I.BRITCHENKO, O. CHUKURNA, T. TARDASKINA

DIGITAL ECONOMY

TEXTBOOK

Издателство на Българската академия на науките
"Проф. Марин Дринов"
Professor Marin Drinov Publishing House
of Bulgarian Academy of Sciences

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The textbook contains conceptual, methodological and methodological provisions for management in the digital economy. The replacement of the concept of the digital economy and the concept of management in the digital economy is open.

The development of cutting-edge technologies in management in the minds of the digital economy has been highlighted. Particular attention is paid to blockchain technology, dark calculations and great data (Big Data), as the basis for making decisions in the digital economy. Significant technologies for the development of artificial intelligence in various areas of business, e-commerce, management, marketing, finance and education. The fundamentals of information security management in the digital economy are reviewed. Provided diagrams, tables, rules for independent work.

For graduates and students of economic specialties, scientists.

CONTENT

INTRODUCTION

Digitalization is the main tool for achieving strategic goals for the development of Ukraine. In the current global environment, the need for information and knowledge is growing, the role of the digital economy and information and communication technologies is growing, the economic status of information is growing, which is radically changing life and activity of people.

Digitalization has become a stimulus for the development of the digital economy, the development of which has been reinforced by the leader of globalization. The digital economy is a new type of economy that is based on the use of local information technologies for the production, exchange and exchange of related goods and services.

In the minds of the digital economy, the paradigm of management is changing, the conceptual aspirations of which are changing conspicuously with the advancement of digital technologies, such as: Internet of speeches, robotization and cyber systems, piece intelligence, great data, paperless technologies, additive technologies (3D technology), cloud computing, drones and mobiles technologies, biometrics, quantum technologies, identification technologies, blockchain etc.

The management paradigm in the digital economy is being transformed in the context of changes in the value of goods and services in the digital economy, where the key factors of growth are digital data.

The goal of the textbook «Digital Economy» is the formation of theoretical knowledge and practical skills to the formation of conceptual foundations for economics in the digital economy.

The textbook to the conceptual, methodological and methodological provisions of management in the digital economy. The place of the concept of the digital economy, the concept of management in the digital economy is openly discussed.

Relevant is the development of technology to develop artificial intelligence in various areas of business, e-commerce, marketing, finance and lighting. The fundamentals of information security management in the digital economy are reviewed. The development of cutting-edge technologies in management in the minds of the digital economy is highlighted. Particular attention is paid to blockchain technology, dark calculations and great data (Big Data), as the basis for making decisions in the digital economy.

During the preparation of the initial guide, the use of local and foreign faculties was used. The textbook manual for the development of higher education components within the framework of the educational and professional program «Digital Economy» and «Digital Management» for students of the first (bachelor's) and other (master's) levels of higher education.

CHAPTER 1.

STAGE OF THE EMERGENCE OF THE DIGITAL ECONOMY

1.1. Influence of techno-economic structures on the formation of the foundations of the digital economy.
1.2. Change in the paradigm of human development depending on changes in technologies.
1.3. The concept of the digital economy and its periodization.
1.4. Global nature of the digital economy.

1.1. Influence of techno-economic structures on the formation of the foundations of the digital economy.

Beginning from the mid-20th century to the present day, the world economy has been undergoing transformations associated with changes in the technical and economic structure of society and global processes.

The development and spread of information and computer technologies, digitization of all spheres of life have contributed to the acceleration of communication processes and interaction between people.

The transformation of socio-economic relations associated with the spread of information technology is interpreted differently by various scientific schools.

In the 1970s and 1980s, scientific views on the theory of post-industrial or information society were widespread in economic literature. These views had a significant impact on the development of the theory of value, which assumed the emergence of a new factor influencing value - information and knowledge. In this aspect, the theory of the information society developed the concept of value, adding to the socially necessary costs of producing goods another significant factor - information, which led to the emergence of the information concept of value.

This thesis was justified by D. Bell, who believed that “if knowledge in its systemic form is used in the practical processing of existing production resources, then they, and not labor, can be considered to be the source of value” [69].

In turn, the founder of knowledge economics, Mahlup, also suggested that new knowledge in the field of technology creates a tendency to switch demand from physical labor to mental labor [91].

The famous scientist M. Castells considers the information economy as an era of globalization, in which the processing and use of information is the main source of labor productivity. That is, new information technologies serve as the material basis of the global economy [71].

The founders of the theory of the information society are united in their approach to justifying the concept of value, the source of which becomes information and knowledge, rather than material labor and traditional production factors.

The concept of technological structures was first proposed by S. Y. Glaziev and D. S. Lvov in 1986.

Technological structures are understood to mean groups of technological aggregates that are distinguished in the technological structure of the economy, related to each other by identical technological chains and forming reproducing entities.

Each such structure represents a complete and stable formation, within which a complete technological cycle is carried out, including the extraction and reception of primary resources, all stages of their processing, and the release of a set of final products that satisfy the corresponding type of public consumption.

The periodization and classification of technological structures according to S. Y. Glaziev are presented in Table 1.1.

Table 1.1. - The periodization and classification of technological structures according to S. Y. Glaziev

Stage of developme nt	Nucleus of technological structure	Prevalent infrastructure	Organization of production
1770–1830 The beginning	Textile industry, textile engineering, iron smelting, iron	roads, irrigation canals	factory production

of industrial revolution	processing, canal construction, water engine		
1830–1880 The age of steam	steam engine, railway construction, transport, machine and shipbuilding, coal, machine tool industry, black metallurgy	railways, shipping lines	industrial mechanization, urbanization
1880–1930 The age of steel	electromechanical, heavy engineering, steel production and rolling, power transmission lines, inorganic chemistry	power grids, post, telegraph, radio, telephone, railways	production standardization
1930–1970 The age of oil	Automotive, tractor construction, non-ferrous metallurgy, durable goods, synthetic materials, organic chemistry, oil production and refining	high-speed motorways, power grids, pipelines, radio and television communications, shipping and airlines	mass production, quality growth
1970–2010. Scientific and technological revolution	electronic industry, computing, fiber-optic technology, software, telecommunications, robotics, gas	computer networks, satellite communications, internet, global energy	networking, logistics, clusters, outsourcing

	producing and processing, information services	systems, airlines	
2010–2050 Digital revolution	biotechnologies based on the achievements of molecular biology and genetic engineering, nanotechnology, artificial intelligence systems.	global information networks and integrated high-speed transport systems	virtual services, 3D printers, Internet of Things, cloud infrastructure

The key shift in the periodization of technological structures is information. Starting from the 1970s, knowledge and information as a valuable asset become the property of the entire society, i.e. a new factor of production. This creates conditions for the development of the fundamental foundations of the information economy or knowledge economy.

During the period of development of the information economy, information acquires the following characteristics.

1. Information is a connecting link between all economic stages. Information exchange systems are introduced into the production process. Information is necessary for the functioning of all four stages of the reproduction process. Various types of information such as technologies, standards, processes are used to organize production. At the stage of consumption information begins to take on commodity character.

2. Information can be a specific economic good that is produced, distributed, exchanged and consumed. The materialization of information leads to the creation of new technologies, the development of new products, equipment, and other intangible assets.

Production at information industry enterprises has a number of features. In particular, primary information is the subject of labor in this industry, and various means of its transformation, storage, and transmission are the means of labor. The goal of production is to satisfy the customer. This leads to problems in evaluating labor, finished products, and the effectiveness of information activities.

Ownership of information is the basis of monopoly power, since ownership of patents and licenses serves as a barrier to entry into the industry. There is another important aspect related to the transfer of information - the conditions of sale of technologies. They may include restrictions that affect competition.

The characteristics of an information product are as follows:

1. information does not disappear when consumed and can be used multiple times. The information product retains the information contained in it, regardless of how many times it has been used. This property of information is called ***durability***.

2. over time, the information product undergoes ***moral obsolescence.*** Although information does not wear out when used, it can lose its value as the knowledge it provides becomes outdated. In different fields of science and technology, the rates of knowledge depreciation varies and can last from five to fifteen years;

3. different consumers of information goods and services find different ways of providing and delivering information convenient, as consuming information products requires effort. This is the property of information ***addressability***. Thanks to this property, as well as the aging property, the need for information products can never be satisfied once and for all;

4. unlike the production of material goods, the production of information requires significant costs compared to the cost of replication. Copying a particular information product is usually much cheaper than producing it. This property of information products - ***the difficulty of production and the relative simplicity of replication*** - creates many problems in determining property rights in the field of information activities;

5. ***non-self-dependence*** - manifested in the fact that the consumption of information is associated with the consumption of other resources.

Most of the methods used to determine the costs of producing information goods and services are based on the same principles that are used to evaluate the costs of producing ordinary goods and services.

The peculiarity of information as a commodity makes it difficult to determine the costs of its production using traditional methods. This is due to the complexity of determining the relationship between the costs and results of information activities. In cases where the factor of timely use of information products plays a significant role, the effect of information impact is disproportionate to the efforts expended on information production. A whole range of information goods and services have a short life cycle, but their timely use has a huge effect.

All these features of information that characterize it as a production factor have influenced the change in the cost structure. The periodization of changes in cost factors depending on the transformation of technological structures is presented in Table 1.2.

Table 1.2 - Periodization of changes in cost factors depending on the transformation of technological structures [62]

Technokogical structure	**The factor of production, underlying the formation of value**	**Innovative structure**
The second (1840-1890) and the third (1890-1940) technological structure	Labour, land (rent), capital. Value is formed on the basis of expenses	Light industry technologies, water and steam power technologies, mechanisation of all industries are on the basis of steam engine. **Key factor**: steam engine
The third (1890-1940) technological structure	Labour, land (rent), capital. Value is formed on the basis of costs. But the concentration of	Use of electric power, development of heavy engineering, chemical industry. Advent and spread of radio communication,

	banking and financial capital increases the influence of capital as a factor of production.	telegraph, automobiles. **Key factor**: electrical engine
The fourth (1940-1990) technological structure	Labour, land (rent), capital Value is formed on the basis of expenses.	Development of energy using oil, petroleum products and gas, as well as means of communication of new synthetic materials. **Key factor:** internal combustion engine
The fifth (1990-2020) technological structure	Labour, land (rent), capital and information. Value for the consumer starts to play a significant role in the basis of value formation. The demand factor becomes the decisive one, which is based on the consumer's perception of the value of the product	Achievements in the field of microelectronics, computer science, biotechnology, genetic engineering, development of new types of energy, space, satellite communications. **Key factor**: gas technologies.
The sixth (since 1995 till present time) technological structure	Labour, land (rent), capital and information. Value is formed based on the value of the	Development of biotechnology, medicine, nanotechnology, information and IT technologies,

	product to the consumer.	optoelectronics, aerospace industry. **Key factor**: non-traditional energy sources.
The seventh technological structure (since 2005 till present time)	Labour, land (rent), capital information and knowledge. Value is formed on the value created by the enterprise (multinational corporations).	Development of neurotechnology, genetic engineering, artificial intelligence, unmanned vehicles, implantable technologies. **Key factor**: non-traditional energy sources.

Thus, information, as a new factor of production, has become a key lever for economic base transformation.

Based on the periodization of changes in cost factors depending on the transformation of technological structures, the evolution of marketing concepts based on the change of technological structures was formed, which is presented in Appendix A.

To develop the production and society, it is important to master information as an inexhaustible cognitive resource, as well as to transform the main types of economic activity that are associated with the development of personality into a means of renewing and increasing this factor. This is where global progress lies.

1.2. Change in the paradigm of human development depending on changes in technologies.

The defining paradigm of human development in the general philosophical sense is his thinking, which is reflected in the term “homo sapiens” - the rational human. The direction and characteristics of human behavior are determined by the specific historical conditions of his activities and the system of values that dominates in society.

Within the general paradigm of “homo sapiens”, subparadigms develop in various cultural fields.

In the context of studying the role of human beings from a socio-economic perspective, the following paradigms are of particular importance:

– *«homo faber»,*

– *«homo economicus»*

– *«homo intelligens».*

«Homo faber» provides for the orientation of the human mind towards labour and economic activity “Homo faber”, as an individual, is a holistic person with experience, skills, knowledge, profession, and qualifications, and at the same time, a partial element of a complex socio-economic system with a specific place in the system of public and manufacturing division of labor and a specific type of activity

"Homo faber" also includes the internal motives of man activity. The main source of his existence is payment for labour or income from the application of his labour.

"Homo economicus" or economic man was formed in the 18th century and reflected in the classical political economy of A. Smith, D. Ricardo, J.B. Say and others. From the point of view of relations between producer and consumer, this man was formed from "homo faber". At the same time, he is not only engaged in production and consumption, but also has the goal of obtaining benefits.

The specific feature of “homo economicus” is the rationality of his behavior. The main motives of human behavior lie primarily in satisfying personal needs. Thus, egoistic principles prevail in him. For his rational behavior, an individual strives for private property, freedom of choice of activity, information, strives to develop innovative abilities, and often takes risks.

Unlike "homo faber", whose main source of existence is salary, "homo economicus" has entrepreneurial income, profit, rent, interest, and dividend.

"Homo intelligens" - a person educated, with a high level of intelligence, informed, understanding that each person on the one hand is an individual with his own interests, on the other hand each person is a member of a collective, society and therefore there are collective public interests, which can be satisfied only on the basis of mutual understanding.

The foundations for the transformation of the human paradigm and his role in socio-economic life were laid down as society transformed under the conditions of scientific and technological progress.

The evolution of the human paradigm is closely connected and dependent on industrial revolutions that accompanied scientific and technological progress and economic development of society. Specifically, the Fourth Industrial Revolution or "Industry 4.0" facilitated the transition from the paradigm of human development "homo faber" to "homo intelligens".

Table 1.3 – Four industrial revolutions according to K. Schwab

Industrial revolution	Main source of growth
1770–1860: 1st industrial revolution – the age of steam and spinning	Steam engine, spinning and weaving machine, metallurgy, lathe
1860–1900: 2nd industrial revolution - the age of steel and flow production	Telegraph, railways, combustion engine, conveyor
1970–2010 г: 3d industrial revolution –the age of computers	Computers, electronics, nuclear power, robots
2010–2060s: 4th industrial revolution – the age of cyber physical systems, internet, digital	NBIC technologies, genetic engineering, 3D printers, RES, drones, Internet of Things

Let's consider the technologies that formed industrial revolutions and created conditions for further scientific and technological progress.

– 1st industrial revolution.

The first industrial revolution (late 18th - early 19th centuries) was caused by the transition from an agrarian economy to industrial production due to the invention of steam power, mechanical devices, and the development of metallurgy.

