting joined Yahoo and Hadoop became a separate full-fledged solution [30–31].

Big Data is sets of information (both structured and unstructured) so huge that traditional methods and approaches (mostly based on business intelligence solutions and database management systems) cannot be applied to them [32, p. 893]. An alternative definition calls Big Data a phenomenal acceleration of data accumulation and complication. It is also important to note that this term can often be used in different contexts to refer to both large amounts of data and a set of tools and methods.

The report by the McKinsey Global Institute in May, 2011 stated: “Big data is data sets that are beyond the capabilities of conventional data collection, storage, management and analysis software”. From these definitions, an object that is considered “big data” changes with the development of technology. Data that was once “big” or data that is considered “big” today will be different from “big data” tomorrow. These definitions mean that the essence of “big data” may differ depending on the industry or even the organization, if there is a significant difference in the capabilities of tools and technologies.

The concept of “big” applies not only to the amount of data. Although, first of all, the presence of a big amount of data is implied, at the same time it implies the presence of some other features. “Big Data” is characterized by increased speed of transmission, complexity and diversity of sources compared to data sources of the past. Such factors make it difficult to work with “Big Data”, because we have to deal not just with a big amount of data, but with the fact that they come very quickly, in complex forms and from different sources.

Big data has been in the spotlight since its inception in business. Many organizations understand the importance of Big Data and use it for their business. Entering big data helps businesses identify new business opportunities and increase their efficiency. This, in turn, will help increase their profits by winning many customers. In today's world, the concept of big data is considered more important for the following reasons:

1. **Costs reduction** – big data technologies are more economical. And it's the best tool for storing huge data at a lower cost. It also helps identify more effective ways to do business.

2. **Fast decision-making** – with in-memory analytics and the ability to analyze new data sources, Big Data helps businesses analyze data and information faster than ever before. Business can make smart decisions based on learning through analysis.

3. **New products and functions** – with the right analytics, big data concepts know customer needs and satisfaction. That's why they always deliver what customers want. Some companies are also creating new products using big data analytics to satisfy their customers.

The first companies to realize the hidden value of large amounts of information were Google, Amazon, Yahoo, Facebook, which developed tools for collecting, analyzing and storing large amounts of data. The development of cloud solutions has led to an increase in the number of data centers and a reduction in the cost of their services, which in turn has significantly reduced companies' storage costs [33, p. 64].

The active digitalization of documents, books and films has contributed to the development of the big data concept. Another giant data source is IoT (Internet of Things) devices and sensors. IoT and machine learning are key drivers for the growth of the global Big Data market, which Statista/Wikibon estimates will reach $ 103 billion by 2027 (Fig. 11.1) [34].

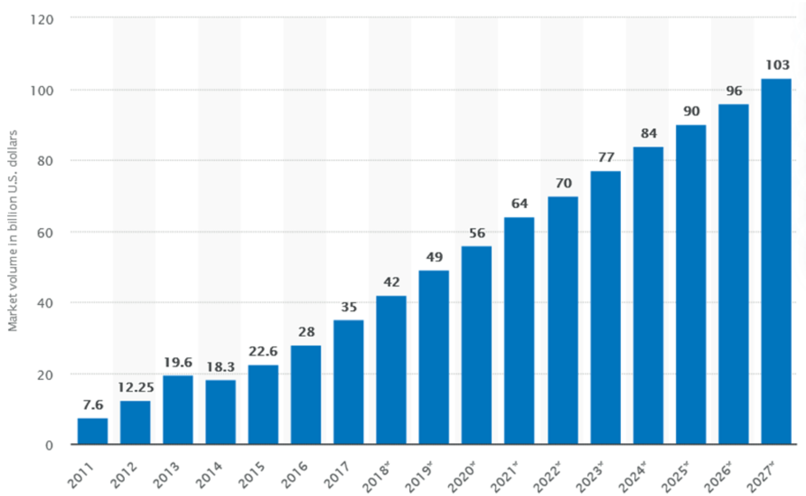

Fig. 11.1 – Forecast revenue big data market worldwide 2011–2027

Source: https://www.statista.com/statistics/254266/global-big-data-market-forecast.