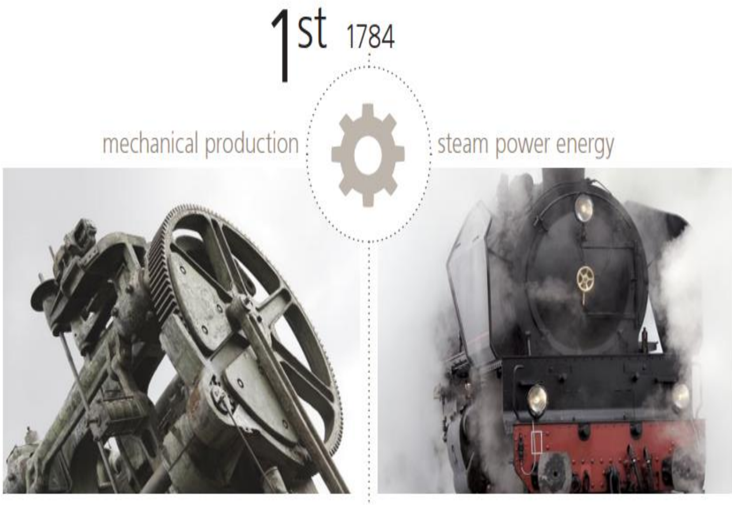

Figure 1.1. –The 1st industrial revolution

– 2nd industrial revolution

The second industrial revolution (the second half of 18th – early 20th) – invention of electrical energy, the following the mass production and division of labour.

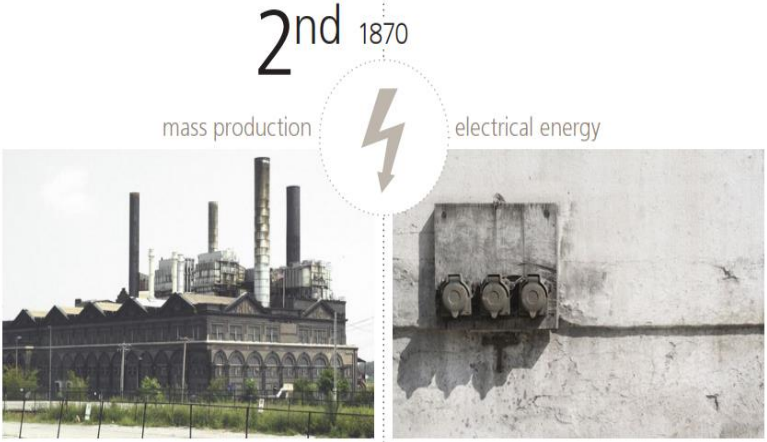

Figure 1.2. The 2nd industrial revolution

–3d industrial revolution

The third industrial revolution (since 1970) - application of electronic and information systems in production, which ensured intensive and robotic automation of production processes.

Figure 1.3. The 3d industrial revolution

–4th industrial revolution

The fourth industrial revolution (the term was introduced in 2011, within German initiative - Industry 4.0).

Figure 1.4. The4th industrial revolution

Industry 4.0 represents a transition to fully automated digital production, controlled by intelligent systems in real-time interaction with the external environment, extending beyond the boundaries of a single enterprise, with the prospect of integration into a global industrial network of Things and Services.

In a narrow sense, Industry 4.0 (Industrie 4.0) is the name of one of the 10 projects of Germany state Hi-Tech strategy, which was originally designed until 2020. This strategy describes the concept of smart manufacturing based on a global industrial network of the Internet of Things and Services.

In a broader sense Industry 4.0 characterizes the current trend of automation and data exchange, which includes cyber-physical systems, the Internet of Things and cloud computing. It represents a new level of production organization and value chain management throughout the entire lifecycle of manufactured products.

The Fourth Industrial Revolution is considered as a new level of organization and management of the value chain throughout the entire life cycle of manufactured products, which is characterized by the following trends:

– transition from simple digitalization (third industrial revolution) to innovation based on the integration of technologies (fourth revolution) into a coherent whole;

– the trend of convergence of the physical, digital and biological worlds, leading to new technologies and platforms and the creation of cyber-physical systems;

– the development of the internet of services. New technologies have made it possible to find new ways to deliver goods to the consumer, which has changed logistics chains;

– increasing transparency in the relations between the population and the authorities, as well as in the activities of power structures, leading to decentralization and redistribution of state power;

– dramatic transformation of world community, including social, economic and political spheres;

– change of a person position in the world, restructuring of his/her inner world, relationships in the family and with society, transformation of the habitual way of life, everyday life, family, living environment, social and economic processes in society, system of economic property relations.

Potential benefits of applying the technology “Industry 4.0”are the following:

– reduction in product maintenance costs by 10-40%;

– increase in labor productivity by 3-5%

– reduction of equipment downtime by 30-50%;

– reduction in time-to-market for new products by 20-50%;

– increase in forecast accuracy by up to 85%;

– reduction in quality assurance costs by 10-20%;

– reduction in inventory holding costs by 20-50%;

– increase in technical function productivity by 45-55% due to labor automation.

One can clearly notice the interconnection and comparability of two concepts: technological paradigms and industrial revolutions. Thus, using the periodization of S. Y. Glaziev and K. Schwab, the place of the digital economy on the time scale is 2010-2060, and it is organically embedded in the final phase of the 6th technological paradigm or the 4th industrial revolution

1.3. The concept of the digital economy and its periodization.

The digital revolution, which has swept the global economy, is impressive in its scale, pace, and geography. Since the 1960s digital innovations have spread around the world in waves emanating from various global scientific centers. Each of these waves was more intense than the previous one, covering new regions and having an increasingly significant effect on the economy.

The first wave of digital innovations was limited to the automation of existing technologies and business processes.

The second wave came in the mid-1990s, when the spread of the internet, mobile communications, social networks, and the emergence of smartphones led to a rapid increase in the use of technology by end-users.

Today, the third wave of digital technologies is changing the very business model of companies, increasing cost-effectiveness, and revealing new opportunities in the market.

Based on the impact of innovations on the global economy, the following periodization of the digital economy can be distinguished.

The first stage (1850-1950s) is associated with the formation of the digital economy and the emergence of the first telecommunications technologies and inventions.

The second stage begins in the 1960s, when the digital economy begins to develop actively, and digital innovations oriented towards the mass consumer begin to spread widely around the world.

The third stage of digitalization started in the early 1990s. With the advent of the World Wide Web (Web 1.0), the Internet began to spread globally in all areas of public life. Web 1.0 technologies are a centralized Internet system.

The main data transmission protocols in Web 1.0 are:

– **HTML** is a markup language that serves as the foundation of the Internet's interface and is still used today.

– **URL** is a universal resource identifier, which is a unique address used to identify each specific website on the Internet.

– **HTTP** is a hypertext transfer protocol that allows resources to be extracted from the Internet.

The fourth stage (2001-2009) is characterized by the active commercial exploitation of high-speed mobile communication systems, the emergence of smartphones, the formation of an international information and communication infrastructure, and the spread of electronic payment systems and internet services. This became possible thanks to the emergence of the decentralized internet or Web 2.0

The main substantial distinguishing features of Web 2.0 are the following:

– development and active use of social networks. Users actively create content, and the blogging industry is developing;

– various aggregators appear in all areas that can only be imagined (taxi, car sharing, tourism, rental of something, entertainment, communication, etc.), and mobile applications that raise the usefulness of the network to a new level are also actively developing;

– Web 2.0 affects not only the information sphere, but also the economic sphere. Users can now earn money online. In particular, blogging is beginning to turn into a full-fledged profession, some services can be monetized by the user (e.g. Airbnb);

– data transfer protocols such as XML, RSS, AJAX, Java Script, CSS and many others are added to Web 1.0 technologies.

The fifth stage of digitalization (since 2010) is associated with the rapid expansion of the mobile and cloud application market, the beginning of mass use of new digital technologies, and the spread of cryptocurrencies in the global economy. Web 3.0 technologies are developing.

Web 3.0 is a concept of using the Internet by the general public in the nearest future, considering the active development and implementation of blockchain-based technologies. It is assumed that the new online network will be free from the negative effects that led to the development of Web 2.0, that is, it will allow people to fully own and manage the content they create, as well as anonymize their personal data, making the Internet more fair and secure. There are the following characteristic features of Web 3.0:

– users will become full owners of their own content, with no possibility of unauthorized censorship.

– users will have the ability to monetize their content.

– users of the network actively participate in ensuring the network functioning, thereby creating the infrastructure of this network. Active involvement is stimulated by value distribution algorithms (for example, through cryptocurrencies).

– users will own their personal data themselves, with a high degree of anonymization of this data (data is stored in the blockchain, not on the service of a centralized company, authorization in services can occur by signing digital certificates, providing tokens, performing hash functions, or in any other way conditioned by smart contracts).

– Artificial intelligence, machine learning, blockchain, RDF, RDFS, OWL, and others are added to Web 2.0 technologies .

Starting from 2011, when the term Industry 4.0 was announced at the Davos Forum, many countries began developing state programs for the development and stimulation of digital transformation of industry.

In 2016 the Japanese government has adopted a strategy for building "Society 5.0," the foundations of which were developed at the initiative and active participation of the Japanese Federation of Business "Keidanren." The plan for Japan's development envisaged solving the most important problems of Japanese society - reducing the population, aging, and childlessness of working citizens. It was the solution to these problems that formed the basis of the new paradigm. In March 2017, at the CeBIT exhibition, held in Hanover, Japan's Prime Minister Shinzo Abe presented the program "Society 5.0" to participants and the global community.

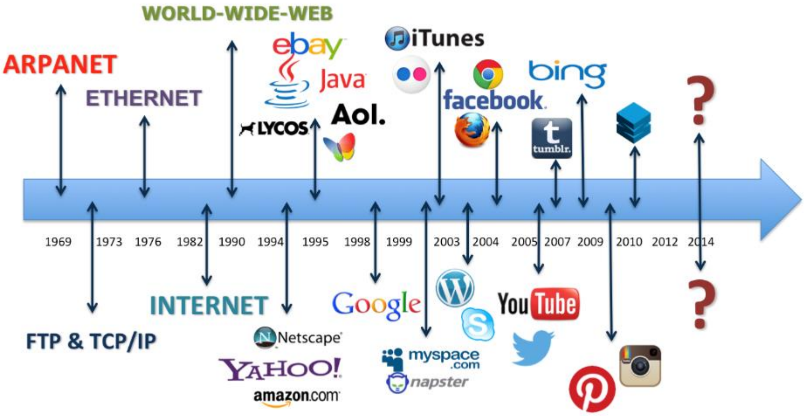

Figure 1.5. Periodization of digitalization, based on Web technologies of different generations

The term "Society 5.0" refers to a new historical type of organization of the socio-economic structure, which replaces the four previous types: hunter-gatherer society (1.0), agricultural (2.0), industrial (3.0), and information (4.0) societies.

"Society 5.0" represents a new social paradigm that replaces the information society (Society 4.0) and implies the total spread of IoT (Internet of Things), its application to Big Data (technology for working with huge amounts of data), and AI (artificial intelligence). In other words, all socially significant processes in physical space are accompanied by the collection of information, which is digitized and directed into virtual space. There, based on its analysis and processing using artificial intelligence, decisions are made and sent back to the world of physical things. "Society 5.0" is also known as "super smart society (Fig.1.6.)

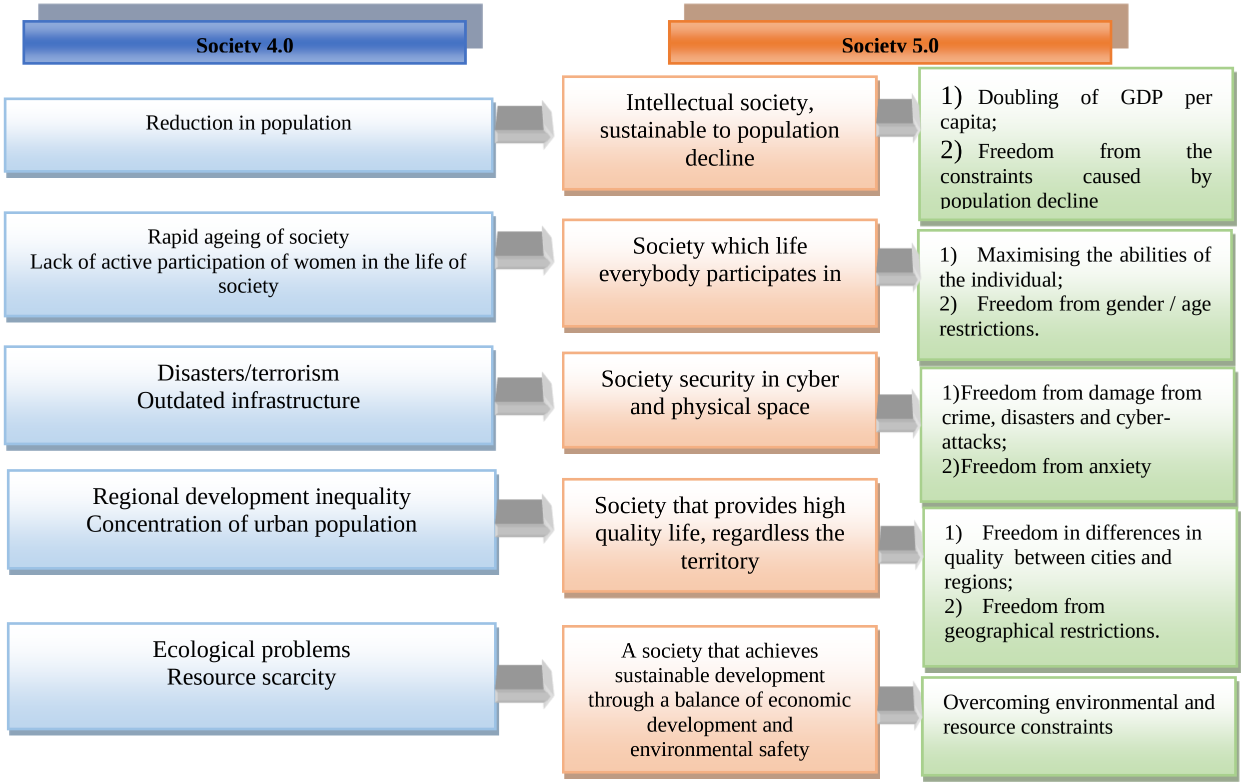

Figure 1.6. Transformation «Society 4.0.» to «Society 5.0.»

The essence of Society 5.0 is the integration of physical and cyber spaces to unite resources of the society as a whole, rather than of individual people.

The paradigm of Society 5.0 is becoming a new stage of globalization. However, most countries will still be far from implementing this concept. Nowadays it is becoming increasingly clear that the new paradigm requires the need to change national legislation and development strategies of states.

The transition to Society 5.0 will be associated with semantic and ideological changes, just like all previous technological revolutions. All civilizational components will change, namely, the essence and functions of politics, economics, production, communication, religion, etc. The world is moving towards augmented and virtual reality, which is becoming a part of people's lives. It is quite possible that technological gaps in societies between 2.0 and 5.0 will lead to new crises, political manipulations, and make them even more dependent on more developed countries

Corporation "Mitsubishi Electric", being one of the world leaders in industrial and infrastructure innovations, actively participates in the creation and implementation of the concept of "Society 5.0" not only in Japan but also in other countries. The company already offers its partners solutions and services based on high-tech, reliable, and cyber-protected "smart" systems that are ready for use in the digital economy. For example, the e-F@ctory platform for industrial enterprises, which is one of the key elements of "Society 5.0".

Based on the evolution of digitization, the periodization of its transformation stages, and its impact on all spheres of public life, theoretical directions and fundamental theories of the emergence of the concept of the digital economy have appeared.

The history of the term "digital economy," according to many researchers, dates back to Nicholas Negroponte, an American scientist from the Massachusetts Institute of Technology, who in 1995 used a metaphor of transitioning from processing atoms that make up the matter of physical substances to processing bits that make up the matter of software codes.

Other experts notice that the term “digital economy” was first coined by Canadian scientist Tapscott in 1994 in the publication "Electronic Digital Society: Pros and Cons of the Age of Networked Intelligence". In this work [113] D. Tapscott describes the features of developed countries and notes the digital form of object representation, the impact of information technology on business and the system of government, also he defines the digital economy as an economy based on the use of information computer technologies.

In 1999, Neil Lane, the assistant of the US President in Science and Technology, in his article “Development of the Digital Economy in the 21st Century,” was actually the first to give a definition of the phenomenon under consideration: “The digital economy is the convergence of computer and communication technologies on the Internet and the emerging flow of information and technologies that stimulate the development of e-commerce and large-scale changes in organizational structure [88].

1. In 2001, Thomas Mezenburg identified three main components of the digital economy that can be statistically evaluated and measured: supporting infrastructure, e-business, and e-commerce [98].

Approaches to interpreting the concept of the “digital economy” are presented in Table 1.4.

Table 1.4. - Approaches to interpreting the concept of the “digital economy”

[Australian Government, 2009].	A global network of economic and social activities supported through digital platforms on the Internet and mobile and sensor networks
[World Bank, 2016].	New economic structure based on knowledge and digital technologies, within which new digital skills and opportunities are formed for society, business, and government”.

[British Computer Society, 2013].	Economy based on digital technology, however, to a greater extent we understand this to mean conducting business operations on markets based on the Internet and the World Wide Web.
[Fayyaz, 2018].	Markets, based on digital technology, facilitating services and commodity trade by means of e-commerce in the Internet.
[European Parliament, 2015].	Complex structure, consisting of multiple levels/layers connected by an almost constantly increasing infinite number of nodes.
[The Economist, 2014].	An economy capable of providing quality ICT infrastructure and mobilizing ICT capabilities for the benefit of consumers, business and government
[Deloitte, 2019].	A form of economic activity that arises from billions of examples of network interactions between people, businesses, devices, data, and processes. The basis of the digital economy is hyperconnectivity, which is the growing interdependence of people, organizations, and machines, formed by the Internet, mobile technologies, and the Internet of Things
[European Commission, 2014].	Economy, dependent on digital technology
[OECD, 2015*a*].	The digital economy is characterized by reliance on intangible assets, mass use of data, ubiquitous implementation of multi-sided business models, and complexity in determining the jurisdiction in which value is created
[European Commission, 2018].	The digital economy is the main source of growth. It will stimulate competitiveness, investment and innovations, which will lead to improved service quality, expanded consumer choice, and the creation of new jobs
[World Bank, 2016].	The digital economy is characterized by increased labor productivity, competitiveness of companies, reduced production costs, creation of new jobs, poverty reduction, and social inequality reduction due to the development of digital technologies

Comparative analysis of numerous definitions of the digital economy allows us to classify views on this concept based on the use of the following attributes:

– type of economy characterized by active implementation and practical use of digital technologies for collecting, storing, processing, transforming, and transmitting information in all areas of human activity;

– a set of economic activities as a branch of the national economy for the production and trade of digital goods and services in the virtual environment;

– system of social economic and organizational technical relations based on the use of real-time digital information and telecommunication technologies and networks;

– a complex combination of various elements (technical, infrastructural, organizational, programmatic, regulatory, legislative, etc.), representing an addition to the real economy, oriented towards sustainable economic development.

The digital economy is a system of social, cultural, economic, and technological relations between the state, business community, and citizens, functioning in the global information space, generating digital types and forms of production and promotion of products and services, which contributes to continuous innovative changes in management methods and technologies to increase the efficiency of social economic processes.

The digital economy is composed of three basic components:

– *infrastructure*, including hardware, software, telecommunications, etc.;

– *electronic business transactions* covering business operations carried out through computer networks within the framework of virtual interactions between subjects of the virtual market;

– *e-commerce*, encompassing all financial and trade transactions carried out through computer networks, as well as business processes related to the conduct of such transactions.

There are the following branches of the digital economy:

1) *e-commerce* – a new type of non-store trade in goods and services that occurs via the Internet in virtual shops;

2) *online – marketing* is a complex of marketing activities of a company related to the use of electronic facilities, the object of which is the informational analytical and expert research activities of an enterprise (organization, company);

3) *online – banking* – is a type of banking service that allows customers to carry out transactions and other banking activities without visiting a bank branch. It is often carried out using computer and telephone networks;

4) *online insurance services* – insurance services, that can be ordered via the Internet.

The subjects of the digital economy are:

– *digital transnational corporations* are the 6th generation transnational corporations (cyber corporations) that have changed the shape and efficiency of global markets as well as their own structure through transactions on the Internet. These include: Apple, Google, Hon Hai, IBM, Microsoft, Amazon, Oracle, Samsung, Sony, LG, America Movil, Deutsche Telekom, NTT, HuaWei, Vodafone and others.;

– *"unicorn companies"* are non-public technology companies whose value exceeds $1bln. For example: ByteDance, Didi Chuxing, JUUL Labs, WeWork, Airbnb and others;;

– *companies*, engaged in the production of ICT goods and services;

– *innovative centers* and high-tech parks;

– persons employed in digital enterprises.

The institutional structure of the digital economy looks as follows (Fig.3).

Objects of the digital economy are vast; they operate in an integrated way as a "people-business-things" paradigm, cover more than 3,000 activities and include more than 1,800 types of cryptocurrencies, the world of Internet Things, networked funding organization (crowdfunding), digital currency exchanges, private and public equity, etc.

According to McKinsey research, the digitalization of the economy can be digitization of the economy can be no less powerful tool for increasing its productivity and competitiveness than creating technological innovations as they are. According to their estimates, in

China up to 22% of GDP growth by 2025 can occur due to digital technologies, in the United States - up to 10%.

The distinguishing feature of the digital economy is the concentration of economic activity on ecosystems that represent a digital environment with a set of functions and services that meet the needs of consumers and producers, as well as implementing opportunities for direct interaction between them. The value of a digital ecosystem lies in providing the possibility of direct communication and facilitating the procedure of interaction between participants.

Digital ecosystems reduce costs and provide additional functionality for all participants in the digital economy. Successful business models that operate on the basis of digital ecosystems include Uber and Airbnb.

New business-models implementation in the digital economy based on digital platforms has allowed for the formation of a greater number of interconnections between participants in digital markets, namely:

– *B2B (business-to-business*) – interaction of various businesses (private companies) between each other;

– *B2C (business-to-customer/consumer)* – interaction of business with customers;

– *B2G (business-to-government)* – interaction of private business with the state;

– *C2B (customer-to-business)* – interaction of a customer (individual) with a business;

– *C2C (customer-to-customer)* – interaction of a customer with a customer.

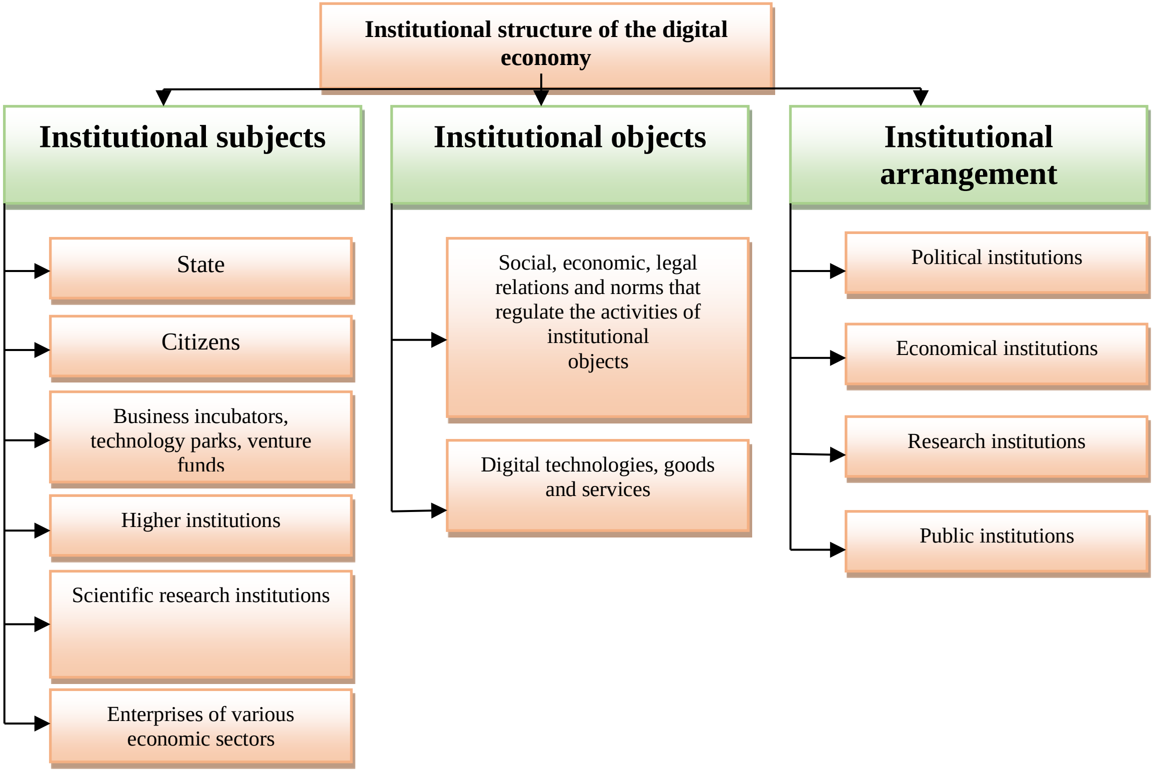

Figure 1.7. Institutional structure of the digital economy

1.4. Global nature of the digital economy.

The term globalization was first applied in economic terminology by the American sociologist R. Robertson, who used this term in his article in 1983. By 1992, R. Robertson had outlined the basics of his concept as an idea of the integrity of the world, which is conditioned upon the spread of the achievements of Western civilization.

The scientific research conducted by members of the Club of Rome (A. Peccei, D. Meadows, J. Tinbergen, J. Forrester) contributed to the spread and popularization of the ideas of globalization. In fact, the scientists of the Club of Rome founded the first scientific school of globalism, which dealt with global modeling, global problems, and philosophical considerations about human existence in the modern world, values of life, and prospects for the development of humanity

J. Forrester first substantiated the global problems of humanity in his research published in the book "World Dynamics" (1971), in which he emphasized that further development of humanity on the physically limited planet Earth will lead to an ecological catastrophe in the 2020s

D. Meadows completed J. Forrester's research and proposed the "system dynamics" method in his study "The Limits to Growth" (1972) [96]. However, the approach proposed by Meadows was not adapted to the regional world model, so it received critical reviews. Despite some drawbacks, the Forrester-Meadows models were given the status of the first report of the Club of Rome. In addition, the "Limits to Growth" study laid the foundation for a whole series of studies and reports of the Club of Rome, which received a deep development of the issue related to economic growth, development, education, consequences of the application of new technologies, global thinking. This approach became fundamental in the foundation of the first school of globalism, which received the name of the scientific concept "Limits to Growth" .

The following studies of the Club of Rome were based on the scientific works of M. Mesarovic and E. Pestel [29], who proposed the concept of "organic growth", according to which each region of the world should fulfil its special function, like a cell of a living organism.

In general, the representatives of the first school of globalism, who conducted scientific research within the framework of the Club of Rome, based their scientific views on an attempt to model the global economic dynamics based on five interconnected variables (population, capital investment, use of non-renewable resources, environmental pollution, food production) and formed a working hypothesis about the dysfunctionality of the global system

The next work of the Club of Rome is the report by J. Tinbergen "Reshaping the International Order" (1976). The approach outlined by J. Tinbergen differs significantly from previous works and belongs to the second school of globalism. It revealed specific recommendations regarding principles of behavior and activity, main directions of policy, creation of new or reorganization of existing institutions in order to provide conditions for more sustainable development of the world system. In other words, a concept of sustainable development of the world economy was developed. Other representatives of this school (L. Brown) proved the inefficiency and underdevelopment of traditional human society, the main cause and consequence of which is excessive demographic growth. The main goal of the concept of sustainable development, according to its authors, is to search for new ways that would ensure progress of humanity not only in elite regions and in short periods (cycles), but also in the entire global space and in the long term [52].

The third school of the globalism under the name "Universal evolutionism" is associated with Vernadsky's theory of noospheric doctrine, which was improved by N. Moiseyev. According to representatives of this school of thought, the global nature should be viewed as a self-organizing system, the reaction of which, although unpredictable due to an incredible number of critical threshold factors, is inevitable in the long term. The founders of this concept assume a reverse reaction of the biosphere to the processes of global development.

The fourth school of globalism, "Mitosis of Biosphere", has an indirect relation to globalism, but is considered important in the theory of rationalizing human ecological activity. The main representative of this school is M. Nelson [34], who condsidered that the genesis of the paradigm of ecotechnology is conditioned by the practical needs of cosmonautics in creating small-scale artificial biospheres with specified qualities. The idea was to achieve results for improving the Earth biosphere and for forming the noosphere, which is understood as the synthesis of the biosphere and the technosphere. Moreover, the technosphere is understood as a new culture type, the area of distribution of which will be the planetary market.

The fifth school of globalism, “Controlled Global Development”, represented by D. Gvishiani and E. Kochetov [25], considers globalization in the context of information society, which has a significant focus on social issues.

The sixth school of globalism “The World-System Analysis”, founded by I. Wallerstein, developed a paradigm for the development of economies, system histories, and civilizations. The basis of this paradigm is the capitalist world, as the first historical form of the global system, developing in the interaction of the core, semi-periphery, and periphery of the world [127]. The process of capital reproduction is a characteristic of the capitalist economic system and is accompanied by cyclical crises with a periodicity of 50-100 years. The paradigm of world-system analysis is close in conceptual principles to the concept of “Global Socialization of Future Development” proposed by the International Sociological Association.

I. Wallerstein’s approach deserves attention as it is based on the study of a great historical period of capitalism development. This approach is based on the historical process of forming the world economy, illustrating three stages of the formation and development of classical capitalism: simple cooperation (mid-16th century), manufacturing production (16th-18th centuries), and large machine production (18th-20th centuries). During the period of industrial revolutions in capitalist countries (starting from the mid-18th century) and the introduction of the electrical revolution (the last third of the 19th to the beginning of the 20th century), the historical formation of the world economy was completed. In addition, this approach fully justifies the global heterogeneity of economic development, reinforced by the collapse of the USSR and the emergence of a new economic phenomenon, countries with transitional economies (emerging markets). The main approaches to substantiating the scientific concepts of globalism schools are presented in Table 1.5.