The peculiarity of big data sets is that this resource is inexhaustible. It is not tied to a specific region, so it matters the absolute number of digital traffic generated and consumed, the number of active Internet users, the quality and availability of digital information in a given country. It is clear that under such conditions, developed economies that invest in digital transformation (USA, UK, China, Switzerland, South Korea) will benefit.

In February 2001 Doug Laney, an analyst with the Meta Group, published a research note titled "3D Data Management: Controlling Data Volume, Velocity, and Variety". A decade later, the "3Vs" have become the generally-accepted three defining dimensions of big data, although the term itself does not appear in Laney's note. SAS (Statistical Analysis System) has added two additional dimensions i.e. Variability and Complexity. Further, Oracle has defined big data in terms of four V's i.e. Volume, Velocity, Variety and Veracity. Oguntimilehin. A, presented big data in terms of five V's as Volume, Velocity, Variety, Variability, Value and a Complexity. In 2014, Data Science Central, Kirk Born has defined big data in 10 V's i.e. Volume, Variety, Velocity, Veracity, Validity, Value, Variability, Venue, Vocabulary, and Vagueness [35]. All the big data characteristics has been listed and defined in Table 11.2.

Table 11.2 **– Big Data Characteristics**

No	Big Data Characteristics	Elucidation	Description
1.	Volume	Size of Data	Quantity of collected and stored data. Data size is in TB
2.	Velocity	Speed of Data	The transfer rate of data between source and destination
3.	Value	Importance of Data	It represents the business value to be derived from big data
4.	Variety	Type of Data	Different type of data like pictures, videos and audio arrives at the receiving end
5.	Veracity	Data Quality	Accurate analysis of captured data is virtually worthless if it's not accurate
6.	Validity	Data Authenticity	Correctness or accuracy of data used to extract result in the form of information
7.	Volatility	Duration of Usefulness	Big data volatility means the stored data and how long is useful to the user
8.	Visualization	Data Act / Data Process	It is a process of representing abstract
9.	Virality	Spreading Speed	It is defined as the rate at which the data is broadcast / spread by a user and received by different users for their use
10.	Viscosity	Lag of Event	It is a time difference the event occurred and the event being described
11.	Variability	Data Differentiation	Data arrives constantly from different sources and how efficiently it differentiates between noisy data or important data
12.	Venue	Different Platform	Various types of data arrived from different sources via different platforms like personnel system and private & public cloud
13.	Vocabulary	Data Terminology	Data terminology likes data model and data structures
14.	Vagueness	Indistinctness of existence in a Data	Vagueness concern the reality in information that suggested little or no thought about what each might convey

These characteristics provide research horizon to the researcher and practitioners in order to effectively manage big data. But some gap still exists which need to be addressed in order to get better insight in the area. These distinct sets encompass different "V's", orbiting the original three. We can safely say we are now well on the way to 100 V's of Big Data and Data Science [36–38].

The main principles of Big Data according to Mayer-Schönberger and Cukier:

1. Absolute accuracy is impossible and unnecessary. With a large amount of information, absolute accuracy is almost impossible and therefore goes into the background. This concept is used to analyze large amounts of data, most of which are constantly in the dynamics.

2. Disorder of big data. The loss of data due to inaccuracies at the micro level is compensated by the unique information obtained at the macro level. The big data that is analyzed is often heterogeneous and of different quality, and can be spread across countless servers around the world.

3. Deviation from the traditional search for causality. When solving a problem, we do not always need to know the causes of certain events. Using the search for correlation between data, new solutions to a problem are discovered. For example, imagine that using correlations between data, we analyzed changes in airfare prices and the number of days before departure. Finding the answer, when it is better to buy the cheapest ticket, you can save money, without having an absolute idea of what is behind their pricing.

4. More efficient data management. The time for searching, collecting and calculating data has been significantly reduced, and in the past years, it is now a few days, or even faster.

5. Using the concept of "dating". Dating is seen as the concept of transforming into a data format everything on the planet, even what at first glance is not perceived as information (such as human location, engine vibration or bridge load), by quantitative analysis.