Table 1.5.- Characteristics of the main schools of globalism

Scientific schools of globalism	Representatives	Scientific approaches to global development
The school of "The Limits to Growth" concept	A. Pechei, D. Meadows, J. Forrester, M. Mesarovic, E. Pestel	The modeling of global economic dynamics based on five interconnected variables (population, capital investment, use of non-renewable resources, environmental pollution, food production) and the formation of a working hypothesis about the dysfunctionality of the global system
The school of "sustainable development"	L. Brown, J. Tinberger	Inefficiency and underdevelopment of traditional human society as the cause and effect of excessive population growth. The ultimate goal of the sustainable development program is to find new ways to ensure progress for humanity not only in elite regions and short periods (cycles), but also in the entire global space and in the long term
The school of "Universal evolutionism"	V. Vernadsky, N. Moiseyev	The global nature is considered as a self-organizing system, the reaction of which, although unpredictable due to an incredible number of critical threshold factors, is inevitable in

		the long term. The initiators of the concept call for taking into account the reverse reaction of the biosphere to the processes of global development
The school of “Mitosis of Biosheres”	M. Nelson	It is considered important in the theory of rationalizing human ecological activity.The idea was to achieve results for improving the Earth’s biosphere and for forming the noosphere, which is understood as the synthesis of the biosphere and the technosphere. Moreover, the technosphere is understood as a new culture type, the area of distribution of which will be the planetary market
The school of “Controlled global develomnent”	D. Gvishnani, E. Kochetov	Globalization is considered in the context of the information society, where significant attention is paid to social problems
The school “”World-System Analysis	I. Wallerstein	The paradigm for the development of economies, system histories, and civilizations has been developed. The basis of this paradigm is the capitalist world as the first historical form of the global system, developing in the interaction of the core, semi-periphery, and periphery of the world.

All the schools of globalism have different fundamental approaches to globalization as a process and concept of human development. There is no consensus on the interpretation of the historical conditions of the emergence of globalization, its conceptual foundations, and the paradigm of its further development. Currently, there are several noteworthy points of view on globalization processes in the context of their impact on the development of the global economy.

There are different periodization of the globalization process. E. Maddison in his study “Contours of the World Economy, 1-2030 AD” argued that human civilization has gone through six stages of globalization in its development. Based on this approach, seven stages of globalization were identified, which end with the stage of digitization and the emergence of the digital economy [32] (table 1.6).

It was under the influence of the fifth stage of globalization that international economic relations developed rapidly, trade unions and organizations were created, sustainable intergovernmental institutional ties were formed, and capital and labor migration increased.

The sixth stage of globalization began in the 1970s and is associated with the integration of the global economy and the emergence of transnational corporations. One of the most important achievements of the fifth-sixth stages was the rules of trade of GATT-WTO and global payment systems SWIFT, VISA, Europay.

Table 1.6. - Periodization of globalization

Stages of glalobalization	Average annual growth of GDP, %	Average annual growth of world trade, %	Excess trade growth over GDP (times)
Merchant (trading) capitalism, European colonization of the Americas, East India TCs (1500-1820)	0.32	0.96	3.0
Industrial capitalism, the growing size of	0.94	4.18	4.4

European global empires (1820-1870)			
Age of imperialism, financial globalization (1870-1914)	2.12	3.4	1.6
The stagnation of globalization - World Wars. The Great Depression (1914-1945)	1.82	0.9	0.5
Bretton Woods Monetary System, GATT (1945-1973)	4.9	7.88	1.6
The golden era of globalization. The Jamaican monetary system. WTO (1973-2010)	3.17	5.38	1.7
Digital globalization (2011- up to now)	3.14	10.44	3.3

At the turn of the 21st century, new trends in the development of human civilization towards network convergence of countries and peoples on a planetary scale, towards intensive network exchange of knowledge and technologies, have clearly emerged.

The introduction of the term “digital globalization” is conditioned by the fact that globalization is now entering its new, digital phase, where digital flows of data and information represent enormous value, as they allow the movement of goods, services, finances and people and have a greater impact on GDP growth than international trade and cross-border capital movement. Virtually every type of cross-border transaction now has a digital component

World trade was once largely confined to advanced economies and their large multinational companies. At present, digital globalization is opening doors for developing countries, small companies, and emergent entrepreneurs, as well as billions of people.

Digital globalization not only enhances competitiveness but also opens up new channels of access to foreign markets and global electronic value chains.

The most important feature of digital globalization and the mechanism that generates it at the turn of the last and the beginning of this century is considered to be the massive spread of the Internet, which has led to the formation of a global information space and global communication hypersystems.

According to reports from We Are Social and Hootsuite, the number of active internet users worldwide reached 4333 mln in mid-2019, with 3937 mln unique mobile internet users. The audience of social networks is 3534 mln people.

The global level of internet penetration among the population is 57%, while in North America and Northern Europe it is 95%. Today, there are 5117 mln unique mobile users worldwide, which is 100 million more than last year.

Digital globalization includes:

- formation and development of global electronic networks, production of non-material products and services of IT companies;
- the emergence of fundamentally new cross-border virtual markets for transport, banking and insurance services, as well as new financial markets operating around the clock;
- the emergence of new IT-subjects of international interaction represented by TNCs in the digital economy (Amazon, Alibaba, Uber, etc.), international economic organizations, consulting companies and rating agencies.

The global digital economy provides companies with new business functionality:

- full access to the best suppliers, customers, labour, financial resources, wherever they are located;
- doing business "without borders": real-time interaction with foreign customers and partners, supply chain management on a global scale, support of overseas employees in operations and customer service, instant cross-border transactions in remote markets;
- reducing transaction, marketing, and customer interaction costs in new markets;

- organizing virtual teams through effective use of digital platforms interacting online;
- transition of small businesses and start-ups into the category of transnational corporations from the moment they start operating.

The wide spreading of digital technologies has significantly influenced the formation of a new stage of globalization - digital globalization, which provides companies with new business opportunities.

The global digital economy is changing business models, which entails a review of the principles of interaction with customers, suppliers, and partners, including changes in product lines including changes of customer preferences, as well as conditions for providing products and services. The global digital economy opens up unprecedented opportunities for acquiring new knowledge, expanding horizons, mastering new professions, and improving qualifications. New social lifts are emerging, and geographical horizons of opportunities are expanding

TEST QUESTIONS:

1. *How did the change in techno-economic paradigms affect the formation of the digital economy foundations?*
2. *How has the paradigm of human development changed depending on the change in technology?*
3. *Explain how approaches to interpreting economic relations have changed in the context of digitalization?*
4. *What are the characteristics of the digital economy?*
5. *What is the fundamental difference between economic relations in the digital economy and traditional economy?*
6. *What is the digital economy?*
7. *What are digital eco-platforms?*
8. *What opportunities do digital eco-platforms provide for conducting business?*
9. *What is the global nature of the digital economy?*
10. *What changes are taking place in the concept of management in the digital economy?*

CHAPTER 2. BUSINESS MODELS IN THE DIGITAL ECONOMY

2.1. Technological solutions are the basis of business models of the digital economy

"End-to-end" digital technologies are technologies used for searching, collecting, storing, processing, transmitting and presenting data in electronic form, the basis of which are software and hardware tools and systems that are in demand in all sectors of the economy, create new markets and business processes and business models are changing.

Currently, there are nine main "end-to-end" digital technologies, which include the following:

- big data (Big Data);
- quantum technologies;
- components of robotics and sensors;
- neurotechnology and artificial intelligence;
- smart production technologies (smart);
- industrial Internet;
- distributed registry systems;
- wireless communication technologies;
- virtual and augmented reality technologies.

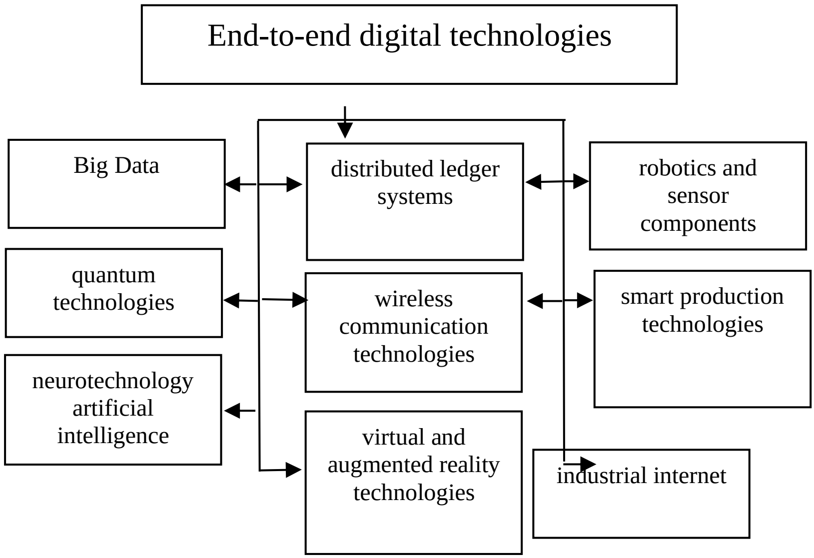

Figure 2.1. «End-to-end» digital technologies

Support measures are being developed in the directions of "end-to-end" digital technologies and roadmaps for their development are being implemented. The introduction of "end-to-end" digital technologies has changed the fundamentals of doing business in the digital economy.

We will describe in more detail "end-to-end" digital technologies.

1. Big Data is the collection, processing and storage technologies of structured and unstructured arrays of information, which are characterized by a significant volume and speed of changes (including in real time), which requires special tools and methods of working with them.

2. Quantum technologies are technologies for the creation of computing systems based on new principles (quantum effects), allowing to radically change the methods of transmission and processing of large data sets. On the basis of quantum technologies, supercomputer technologies are introduced, which make it possible to carry out high-performance calculations, due to the use of the principles of parallel and distributed data processing and high bandwidth.

3. Components of robotics (industrial works) are production systems with three or more degrees of mobility (freedom), built on the basis of sensors and artificial intelligence, capable of perceiving the environment, controlling their actions and adapting to its changes. The productivity and functionality of such systems is largely based on sensorics - the technology of creating devices that collect and transmit information about the state of the environment using data transmission networks.

4. Neurotechnologies are cyberphysical systems that partially or completely replace/supplement the functioning of the nervous system of a biological object based on artificial intelligence. Artificial intelligence is a system of software and/or hardware capable of receiving information with a certain degree of autonomy, learning and making decisions based on the analysis of large data sets, including imitating human behavior.

5. Smart production technologies is a modern approach to the organization of industrial production, focused on the intellectual management of the production process, based on the use of digital and information and communication technologies. Smart production systems use computer engineering technologies, that is, technologies for digital modeling and design of objects and production processes throughout the life cycle.

6. Industrial Internet - data transmission networks that unite devices in the production sector, equipped with sensors and capable of interacting with each other and the external environment without human intervention.

7. Distributed register systems (Blockchain) are algorithms and protocols for decentralized storage and processing of transactions, structured in the form of a sequence of connected blocks without the possibility of their further modification.

8. Wireless communication technologies are data transmission technologies using a standardized radio interface without using a wired connection to the network. Modern wireless communication technologies include 5G - fifth-generation technologies, which are characterized by high throughput (at least 10 Gbit/s), network reliability and security, and low data transmission delay (no more than one millisecond). As a result, it becomes possible to effectively use large data of computer modeling of a three-dimensional image or space, with the help of which a person interacts with a virtual environment with subsequent sensory feedback.

9. Technologies of virtual and augmented reality belong to additive technologies that allow creating three-dimensional objects based on their digital models and make it possible to manufacture products of complex geometric shapes and profiles

Virtual and augmented reality technologies are visualization technologies based on adding information or visual effects to the physical world by overlaying graphic and/or audio content to improve user experience and interactive capabilities.

Digitization provides fundamental transformations in all areas of human life and activity. Technologies become not only the driver of the development of new industries, but also influence the solution of social problems of society, such as the aging of the population, social stratification, environmental problems and climate change. With the help of "end-to-end" technologies, it becomes possible to implement "Society 5.0" systems based on new values, orientation to human needs, flexibility, creativity. Under the influence of digitization, the labor market, healthcare, education, and spatial development are radically changing.

2.2. Approaches to the formation of business models in the digital economy

In the conditions of the development of digitalization, business approaches to the formation of enterprise business models are changing. Digital technologies contributed to the transformation of traditional approaches to building business models.

The term "business model" was formed at the end of the 20th century and in the generally accepted sense was used for a wide range of informal and formal key aspects of business. The construction of business models presupposed the substantiation of the following constituent elements, namely: goal, potential clients, proposal, strategy, infrastructure, organizational structure, trading practice, management processes, etc. In a broad sense, a business model is a structurally constructed system, the purpose of which is the realization of commercial and marketing opportunities.

The emergence of Internet technologies and the development of electronic commerce created conditions for the change of traditional business processes. Scientific substantiation of business models in this direction was carried out by many scientists.

The conducted analysis allows us to substantiate the following stages of the evolution of the concept of business models (Table 2.1.).

Table 2.1. – Stages of evolution of business models

Stage	Period	Characteristic
The stage of emergence концепции	1995-2000	The first definitions of the concept of a business model of a firm appear, as well as works devoted to the analysis of business models of firms engaged in electronic commerce [90, 108, 110]. Studies of the e-commerce market contributed to the understanding of the business model as a characteristic way of obtaining income
The stage of development of the business model	2000-2005	There are opportunities to use the business model as a tool for analyzing companies in any industry. This leads to a rapid increase in the number of publications on the use of business models. In turn, the multitude of works was reflected in the variety of approaches to the definition, analysis and selection of components of the business model of the company [67, 72, 103, 107].
The stage of operationa	2005 to the present day	The focus of research is shifting to the development of specific characteristics of business models, suitable for creating classifications and identifying specific types of business models [67, 92]. This made it

		possible to compare the results of the activities of companies with different business models and to use the selected characteristics of the business model to interpret the differences in the revenues generated by the companies [67, 92]. Thus, within the framework of the selected stages of the evolution of the concept of business models, the understanding of the business model changed, which led to the existence of a variety of approaches to the definition and selection of structural elements of the business model.

I single out the following three approaches to the definition and analysis of business models:

- appropriation of value through its creation and promotion through the diversification of strategies. This approach assumes the generation of income in new industries or types of activity (sales via the Internet, Internet advertising, etc.) (Mahadevan B., 2000);

- the process approach, which assumes the creation of value through business processes occurring at the enterprise (Mahadevan, 2000; Shafer, Smith, Linder, 2005).

- the creation of dynamic business models, which implies the company's constant search for new opportunities, both within the framework of existing business models and their modifications (Teec D. J., 2007).

The development of the digital economy contributed to the transformation of traditional views on these aspects.

As a result of the transformations, it is possible to define digitalization as a factor influencing the change in the economic base:

- the development of the digital economy challenges the traditional principles of national or regional economic systems. In the conditions of erasing the boundaries of national economies, the question of real processes of creation and distribution of value in the digital economy arises;

- in the digital economy, there is a change in the factors of value formation and the transformation of the law of value due to the appearance of new factors of production;

- the digital economy is characterized by reliance on intangible assets, mass use of data, introduction of non-standard business models and difficulties in determining the jurisdiction in which value is created.

All of the above trends contributed to the emergence of a new type of business model inherent in the digital economy.

The most common business models in the digital economy are:

- *Digital platforms* that provide direct interaction between sellers, buyers and supplier partners. This allows you to minimize transaction costs and expand opportunities for joint consumption of goods and services. Depending on the product and market segment, platforms can be communication, social, media, search, operational and managed, service, sharing, product, transaction, etc.

- *Service business models,* basic for services and based on using resources instead of owning them (including software as a service (SaaS), infrastructure as a service (IaaS), etc.). Today, new types of service models are emerging, in particular, Robots-as-a-Service, City-as-a-Service. Service models contribute to the personalization of goods and services, allowing the client to consume the necessary product in the necessary quantities to achieve the desired result.

- *Models based on results.* These are business models, pricing in which is based on achieving results and effect for the client, including on the basis of consumption of complex products and services. By analogy with service models, such business models are often called Product-as-a-Service (PaaS). For example, BASF's business model, which is focused on the supply of fertilizers, however, provides customers with detailed recommendations on what fertilizers to use, in what quantity and on what plants in a certain period of time, based on monitoring and analysis of data on soil, plant condition, weather . conditions and other parameters.

- *Crowdsourcing models* based on the attraction of external resources (money, people, ideas, etc.) for the implementation of business processes — the introduction of innovations, product development, production, marketing and sales.

- *Business models based on the monetization* of personal data of clients, when free services for users sell their data to other segments of consumers.

The fundamental differences of digital business models are presented in the table. 2.2.

The main feature of business models used in the digital economy is a client-oriented approach that allows optimizing the company's activities and taking into account the needs of clients in accordance with all key resources.

Customer-oriented models do not just drive value and justify the key resources necessary for this, they assume constant interaction with the company's customers. This allows you to constantly adjust business processes and interact with all counterparties and clients in an interactive mode.

Table 2.2. - Principal differences of digital business models

Key parameters	**Digital business models**	
— direct interaction between sellers, buyers and supplier partners; — minimization of transaction costs; — expanding opportunities for joint consumption of goods and services.	Digital platforms	**Customer-centric models**
— based on the use of resources instead of owning them; — promote the personalization of goods and services; — allow the client to consume the required product in the required volumes to achieve the desired result	Service business models	
— business models, the key aspect of which is the approach to pricing; — the pricing strategy is based on the consumption of complex products and services	Outcome-based models	

The ability to attract external resources (money, people, ideas, etc.) to implement business processes with their optimal use	Crowdsourcing models	
Free services for users sell their data to other users or consumers	Business models based on monetization of personal data of clients	

2.3. The concept of a digital ecosystem as the basis of business models in the digital economy

Platforms and digital ecosystems are one of the most promising digital business models.

A digital ecosystem is a network of interconnected digital technologies, platforms and services that interact with each other to create value for businesses and consumers.

The digital ecosystem consists of the following elements:

- software,
- equipment,
- big data,
- people who work together to facilitate digital transactions, communication and collaboration at various stages of the customer journey.

These customer paths can be interconnected, and the ecosystem can support a variety of activities, including e-commerce, social networks, software solutions, hardware offerings and digital entertainment.

In the context of business, a digital ecosystem can also mean a set of digital platforms and technologies that a company uses to interact with its customers, partners, and other stakeholders.

The digital ecosystem focuses on creating additional value for customers by optimizing data and work processes of various internal departments, tools, systems, as well as customers, suppliers and external partners. It should eliminate obstacles on the client's path and give the opportunity to each participant of the ecosystem to use the most modern technologies and systems to meet their individual needs.

An example of a digital ecosystem: Amazon

Since 2000, Amazon has been constantly building its digital ecosystem. The beginning of the formation of Amazon's service infrastructure was connected with the development of e-commerce and the need to serve customers on its e-commerce platform.

Soon, Amazon began leasing server capacity to other companies. This step led to the emergence of **Amazon Web Services (AWS**) and became an important stage for the company in terms of creating its huge ecosystem.

Amazon used its own AWS infrastructure not only to provide other companies with infrastructure services, but also as a launching pad for all other services, such as Amazon Prime Videos, Prime Music, Studio, and others.

This led to the rapid creation of services in the Amazon universe. The advantages of these services were that they were available to basic users who quickly received packages, had access to Amazon music and could watch series and films from the main library.

Later, Amazon attracted many third-party companies to participate in this ecosystem. As with e-commerce, Amazon was the first to open up and allow all users, including competitors, to use its own infrastructure of services and tools.

This brought huge success to Amazon. If we consider the Amazon ecosystem, it should be noted that it includes more than 40 Amazon subsidiaries, the number of which will grow in the future.

Figure 2.2. - Components of the Amazon digital ecosystem [based on 112]

The main characteristics of the Amazon digital ecosystem

1) Customer orientation

Client orientation is not only for customer service or personalized advertising, marketing or company offers, but also for the entire scale of business. This means holistic operational activity and cooperation between departments and between products and services in order to integrate the client as best as possible.

2) Ability to use and process big data

One of the main advantages of using a digital ecosystem is the ability to collect additional information about processes, customers, transactions and much more. This makes data one of the key factors for every digital ecosystem.

3) Automation

Automation is one of the key elements in reducing costs, increasing customer satisfaction, and offering new services/products to increase the value stream.

4) Global presence

Digital ecosystems exist for scaling, so they are intended for use without restrictions by countries or regions. Digital ecosystems must also be built in such a way as to enable cooperation between countries, regions and even languages. Sometimes it is necessary to eliminate even cultural barriers.

5) Dynamism

Ecosystems must quickly adapt and quickly respond to changing market dynamics, otherwise the user base will move forward and switch platforms. Business intelligence, quick decision-making, as well as the use of new technologies and business models should be at the center of every decision.

6) Roles in the digital ecosystem

Before a participant becomes an ecosystem builder, he needs to determine which ecosystems are important to him and what role he will play in each ecosystem.

There are 3 main roles that a company can play in the ecosystem:

- *Organizer of the ecosystem*. These companies take on the risk, complexity, and challenges of building a digital ecosystem. These are companies like Amazon, Alibaba, Ping, etc. that allow others to participate in the ecosystem and sell goods and services through this system.

- *Modular manufacturer*. These are companies that contribute to the ecosystem and monetize value in various ecosystems. One of the most well-known manufacturers of modules can be PayPal. With the help of their services, they offer various platforms and service ecosystems in order to have a single payment gateway so that clients can easily pay. A module manufacturer can add basic services to ecosystems that meet the needs of consumers, businesses, and buyers and sellers in a certain sense.

- *The buyer*. The client can be a person or an enterprise that benefits from the ecosystem. By booking an Airbnb, you can become a client of the ecosystem created and organized by Airbnb.

Sometimes the boundaries are changeable. So, for example, a Facebook user is both a creator (content) and a consumer (advertisement). In addition, companies can sometimes use, sometimes organize, and sometimes add services in several digital ecosystems.

There are 3 types of digital ecosystems:

1) Functional digital ecosystem.

This is one of the simplest ecosystems, which is usually built around an existing product or company offering. It involves a limited number of companies and partners (perhaps 10-100), and it is very focused on the internal aspect. Due to its simplicity and ease of integration, it is the most widely used ecosystem. This ecosystem has its own limitations, as data collection and further integration are difficult, since in most cases it is a closed ecosystem.

Examples of such functional ecosystems can be found in the automotive industry, where platforms connect to digital services of partners, creating a product-oriented ecosystem of a smart and connected car, mostly limited by a limited number of products.

2) Platform ecosystem

Ecosystems of digital platforms are more advanced ecosystems. They can include millions of partners and also include many digital offers. These digital ecosystems are largely based on the "data first" approach, which allows you to use customer information to further increase sales or develop new offers based on the data obtained. The biggest difference is the common platform on which all partners participate and create their own value. Thus, the organizer of the ecosystem offers a common platform on which all connected parties work together.

Google Home is a good example of this. Google provides a common platform where developers, manufacturers and engineers can work together to create home appliances that use the Google Home platform to become connected and smart. Google itself develops such tools as a home speaker, but partners can also use the platform's ecosystem to offer their products and services.

3) Super platform ecosystem

One of the most complex and confusing ecosystem models involves the integration of various platforms and the use of various user paths, including their data. Super-platform ecosystems usually include many different industries, different services and try to connect the entire user path with the ecosystem as best as possible. Most of the super-platform ecosystems today are in the hands of such technological giants as Apple, Google, Amazon, Tencent and some others.

WeChat, the Chinese super-app, is a perfect example of creating a super-platform ecosystem. The application now covers all important aspects of the user's life. Within a single platform, it offers thousands of services and functions, including everyday banking, social networks, shopping, communication and much more. With each new offer, WeChat is increasingly integrated into everyday life, which allows better data collection.

Challenges and risks of digital ecosystems

So far, we understand that while digital ecosystems have enormous potential for value creation and growth, they also bring with them a unique set of challenges and risks due to their size and complexity.

One of the main issues is data confidentiality and security. Given the huge amount of data that is tracked, transmitted and processed within the ecosystem, there is a significant risk of data leakage, misuse and, of course, cyberattacks seeking to obtain this data. In addition, dependence on one or more platform providers can lead to monopoly control over data, which in the long term limits competition and innovation, and existing trends also try to prevent this through regulatory and legal means.

For modular manufacturers in the ecosystem, there is also a risk of becoming too dependent on the ecosystem in terms of their business, which makes them vulnerable if the ecosystem fails or changes significantly. Examples of such problems for communities and companies are Twitter and Reddit.

For the organizer of the ecosystem, a more serious problem, but also a risk, is also the compatibility of various technologies and systems within the ecosystem. Inappropriate or incompatible technological standards can have a strong impact, so it is not surprising that Google, Facebook, etc. set their own technological standards and develop them independently.

Depending on the business model, regulatory requirements are also a problem. Because digital ecosystems are complex and global, and regulations related to data protection, compliance, antitrust laws, and other relevant policies must be constantly monitored and enforced, countries are often not allowed to access various services.

Creating such an ecosystem requires a broad client base, consistent value creation, clear coordination of various partners, clients, and technologies, as well as a very flexible mindset.

TEST QUESTIONS:

1. What technological solutions underlie business models of the digital economy?

2. Describe scientific approaches to the formation of business models in the digital economy.

3. What stages of the evolution of business models do you know?

4. What are the fundamental differences between digital business models and traditional ones?

5. What is a digital ecosystem?

6. What are the main characteristics of Amazon's digital ecosystem?

7. What challenges and risks exist when using digital ecosystems?

8. What are the main types of digital ecosystems you know?

9. What are the main roles that a company can play in the ecosystem?

10. What does the term «smart analytics» mean in the context of business models?

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CHAPTER 3.
BIG DATA – BASIS FOR DECISION MAKING IN DIGITAL ECONOMY

3.1. Components of Big Data and their nature
3.2. Methods of Big Data Analysis
3.3. Methods of Big Data visualization and presentation
3.4. Technologies, means of storing and processing Big Data
3.5. Stages of the Big Data management life cycle
3.6. Cloud technologies
3.7. Amazon Web Services

3.1. Components of Big Data and their nature

The term Dig Data was first introduced by John Mashy in 1998.

In 2005, O'Reilly media company publication defined Big Data as follows: the first mention of data that traditional data management and processing technologies could not handle due to their complexity and volume.

In 2008, Clifford Lynch, in a special issue of the journal Nature, introduced the term "big data" in the modern sense.

In 2011, Gartner company predicts that Big Data will impact information technology approaches in manufacturing, healthcare, commerce and government. Big Data is becoming the number two trend in information technology infrastructure (after virtualization).

Big Data was compared with:

1) *mineral resources* —
— the new oil,
— gold rush
— data mining, that emphasizes the role of data as a source of hidden information;

2) *natural disasters* —
— data tornado,
— data deluge,

3) data tidal wave, seeing threaten in it;

4) *industrial manufacturing* —
— data exhaust,
— firehose,
— Industrial Revolution.

Big Data is an "umbrella" term that combines a group of concepts, technologies and methods for productive processing of very large volumes of data, including unstructured ones, in distributed information systems that provide the organization with qualitatively new useful information (knowledge).

Although *Big Data and business analytics* have the same goal (searching answers to a question), they differ from each other in the following peculiarities:

❑ Big data is designed to process new and changing information faster, which means deep research and interactivity. In some cases the results are formed faster than the page is downloaded.

❑ Big data is designed to process unstructured data, the use of which is in the initial stages of the study, after its collection and storage has been established, and algorithms and the ability to dialogue are required to facilitate the search of trends within these arrays.

Big Data as technology is:

— a series of approaches, tools and methods for *processing* structured and unstructured data of huge volumes and significant diversity *to obtain* human-perceivable results that are effective in conditions of *continuous growth* and *distribution* over numerous nodes of a computer network, *alternative to traditional database management systems*.

Based on the definition Big Data, we can formulate the basic principles of working with extensive (large bulk) data [107]:

1. Distributiveness. Storing information in one place is stupid and almost impossible. Therefore, Big Data technology must use distributed storage, management, processing and analysis of data located in various data warehouses around the world.

2. *Horizontal scalability*. Since there can be as much data as desired, any system that involves processing big data must be extendable. The volume of data increased by 2 times - the cluster was doubled and everything continued to work with the same performance.

3. Fault tolerance. The principle of horizontal scalability implies that there can be many machines in a cluster. For example, Yahoo's Hadoop cluster has more than 42,000 machines. This means that some of these machines will be guaranteed to fail. Big data practices must take into account the possibility of such failures and survive them without any significant consequences.

4. Data locality. In large distributed systems, data is distributed across a large number of machines. If data is physically located on one server and processed on another, the expenses of data transfer may exceed the cost of processing itself.

Therefore, one of the most important principles for designing BigData-solutions is the principle of data locality - if possible, we process data on the same machine on where it is stored.

5. *Interpretation of data during processing.* Data enters the warehouses (store) as it is, without any preliminary description, without indicating its structure and semantics. And only in the process of selecting (sampling) it for processing does its “comprehension” occur. All modern big data tools follow these five principles in one way or another.

The table of bytes for measuring big data arrays is presented in Table 3.1.

Table 3.1. – Byte table for measuring big data arrays

1 byte	8 bites
1 Kb (1 **Kilobyte**)	2^{10} bytes = 2*2*2*2*2*2*2*2*2*2 bytes = 1024 bytes (approximately 1 thousand bytes – 10^3 bytes)
1 Мб (1 **Megabytes**)	2^{20} bytes = 1024 kilobytes (approximately 1 million bytes – 10^6 bytes)
1 Gb (1 **Gigabytes**)	2^{30} bytes = 1024 megabyte (approximately 1 billiard bytes – 10^9 bytes)
1 Tb (1 **Terabytes**)	2^{40} bytes = 1024 gigabyte (approximately 10^{12} bytes). Terabyte is sometimes called a *ton*
1 Pb (1**Petabytes**)	2^{50} bytes = 1024 terabytes (approximately 10^{15} байт)

1 **Exa bytes**	2^{60} bytes = 1024 petabytes (approximately 10^{18} байт)
1 **Zetta bytes**	2^{70} bytes = 1024 exabytes (approximately 10^{21} байт)
1 **Yotta bytes**	2^{80} bytes = 1024 zettabytes (approximately 10^{24} bytes)

— *A bit is the minimum unit of measurement of information: zeros or ones.

Differences of standard database from Big Data are shown in Table 3.2.

Table 3.2. – Differences of standard database from Big Data

Characteristic	Standard database	Big Database
Volume of Data	From gigabyte (10^9 byte) to terabyte (10^{12} byte)	From petabyte (10^{15} byte) to exabyte (10^{18} byte)
Means of data storage	Centralized	Decentralized
Data structure	Structured	Semi-structured and unstructured
Model of data storing and processing	Vertical data	Horizontal model
Data interconnection	Strong	Poor (weak)

Big Data classification:

- ❑ Fast Data, its volume is measured with terabytes;
- ❑ Big Analytics is petabyte data is petabyte data
- ❑ Deep Insight — exabytes, zettabytes.