6. Using the *"N = all"* approach. During the study of various phenomena of social life, we often have to meet with examples of the impossibility of continuous observation, i.e. the study of all units. Due to the high complexity, duration, high cost, continuous monitoring is often economically impractical or virtually impossible. Therefore, in practice, continuous observation, a variety of which is selective, is mainly used. Thanks to the "big data" these difficulties are eliminated and it becomes possible to collect as much information as possible, or even all,

when the number of general population elements *"N = all"*.

Initially, the set of Big Data approaches and technologies included tools for mass-parallel processing of indefinitely structured data, such as NoSQL, MapReduce algorithms and Hadoop project tools. Later, big data technologies began to include other solutions that provide similar characteristics of the processing of ultra-large data sets, as well as some hardware [36].

MapReduce is a model of distributed parallel computing in computer clusters provided by Google. According to this model, the application is divided into a large number of identical elementary tasks that are performed on the nodes of the cluster and then naturally reduced to the final result. MapReduce is a software model and software framework that implements it for distributed parallel processing of large data sets using clusters of ordinary low-cost computers. MapReduce consists of the Map function, which processes key/value pairs and generates a set of intermediate key/value pairs, and the Reduce function, which brings together all intermediate values associated with the same intermediate key. The term "MapReduce" originally meant only Google's proprietary technology, but has now become commonplace and is used to describe a programming model. MapReduce libraries have been created for various programming languages. One of the most popular free implementations is Apache Hadoop.

NoSQL is a general term for various non-relational databases and repositories, not referring to any specific technology or product. Conventional relational databases are well suited for fairly fast and uniform queries, but in complex and flexible queries inherent in big data, the load exceeds the reasonable limits of DBMS usage becomes inefficient. NoSQL is a database that provides a mechanism for storing and retrieving data different from the relationship tables in relational databases. Similar databases existed in the second half of the 1960s, but at that time they had not yet gained the big name "NoSQL", gained after the surge in popularity in the early 21st century, caused by the needs of Web 2.0 companies such as Facebook, Google, and Amazon.com. NoSQL databases are increasingly being used in big data and real-time web applications. NoSQL systems are also called “Not only SQL” to emphasize that they can support SQL-like structure and query language.

The reasons for this approach include: simplicity of database schema design, significantly simplified horizontal scaling to machine clusters (which is a problem for relational databases), and fine-grained availability control. The data structures used in NoSQL (such as key-value, wide-column storage, graph, document) are from variables than those used by default in relational databases, which makes some data operations much faster on NoSQL. The exact compliance of the use of NoSQL database depends on the problems to be solved. Sometimes the data structures used in NoSQL databases can be considered more flexible than relational model tables. Most NoSQL databases offer the concept of random data matching, in which database changes are duplicated to all nodes “randomly” (usually in milliseconds), so that data queries may not return updated data instantly, or read data may not be accurate. Some NoSQL systems may contain wired or other forms of data loss. Some NoSQL provide the principle of write-ahead logging (WAL) to avoid data loss.

Hadoop is a set of freely distributable utilities, libraries, and frameworks for developing and running distributed applications running on clusters of hundreds and thousands of nodes. It is considered one of the main technologies of big data. Apache Hadoop is a free software platform and framework for distributed storage and processing of large datasets using the MapReduce programming model, in which the task is divided into many smaller isolated fragments, each of which can be run on a separate cluster node consisting of serial computers. All modules in Hadoop are designed with the assumption that the hardware often fails and such situations should be handled automatically by the framework.

The core of the Apache Hadoop system consists of the Hadoop Distributed Filesystem (HDFS) and the MapReduce-based computing system. Hadoop divides files into large blocks and distributes them between cluster nodes. It then passes the packed code to the nodes for parallel data processing. This approach uses data locality when nodes manipulate only the data they have access to. This allows the data set to be processed faster and more efficiently than in the more traditional supercomputer architecture, which relies on a parallel file system in which calculations and data for them are transmitted over a high-speed network.