The groups differ from each other not only in the amount of data they handle, but also in the quality of their processing decisions.

Processing for ***Fast Data*** does not imply obtaining new knowledge, its results are correlated with a priori knowledge and allow one to judge how certain processes proceed; it enables to see what is happening better and in more detail, confirm or reject any hypotheses. Only a small part of existing technologies is suitable for solving Fast Data problems. This list includes some storage technologies. The speed of these technologies should grow synchronously with the growth in data volumes.

The tasks solved by ***Big Analytics*** tools are remarkably different, not only quantitatively but also qualitatively, and the corresponding technologies should help in obtaining new knowledge - they serve to transform the information recorded in the data into new knowledge. However, at this middle level, presence of artificial intelligence is not expected when choosing the decisions or any autonomous actions of the analytical system - it is built on the principle of “supervised learning”. In other words, all its analytical potential is laid down with it in the learning process. The ***Big Analytics*** toolkit is presented in Figure 3.1.

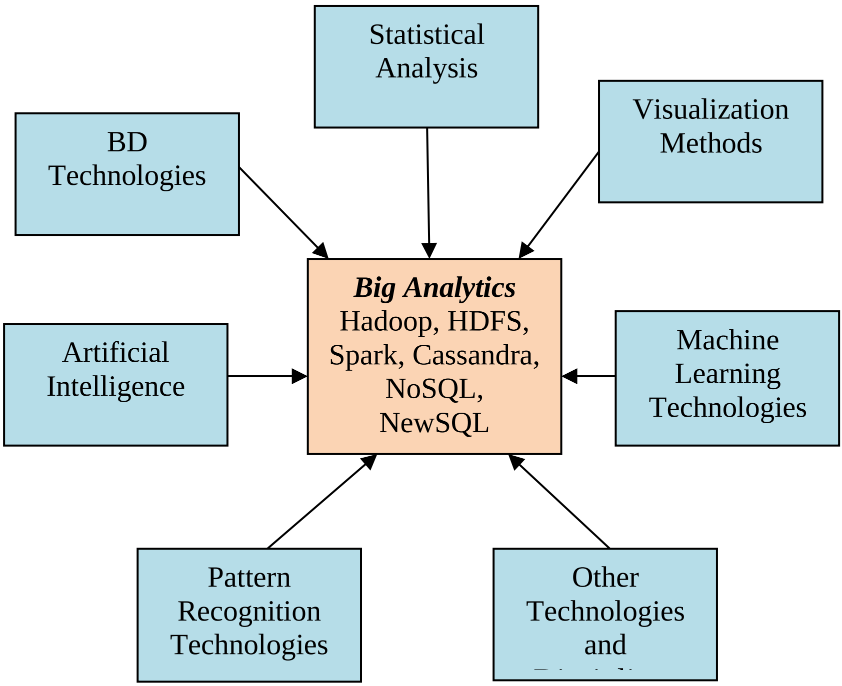


Figure 3.1. Big Analytics toolkit and its components

The highest level, ***Deep Insight***, involves unsupervised learning and the use of modern analytics methods, as well as various visualization methods. At this level, knowledge and patterns, that are a priori unknown, is possible to identify.

Big Data characteristic's (Fig. 3.2.**)**:

Volume. Big Data is considered to start at petabytes (1024 terabytes). Big Data emerges when hundreds of millions of people unite into communities and make their information resources available, or joint research centers make their research data available. For example, in 2017 the CERN (European Organization for Nuclear Research) data center exceeded the size of 200 petabytes and this volume is increasing by another 15 petabytes annually.

Velocity. It is one of the important characteristics of Big Data from the point of view of its practical use. Speed refers to both the growth rate (receipt, accumulation) of data and the speed of their processing in order to obtain final results. In addition, this category includes characteristics of intensity and volume of information flows. To do this, the technology for processing such data must allow for the possibility of analyzing it already at the moment of its occurrence (sometimes called "operational analytics"), that is, before it enters the data warehouse (storage). According to experts, the Big Data category includes most data flows over 100 GB per day.

Variety. The ability to perceive, store and process various data. When talking about diversity, the following is meant.

1. Various sources of data.

Here are examples of extensive data sources:

— data is continuously received from measuring devices;

— recording from radio frequency identifiers;

— flows of messages on social networks;

— meteorological data;

— data streams about the location of cellular networks subscribers, audio and video recording devices;

— Earth remote sensing data.

2. Various methods of data presentation. So the signals coming from the sensors differ from scientific texts.

3. Various formats for storing (receiving) data. There can be texts, audio and video data, images. Moreover, the same data can be presented in different formats. Human spoken language can be presented in audio format and as a text file.

4. Semantic diversity. The semantics of the same data can be presented in different ways. For example, a person's age can be indicated quantitatively or in the form of concepts such as child, youth, adult man.

5. Different degrees of data structure. Traditional databases allow storing structured data, but in fact, currently, 80% of existing data is poorly structured or even unstructured.

Big Data technology allows you to combine and process data with diversity given above.

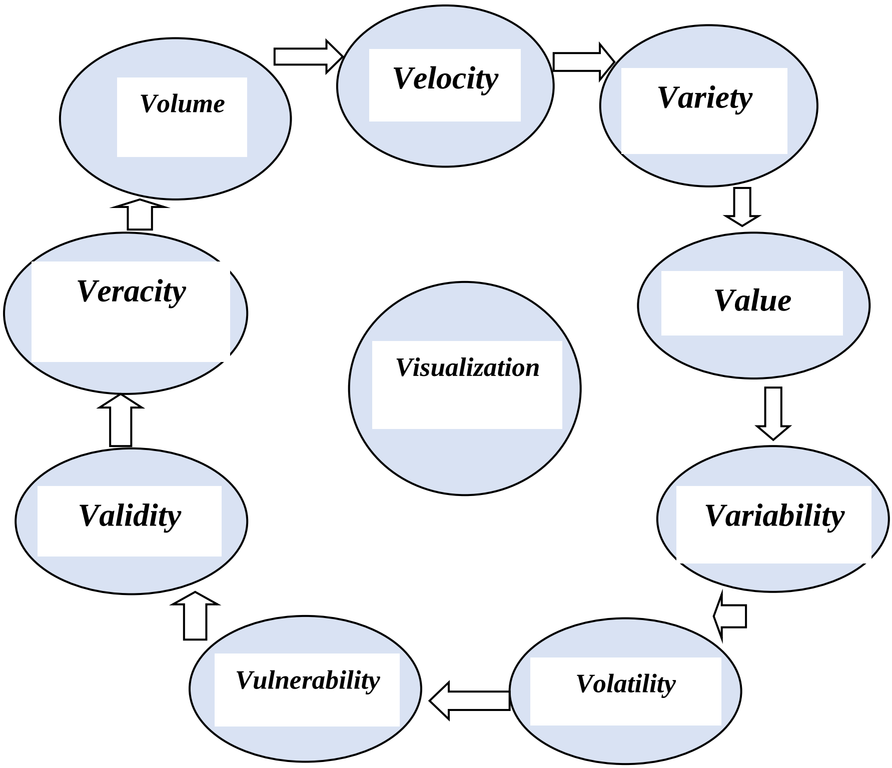


Figure 3.2. Relationship between characteristics of Big data

Veracity. A property characterizing the reliability of data. The technology for creating and using traditional databases (DBs) implies that carefully selected and verified data enters the database. In Big

Data, the source data can be “raw”, that is, it comes without any preliminary processing, it can be subjective, random and contain a lot of “noise”. Another criterion for this characteristic is the degree of confidence in (credibility to)the data. Although Big Data provides excellent opportunities for decision making and analysing, its value largely depends on the source (initial) data quality. Big Data technology considers this characteristic and allows reliably working with such data.

Value. When it comes to the value of data, its social significance from the point of view of applied tasks are meant. IBS estimates, that only 1.5% of accumulated data amount is of no use if the data is of no interest.

Later, additional defining characteristics of Big Data: 7V and 10V were proposed.

Variability. Big Data volatility refers to a situation where the data meaning is constantly changing. For instance, this is the case when data collection and processing occurs during test analysis and especially when translating from one language into another.

Volatility is a characteristic that defines the length of time data ageing when it becomes irrelevant or useless. Before the era of Big Data, data could be stored indefinitely; using several tens of terabytes for these purposes was not burdensome.

Moreover, it can be stored in an active database without causing resource issues. However, with Big Data, considering volume and velocity characteristics, data volatility should be carefully monitored. Rules should be set for data storage management to ensure it is used efficiently.

Vulnerability. Big data causes new security problems. Big data hacking leads to a big breach overall. An example is the hacking of the LinkedIn social network database, as a result of which 167 million accounts and 360 million e-mail information were stolen.

Validity is closely connected with reliability and characterizes to which the extent available data is accurate and correct in terms of their intended use. According to Forbes, scientists spend their time working with data in the following ways:

− data collection – 19%;

− data cleaning and systematization – 60%;

– test data collecting– 3%;
– data analysis for building a model – 9%;
– refinement of algorithms – 4%;
– other types of work with data – 5%.

Thus, a scientist spends 80% of his time collecting and preparing data before proceeding to its analysis. The benefits of using bulk data for analytical research can only be fully exploited after the data is carefully selected, relevant and reliable.

Visualization. After receiving and processing, the data should be represented in a readable and available form. Visualization means exactly this process.

Big Data priorities:

– Big Data collecting and processing;
– Analytics;
– Big Data engineering;
– Big data architecture and system integration;
– Products and services development based on big data;
– Big Data and systems management based on big data;
– Researches to obtain new mathematical and technical solutions for working with Big Data.

Big Data professions:

– Data researcher;
– Big Data consultant;
– Big Data engineer;
– Big Data architect;
– Specialist on Big Data management.

Market entities of Big Data:

– *Infrastructure providers* - solve problems of data storing and preprocessing. For example: IBM, Microsoft, Oracle, Sap and others.
– *Data miners* are developers of algorithms that help customers extract valuable information.
– *System integrators* are companies that implement Big Data analysis system on the client side.
– *Customers* are companies that purchase software and hardware systems and order algorithms from consultants.

– *Ready-made services developers* - offer ready-made solutions based on access to big data. They open up the of Big Data capabilities to a wide range of users.

***Application purposes*:**

– Efficiency.

– Customers satisfaction.

– Risk reducing.

– Business expansion.

Big Data is not needed if:

– employees are capable to process and automate the clients data using standard CRM-systems;

– business processes planning, accounting and controlling are completely feasible with ERP-systems;

– data used to be combined from various sources of information and processed, the given result being evaluated using BI systems and no difficulties were encountered.

3.2. Methods of Big Data analysis

Some methods and technologies were developed to manage significantly smaller volumes and variety of data, but have been successfully adapted for Big Data. The rest have been developed recently to collect and analyse large bulk of data. According to the McKinsey consulting group, there are the following methods and technologies of analysis and visualization applicable in Big Data.

Basic methods and technologies used to analyze Big Data:

1. Data Fusion and Integration – a set of methods that enables integration and analysis of heterogeneous data from different sources for data mining more precisely and effectively than from a single data source. The examples of these class methods are signal digital processing and natural language processing.

2. Association Rule Learning – set of methods for analyzing necessary relationship, i.e. “association rules”, among variables in big database.

Association refers to data mining between related events. For example, we can give the following rule: event X follows event Y. Such rules are called associative.

Popular algorithms: Apriori, Euclat, FP-growth

are used for:

– Promotions and sales forecasting;
– Analyzing goods purchased together;
– Placing the goods on the shelves;
– Patterns behavior analyzing on websites.

While teaching the association rules, sequential patterns are used, which are aimed at establishing patterns between events related in time, i.e. detection of a dependence that if event X occurs, then event Y will occur after a given time. That is similar to association, but considering the time component.

Popular algorithms: AprioriAll, AprioriSome, DynamicSome.

Are used for: forecasting event sequence; searching cause-and-effect relations.

3. Classification is the dependence of input data on discrete output data.

Methods of data classification is a set of techniques for dividing a set of objects into a subset. There are three methods of object classification known in science: hierarchical, facet and descriptor one. These methods differ in the strategy for introducing classification features.

Hierarchical method is a method in which a given set is sequentially divided into subordinate subsets, gradually specifying the object of classification. In this case, the basis of the distribution is some selected attribute. The set of resulting groupings forms a hierarchical tree structure.

Facet method involves the parallel division of multiple objects into independent classification groups. Concurrently, a rigid classification structure and pre-constructed finite groups are not provided. Classification groupings are formed by combining values taken from the corresponding facets.

Descriptor method is the selection of a set of keywords or phrases that describe a specific subject area or a set of homogeneous objects that are normalized. For this reason, a dictionary of descriptors is created, which serves as the basis for classification.

Popular algorithms: Naive Bayes, Decision Trees, Logistic Regression, K-Nearest Neighbours, Support Vector Machines.

Are used for: Spam filters; Language definitions; Search for similar documents; Sentiment analysis; Handwritten letters and numbers recognition; Suspicious Transaction Definitions.
Classification method: Decision Tree is shown on Figure 3.3.

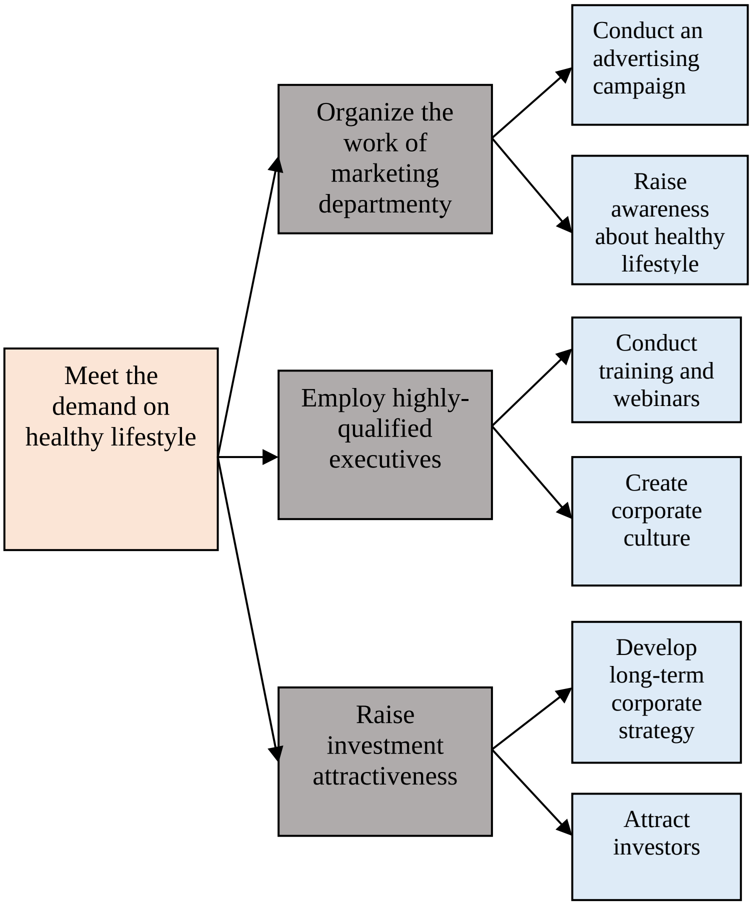
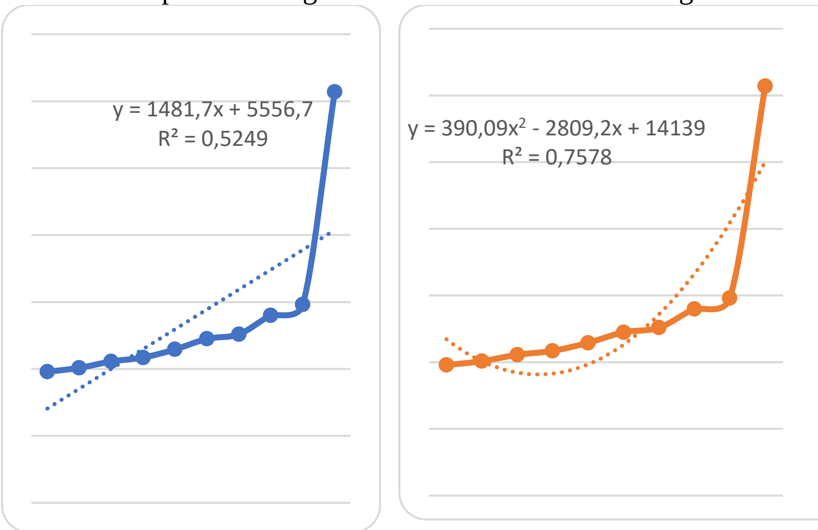


Figure 3.3. Classification method: Decision Tree

4. Regression Method.

Regression Method is dependence between input data and continuous output data. Regression Method is shown on Figure 3.6.



A) gross profit margin forecast according to regression method using linear function

B) gross profit margin forecast according to regression method using polynominal function

Figure 3.4. Regression Method

Are used for: security prices forecast; demand analysis, sales volume; medical diagnoses; any number-time dependencies.

Popular algorithms: Linear Regression; Polynominal Regression.

5. Clustering is the grouping of data based on this data properties. Data within a cluster should have the same properties and differ from the properties of data in other clusters.

Popular algorithms: k-means method, Mean-Shift, DBSCAN

Are used for: market segmentation (kind of customers, loyalty); combining (grouping) nearby points on the map; image compression; analysis and marking of new data; abnormal behavior detectors.

Dimensionality Reduction Method combines particular properties into higher level abstractions.

Popular algorithms: principal component analysis (PCA); singular value decomposition (SVD); latent Dirichlet placement (LDA); latent semantic analysis (LSA, pLSA, GLSA); t-SNE (for visualization).

Are used for:

- Reference Systems
- Beautiful visualization
- Topic spotting and similar documents searching
- Fake images analysis
- Risk-management

Unsupervised learning: Dimensionality reduction: LSA.

4. Machine Learning is a set of AI methods, which distinctive feature is not direct task solving, but studying during solving similar multiple tasks. It includes both supervised and unsupervised learning, as well as deploying models based on static analysis or machine learning, to obtain complex forecasts based on basic models.

Machone learning is the basis for Big Data processing.

Machine learning among other technologies:

- Pattern Recognition
- Pattern Recognition ≈ Machine Learning
- Data Mining (including Big Data)
- Data Mining ∩ Machine Learning <>0
- Artificial Intelligence

Types of Machine Learning:

– *Deductive or analytical learning (expert systems).*

There is knowledge that is formulated by an expert and formalized in some degree. The program derives specific facts and new rules from these rules.

– *Inductive learning (≈statistic learning).*

Based on empirical data, the program creates a general rule. Empirical data can be obtained by the program itself in previous sessions of its operation or simply presented to it.

– *Combined (mixed) learning.*

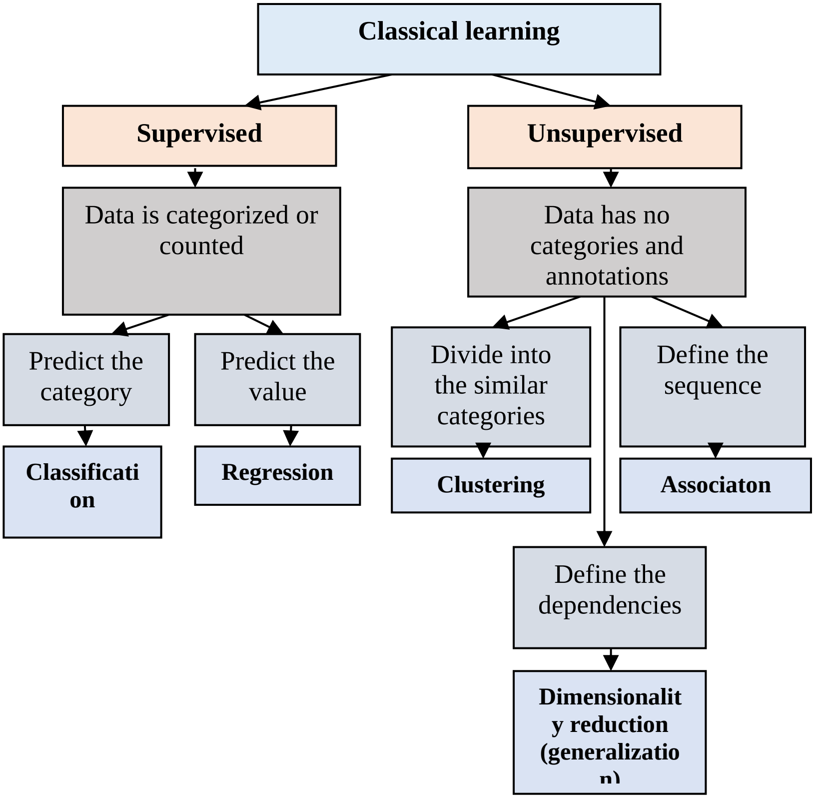


Figure 3.5. Typology of classical learning

Classification of Machine learning tasks:
– Deductive or analytical learning (expert systems)
– Inductive learning (≈statistic learning)
(Mitchell definition refers only to this learning)
Supervised learning:
– classification;
– regression recovery (restoring);
– structured learning.

Unsupervised learning:

– clustering;
– data visualization;
– dimensionality reduction.

Reinforcement learning

– Active learning

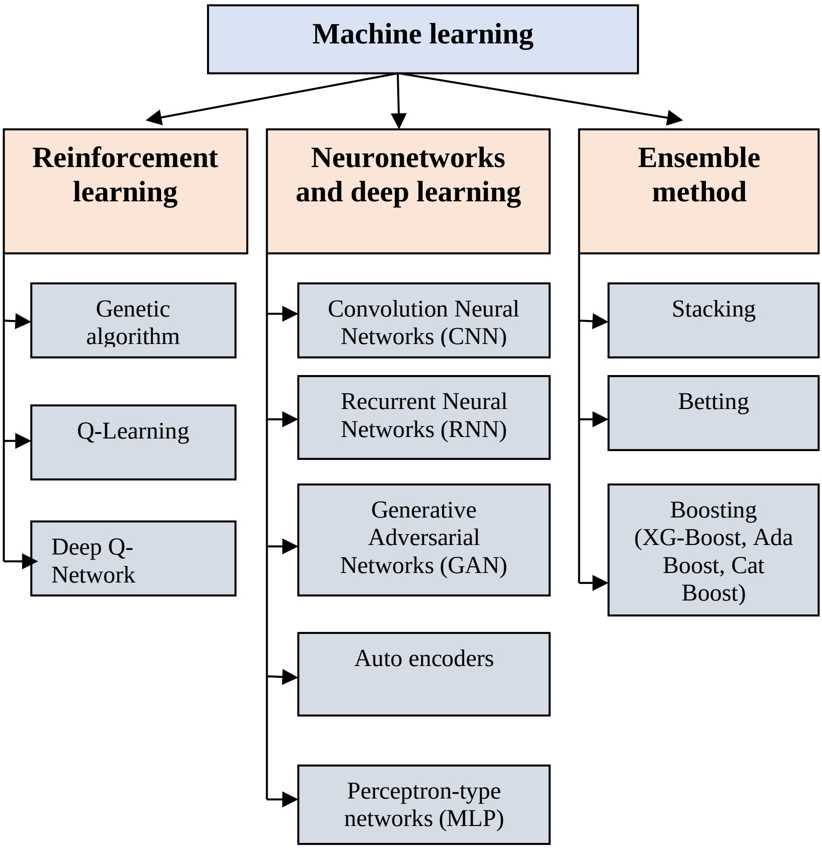


Figure 3.6. Technologies underlying Machine learning

5. Natural Language Processing, NLP is a general direction of artificial intelligence and mathematical linguistics, studying the problems of computer analysis and synthesis of natural languages. In artificial intelligence, analysis means understanding language, and synthesis means generating literate text. Many NLP methods are machine learning methods.

6. Artificial Neural Networks is a mathematical model built on the principle of organization and functioning of biological neural networks - networks of nerve cells of a living organism.

7. Network Analysis is a set of methods used for describing and analysing the relation between discrete nodes in a graph or network. In social network relations between people in society or organisation are analyzed, for instance, how information travels or who has the greatest influence over whom.

8. Pattern Recognition is a set of machine learning that develops principles and methods of classification and identification of subjects, notions, processes, signals, situations, objects, that are characterized by a set of some properties and attributes.

9. Predictive Analytics – is a set of methods of data analysis, concentrating on predicting the future behavior of objects or subjects in order to make optimum decisions.

10. Sentiment Analysis is a set of content-analysis methods in computational linguistics is designed for automated detection of emotionally coloured vocabulary in texts and emotional evaluation of authors (thoughts) to the objects in the text.

11. Simulation Modeling is a method in which the studied system is replaced with the model that accurately describes a real system (designed model describes the processes as they would take place in reality), where experiments are conducted to obtain information about this system.

12. Spatial Analysis is a set of methods that analyze topological, geometrical or geographical properties that are represented in the dataset. Frequently, the data for spatial analysis come from geographic information systems.

13. A/B Testing. A control group of elements are compared with a set of testing groups, where one or several parameters were changed to discover which changes improve the target.

14. Time Series Analysis a set of mathematical and statistical analysis methods designed to identify the structure of time series and their forecasting. Particularly, it includes methods of regression analysis. It means identification of the time series structure, necessary to build a mathematical model of the phenomenon, which is the source of the analysed time series.

15. Crowdsourcing is a method of data collection, categorization and enrichment by a wide range of individuals engaged on the basis of a public offer, without entering into an employment relationship, generally through online media.

The key problem of Big Data analysis is the ability to visualize the data to present and interpret the results.

3.3. Methods of Big Data visualization and presentation*:*

1. Tag Cloud. Each element in Tag Cloud is attributed with a definite weight coefficient correlating with font size. When analyzing a text, the value of the weighting factor directly depends on the frequency of use (citation) of a certain word or phrase. It give a reader a clear picture of the key points of any large text or set of texts in a short time (Fig. 3.7).

What way Artificial Intelligence sees Big Data is shown in Figure 3.7.

Figure 3.7. Tag cloud in the Big Data definition by artificial intelligence

2. *Clustergram* is a visualization method used in cluster analysis. It shows how definite elements of multiple data relate to the clusters in their number changing (Fig. 3.8). Choosing the optimal number of clusters is an important part of cluster analysis. This visualization method allows the analyst to better understand how clustering results change as the number of clusters changes.

3. History flow helps tracking the evolution of a document under which many authors worked simultaneously. In particular, this is a typical situation for Wiki services. The horizontal axis shows the time, the vertical axis shows the contribution of each co-author, i.e. the amount of text entered. Each unique author is assigned with a specific colour on the diagram.

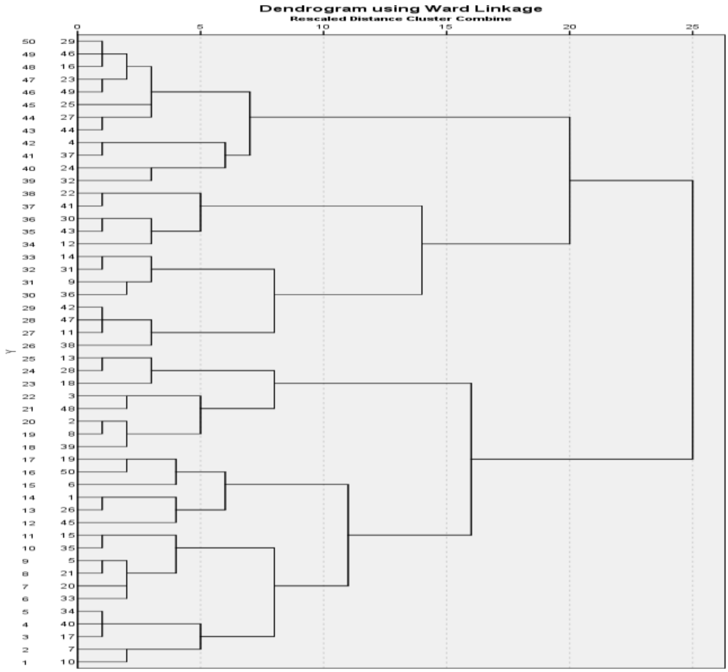


Figure 3.8. Clustergram

4. Spatial Information Flow. The diagram allows tracking spatial time distribution.

3.4. Technologies, means of storing and processing Big Data:

− *Big Table* – patented distributed system built on Google File System;

− *Business Intelligence* is a set of methodologies, processes, architectures and technologies, that convert large volumes of “raw” data into meaningful and useful information suitable for business analysis and for providing optimal tactical and strategic decision-making;

− *Cassandra* is freely distributed database management system designed to manipulate huge amounts of data in distributed systems;

– *Cloud Computing* is a computing paradigm where highly scaled computing resources, generally configured in the form of distributed systems, are provided in the networks as services;

– *Data Warehouse* is a domain-specific information database specifically designed to report and analyse data to support decision-making in an organization and is one of the core components of business intelligence. It acts as a central repository of data coming from various sources, saves current and historical data, is built on the basis of database management systems and decision support systems;

– *Distributed System* is multiple computers interacting in the network and combined to solve mutual computing;

– *Dynamo* is a patented distributed data storage system, designed in Amazon;

– *Extract, Transform, And Load* is used for data mining from outside sources, their converting to meet operational demands, and their uploading to database or data warehouse;

– *Google File System* is a patented distributed file system. Hadoop system is based on its basis;

– *Hadoop* is a project by Apache Software Foundation, free shared set of utilities, libraries and frameworks to design and implement distributed programs based on clusters made of hundreds and thousands nodes. It is used to implement search and thematic mechanisms of many high-load websites, including Facebook and Yahoo! It is based on Mapreduce and Google File System;

– *Hbase* is free shared distributed non-relational database built on Big Table Google;

– *Mapreduce* is a distributed computation model introduced by Google company, used for parallel computations on a bulk (to several petabites) sets of data in computer clusters. This model is implemented in Hadoop;

– *Mashup* is a web application, combining data from multiple sources into one integrated one, for example, when combining Google Maps data with real estate data with Craigslist, produces a new unique web service that was not offered by any data source from the start;

– *R* is a free distributed programming language, programming medium for statistical and graphic computations;

– *Stream Processing* is a technology, designed to process large volumes of data streams in real time.