The main Apache Hadoop framework consists of the following modules:

1) **Hadoop Common** – contains libraries and utilities needed by other Hadoop modules;

2) **Hadoop Distributed File System (HDFS)** – a distributed file system that stores data on conventional machines, providing very high overall bandwidth on the cluster as a whole;

3) **Hadoop YARN** – a platform responsible for managing computing resources in clusters and using them for user tasks;

4) **Hadoop MapReduce** – implementation of the MapReduce programming model for processing large amounts of data.

Over time, the term Hadoop began to be applied not only to the beforementioned core modules and submodules, but also to the "ecosystem", i.e. a set of additional software packages that can be installed on top of or next to Hadoop, such as Apache Pig, Apache Hive, Apache HBase, Apache Phoenix, Apache Spark, Apache ZooKeeper, Cloudera Impala, Apache Flume, Apache Sqoop, Apache Oozie, and Apache Storm.

R is a programming language for statistical data processing and graphics. It is widely used for data analysis and has actually become the standard for statistical calculations, analysis and graphical representation of data. The development of R took place under the significant influence of two existing programming languages: programming languages S with semantics inherited from Scheme. R is named after the first letter of its founders Ross Ihaka and Robert Gentleman of the University of Auckland in New Zealand. Despite some fundamental differences, most programs written in the S programming language run in the R environment. R is distributed free of charge under the GNU General Public License as freely available source code or compiled binary versions of most operating systems: Linux, FreeBSD, Microsoft Windows, Mac OS X, Solaris. R uses a text interface, but there are different graphical user interfaces. R has significant capabilities for statistical analysis, including linear and nonlinear regression, classical statistical tests, time series analysis, cluster analysis and more. R is easy to build thanks to the additional features and packages available on the Comprehensive R Archive Network (CRAN) website.

Hardware solutions. Teradata Corporation, EMC offers hardware and software systems designed for big data processing. These systems are delivered as ready-to-install telecommunication cabinets containing a cluster of servers and software for mass-parallel processing. This also sometimes includes hardware solutions for analytical processing in RAM, in particular SAP's Hana hardware and software complexes and Oracle's Exalytics complex, although such processing is not initially mass-parallel, and the amount of RAM of one node is limited to a few terabytes [26, 29, 31, 36–39].

The consulting company McKinsey, in addition to the technologies analyzed by most analysts NoSQL, MapReduce, Hadoop, R, includes in the context of large data applications also Business Intelligence technology and relational database management systems with SQL.

The use of Big Data technologies provides a great competitive advantage and opens up new opportunities, but their use without a deep understanding of a particular area and features of a particular activity is simply impossible. Competitive advantage must be provided by tools, both software and direct analytical. It is obvious that the need for qualified personnel will increase. However, if the IT development of Big Data services can involve trained IT professionals, then great analytics will require specially trained professionals. They must combine knowledge and experience of information technology with knowledge and experience of subject (economics, marketing, management, finance, etc.) areas. Therefore, it is necessary to modernize curricula and educational programs for training not only IT specialists, but also economic specialties of bachelor's and master's level, in which the basis for mastering Big Data should be the study of disciplines such as: Big Data, Big Data Management, Data Mining, Big Data Analytics and Business Intelligence.

Accelerating the digitalization of Ukraine’s economy will create a new quality of life, outline new opportunities for competitiveness in various sectors of the economy, positively affect the purchasing power of the population, make more accessible and better education, convenient digital services and applications, more attractive national economy for skilled workers.

Questions for self-control:

1. Why is Big Data the capital of the digital economy?
2. Explain the terms “Big Data” and “Data Science”.
3. How is the history of Big Data related to the Yale University Library?
4. Why did the problem of storing large amounts of data increase after the advent of the Internet?
5. Name the reasons for the introduction of Big Data in the business.
6. Explain why Big Data is considered an inexhaustible resource.
7. Basic principles of Big Data.
8. Discover the meaning of MapReduce technology.
9. Discover the meaning of the NoSQL database.
10. Discover the meaning of Hadoop technology.

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Appendix A

List of transactions that belong to electronic services and those that are not classified as such as of October 1, 2022 according to the Tax Code of Ukraine

Tax Code of Ukraine	
Electronic services:	**Transactions that don't belong to electronic services**:
1) supply of electronic copies, providing access to images, texts and information, including, but not exclusively, subscription to electronic newspapers, magazines, books, providing access and/or downloading of photos, graphic images, video materials; 2) providing access to databases, including the use of search engines and directory services on the Internet; 3) supply of electronic copies (electronic-digital information) and/or provision of access to audiovisual works, custom video and audio works, games, including services provision for participation in such games, services provision for access to television programs (channels) or their packages, except for access to television programs simultaneously with their broadcast through the television network; 4) providing access to informational, commercial, entertainment electronic resources and other similar resources, in particular, but not exclusively, placed on platforms for shared access to information or video materials; 5) distance learning services provision on the Internet, the implementation of which does not require human participation, including by granting access to virtual classes, educational resources in which students perform tasks online, and grades are assigned automatically, without human participation (or with minimal participation); 6) providing a cloud service in terms of providing computing resources, storage resources or electronic communication systems using cloud computing technologies; 7) providing advertising services on the Internet, mobile applications and other electronic resources, providing advertising space, including by placing banner advertising messages on websites, web pages or web portals.	1) supply of goods/services, the ordering (booking) of which is conducted via the Internet, using mobile applications and other electronic resources, and the actual supply is conducted without using the Internet (in particular, accommodation services, car rental, catering services for products supply, public transportation services and other similar services); 2) supply of goods and/or other services, different from electronic ones, which include electronic services only if their value is included in the total cost of such goods/services; 3) distance learning services provision on the Internet, if the Internet is used exclusively as a means of communication between the teacher and the student; 4) supply of copies of scientific, literature and art works on physical media; 5) consulting services provision by e-mail; 6) providing Internet access services.

Appendix B

List of available electronic services on the Diia platform as of 01.10.2022

A

Adoption: candidate registration.

Adult Certificate of recovery from COVID-19.

Adult COVID certificate of negative PCR testing.

Adult COVID vaccination certificate.

Application for a subsidy.

Application for a town-planning conditions and restrictions on land plot development.

Application for getting permanent residence status Diia.City.

Appointment of adequate user.

Automatic sole trader registration.

C

Certificate of acceptance of the object in operation.

Certificate of income.

Certificate of income of a pensioner.

Certificate of no criminal record.

Certificate OK-5.

Certificate OK-7.

Change of place of residence.

Child adoption consultation.

Childbirth assistance.

Children’s COVID certificate of negative PCR testing.

Children’s Certificate of recovery from COVID-19.

Children’s COVID vaccination certificate.

Extract on the name change.

Extract on the place of residence.

G

Grant for a garden.

Grant for a greenhouse.

Grant for processing enterprise.

Grant for your business.

I

Information on persons who reviewed information about the land plot.

Information on State Register of rights to real estate.

Information on the landowner.

Inspection of medical reports.

Inspection of road carrier.

Introducing Amendments to food market operators' capacities.

Introducing Amendments to a permit for construction work.

Introducing Amendments to sole trader.

Issuing construction passport.

L

License for auto transportation.

License for Firefighting.

License for import of medical products.

License for sale of pharmaceutical drugs.

License for the production of medicines.

Loan for housing for IDPs.

N

O

P

R

S

State registration of rights to real estate.

T

Tax return of single tax payer.

Transference of a legal entity to work under the model Articles of Association.

Termination of a permit for construction work.

Termination of non-profit status.

Termination of Notification on the commencement of preparatory works.

Termination of registration of food market operators' capacities.

Termination of sole trader.

Educational edition

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Manual

Computer design
and layout: *Viacheslav Tkachuk*

Zhytomyr Polytechnic State University
St. Chudnivska, 103, Zhytomyr, 10005

Формат 60х84/16. Ум. друк. арк. 31,39
Наклад 30 пр. Зам. № 0191.

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Свідоцтво серія ДК №7412 від 27.07.2021 р.

Друк та палітурні роботи ФОП О.О. Євенок
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