3.5. Stages of the Big Data management life cycle

1 Stage: Data collection is the first stage of the Big Data life cycle. A large amount of data comes from a variety of sources: log files that are maintained on servers, sensors of various kinds, mobile devices, data coming from satellites, the results of scientific research, data from computational experiments, the results of search queries generated on social networks, and much more. A variety of methods are used to obtain source "raw" data from different sources. Consider several methods of data collection and technologies used by them.

– *Log File* is a method of automatic data registration, related to different events occurring in automated systems. Log File is used almost in all computer systems. Indeed, web server records all transactions, performed by a system. Having large volumes of data, information is stored in database, not in the text files.

– *Sensor Data.* Typically sensors are used to take physical characteristics converted into perceived digital signals for storage and processing. Sensory data can include data coming in the form of sound, vibration, voice waves, the results of physical, chemical, biological, meteorological or other types of research, the results of taking the characteristics of production processes.

– *Mobile devices.* By means of various technologies, embedded in mobile devices, it is possible to get and transmit information about geographical position, perceive audio and video information, take photos, and receive information about the state of human health using touch screens and gravity sensors.

In the result of such data collection there appears so called. It is a centralized warehouse of large data in unprocessed form. It stores data from different sources, different formats, structured, weakly structured unstructured and binary data (images, audio and video). As a rule, it is stored in non-systemized form as it is, without any preprocessing. It costs much cheaper than traditional data. Data Lake enables to analyse bulk data in initial form.

2 Stage: Data Filtering. There can be much “noise” in raw data. For example, having low-quality audio recording, the background noise may be so strong that it does not allow distinguishing useful audio information on the use of modern recognition tools, or the CCTV camera filmed in the dark and the image is completely black. Filtering allows getting rid of such information.

3 Stage: Data classification. Any incoming data always has some minimal information. For example, it is known where exactly the video camera is installed, where it is pointed, and to what time of day certain frames are attached, or what scientific data is, what experiment results it is, under what conditions the experiment was carried out, and so on. Thus, any incoming data possesses so-called metadata that can be used to conduct initial classification which is the initial step of discovering the data semanticsю. This semantics serves as a basis for further data analysis.

4 Stage: Data analysis. Data analysis allows perceiving and processing large amounts of Big Data. Data analysis is a complex task and depends on the tasks to be solved using this data, the requirements for accuracy and speed of solution, the availability of technical means and, finally, the status of the source data.

Data analysis includes solving of two basic following stages:

− *on the first stage* the problem of uncovering the syntax of data must be solved, that is, data structure identifying, for example, which objects represent the data, what properties they have, what the values of these properties are, how the objects are related to each other, the nature and characteristics of these relationships;

− *the second stage* concerns data semantics disclosure. This is so-called stage of intellectual data analysis is.

For a flexible organization of data analysis, the following principles are proposed to use. *Firstly*, not one, but several relevant methods of analysis should be used to achieve these goals. *Secondly*, different methods and storage methods to store data, which can be distributed across computers on the network, should be used.

- *thirdly*, highly effective methods and access and data processing facilities should be provided. Data analysis is conducted considering heterogeneous and accuracy factors.

5 Stage: Storing, sharing, publication. Once collected, cleaned, and analysed, the resulting data is stored in appropriate repositories, made available and/or published for review by a wide range of stakeholders. Large and intensively used data sets must be stored and managed with a high degree of reliability, availability, and ease of use. Storage infrastructure needs to be flexible enough. The storage system must be distributed. Such a distributed storage system must support the maintenance of integrity, availability, and fault tolerance of various kinds.

In today's world, the scope of application of vast data has almost no limits. Disclosure, alteration, or destruction of data in Big Data can have catastrophic consequences. It should be noted that all big data environments are at risk. In this regard, it is necessary to ensure reliable protection of data during its storage, transmission and processing through the implementation and use of procedures for technological solutions in the information security area. Working with data provides its quality, increasing its significance, reusability, and preservation to identify new and more meaningful information. This area includes data retrieval, detection, management, authentication, archiving, storage and presentation. After data publishing, other researchers should be able to authenticate and regenerate it according to their interests to conduct researches.

TEST QUESTIONS:

1. *What components of Big Data do you know?*
2. *Explain the nature of Big Data.*
3. *What methods of Big Data analysis do you know?*
4. *What methods of Big Data visualization and introduction do you know?*
5. *What technologies of Big Data storage and processing are there?*
6. *What stages of life cycle of Big Data management do you know?*
7. *What are dark technologies?*
8. *What is "MapReduce" and how is it connected with the processing of great data?*
9. *What are the advantages of using modern technologies for processing great data?*
10. *What are the main challenges when working with big data?*

CHAPTER 4.
CLOUD COMPUTING TECHNOLOGIES: THE CURRENT TREND OF THE DEVELOPMENT OF THE DIGITAL ECONOMY

4.1. Basic concepts and tasks of cloud computing technologies in the digital economy

Cloud services have become one of the main systems to support the manufacturing industry. They make it possible to change the traditional business model and create smart production networks that make a significant contribution to promoting effective cooperation.

The National Institute of Standards and Technology (NIST) defines cloud computing as a model that enables widely available, convenient, and scalable, on-demand access to a common array of configurable computing resources (e.g., network, server, storage, applications, services) that can be quickly provisioned and issued with minimal, on the part of the manager, costs for this [97].

The Law of Ukraine "On Cloud Services" provides the following definitions regarding cloud services [6]:

Cloud computing technologies are technologies for providing remote access to cloud infrastructure through electronic communication networks at the user's request.

The cloud (cloud infrastructure) is a set of dynamically distributed and configurable cloud resources that can be quickly provided to the user of cloud services and released through global and local data transmission networks.

Cloud services – a service for providing cloud resources using cloud computing technology.

Cloud resources – any technical and software means or other components of an information (automated) system, access to which is provided by cloud computing technologies, in particular, processing time (computing power), space in data stores, computer networks, databases and computer programs .

A user of cloud services is a natural or legal entity that uses cloud services to meet its own needs.

A cloud service provider is a legal entity or an individual entrepreneur who provides one or more cloud services independently or jointly with other cloud service providers.

Cloud services are provided to cloud service users on a contractual basis by cloud service providers. Types of cloud services are presented in fig. 4.1.

The main types of cloud services are implemented in the following areas:

- infrastructure as a service – a cloud service, which consists in providing the user of cloud services with computing resources, storage resources or electronic communication systems using cloud computing technology;

- platform as a service – a cloud service that consists in providing the user of cloud services with access to the infrastructure and sets of computer programs (operating systems, system computer programs, computer programming software, database management software) using cloud computing technologies;

- software as a service – a cloud service, which consists in providing the user of cloud services with access to applied computer programs using cloud computing technology through an online service or computer agent programs;

- security as a service – a cyber protection service provided to the user of cloud services using cloud resources;

- other services that meet the definition of cloud services.

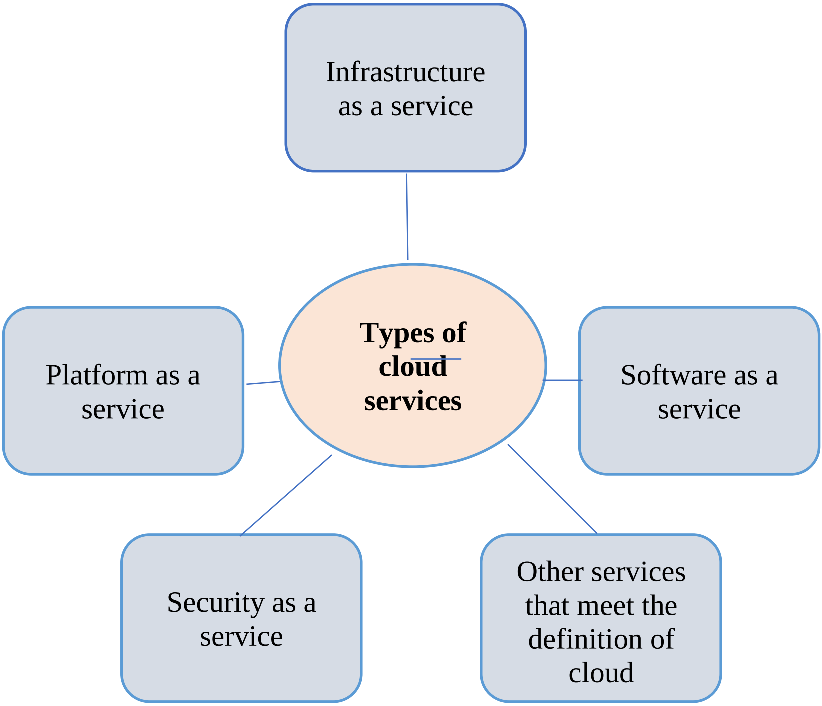


Figure 4.1. Types of cloud services [based on materials 6]

Cloud computing technologies are the result of the evolution and combination of modern virtualization tools, technical capabilities, as well as the use of the modern concept of service-oriented architecture (SOA). This concept is based on the principle of interoperability of services and allows the user to abstract from the technical side of service provision and concentrate on its use.

For the first time, the idea of such calculations was proposed by John McCarthy in 1961. It consisted in the fact that calculations can be sold, accordingly, computing power can be provided like any other service [70]. It is believed that this was actually the first attempt to describe cloud infrastructure.

In 1963, research into the possibility of global access to a computer network began. They were performed by Z.S.R. Licklider, he believed that it would enable a person to access computer programs and data from anywhere on the globe. It was he who formulated the first ideas of a global computer network, the result of which was the emergence of a modern network space, within which cloud resources exist.

For a better understanding of some features of using cloud infrastructure, it is also necessary to have a certain idea about such concepts as «thin» and «thick» client.

A thin client is a computer or client program in networks with a client-service or terminal architecture that transfers all or most of the information processing tasks to the server. An example of a thin client can be a computer with a browser used to work with web applications [61].

Thick client – in the "client-server" architecture, it is an application that provides (in contrast to the "thin client") an expanded range of functionality, regardless of the central server. Under such an approach, the server acts as a data store, and all the work of processing and providing data goes to the client's computer [61].

There are a number of reasons that led to the emergence of cloud infrastructure. Firstly, it is the impossibility of "gadgets", smartphones, tablets, etc. perform all the functions of a regular personal computer. However, in modern conditions, manufacturers strive to make the equipment as small, compact and simple as possible. But sometimes for this it is necessary to neglect some functions.

Secondly, the emergence of cloud infrastructure is related to the desire to receive the benefits of the synergistic effect of using the same programs and standards. Thus, the user will have no other choice but to use resources already existing in the cloud, he will not choose among programs from different manufacturers. This leads to increased profit levels through increased customer loyalty, and it also has a significant impact in terms of security.

Thus, cloud services can be considered as a new approach that will give a powerful impetus to the further development of information technologies and computer sciences. Note that distributed and parallel computing in Europe and America has been widely supported. Currently, the VENUS-C project is being developed in Europe, its goal is to study in more detail the possibilities of using cloud computing for research, as well as in industry.

Cloud computing technologies help in solving a number of problems in various fields. For example, it can be semantic search, social networks, knowledge bases, search for sequences in DNA, etc.

One of the examples of use can be the task of finding spam pages on the Internet. To perform this task, it is necessary to use a significant amount of computing power, which is why cloud resources are a good helper in solving this issue. The situation is similar with the search for information, here also the capabilities of the cloud infrastructure help to speed up the process, as well as make it more accurate.

Server farms are an association of servers connected by a data transmission network that works as a single entity. One type of server farm is defined by metacomputer processing. In all cases, the considered farm provides distributed data processing. It is carried out in a distributed data processing environment. A server farm is the core of a large data processing center and has enormous capacities for data storage [47].

An example of this would be the free e-mail services available on the Internet. One of the main advantages of such a service is the prevention of data loss. By managing them through multiple networked computers, the probability of data loss becomes less likely. Companies providing cloud services position the possibility of providing such a service for their potential customers as a significant advantage.

Preliminary estimates of savings on cloud solutions indicate the possibility of reducing, with their help, the costs of IT operation by an average of 60-70% [97]. Such savings open up the possibility of redirection, thanks to which significant financial and personnel resources are released for solving new tasks and the corresponding modernization of the economy.

However, cloud computing technologies also have a number of disadvantages. Yes, it is obvious that the user depends on the cloud service provider.

Cloud infrastructure, which includes cloud computing, data storage, and services, provides many benefits to businesses and users. However, cloud infrastructure brings new information security risks that must be considered and effectively managed.

The primary goal of enterprises and providers that embrace cloud solutions is to provide enterprise IT infrastructure as a service. Today, the experience gained in the integration and provision of corporate applications as separate services is being applied in the organization of infrastructure levels. Software and physical infrastructure, as well as applications in Service-Oriented Architecture (SOA), are supposed to be discoverable, manageable and adjustable.

Today, there are a lot of technologies that provide solutions based on cloud computing technology. If a few years ago it was difficult to implement them due to the lack of comprehensive, clear tools, such as tools for packaging and deploying the application in the cloud infrastructure or binding to the infrastructure of the cloud provider, now there are standards that are designed to provide general support for virtualization tools.

The open standard for working with cloud infrastructure is OVMF (Open Virtual Machine Format). It describes the requirements that virtual service providers must comply with for the packaging and deployment of virtual objects transferred to cloud service customers. The cloud standard also does not limit the choice of software solutions that can be used for work.

Four directions can be distinguished that must be developed to ensure the security of the construction of a cloud data center:

- secure data storage in cloud storage;
- safe execution of tasks;
- secure data transfer;
- safe access to information.

The creation of new standards, including for ensuring the security of cloud infrastructure, is currently a priority task, and the further development of cloud resources will be carried out together with the emergence of new, more reliable methods of data protection.

Among the key tasks of business automation of any communication enterprise, significant costs for support and development of customer relationship management and sales systems (CRM), automated payment systems, technical accounting systems, and others can be singled out. Such systems require the creation and maintenance of a data center for efficient operation.

Peculiarities of the use and development of cloud computing technology in the conditions of the digital economy [54]:

1. Cloud computing technology helps to optimize operations, thanks to its parameters such as scalability and flexibility, which, combined with the ability to reduce capital costs and administration costs, ensures its relevance. Consumers get the opportunity to quickly and cheaply deploy the necessary digital infrastructure and enjoy the benefits of the digital world.

2. The digital transformation of business contributes to the growth of the spread of cloud services, companies begin to understand in practice the advantages of their use.

3. The number of cloud service providers is not increasing - only market shares are being redistributed. The national cloud services market is growing, and domestic cloud service providers are beginning to gradually reduce the share of foreign providers in the Ukrainian cloud market.

4. Digitization leads to the fact that we suffer from cybercrime more and more often, and therefore the issue of data security becomes more acute. Security issues are one of the main barriers that lead to the refusal to start using cloud infrastructure. Cloud service providers are beginning to use artificial intelligence and machine learning for security purposes, while cybercriminals continue to evolve and invent new forms.

It should also be noted that there are certain barriers to development: lack of legislation on cloud computing technologies, lack of strategies for the development and implementation of cloud services at enterprises and in the public sector, not all local service providers have high-level security certificates. The growing demand for the use of cloud infrastructure is due to the ongoing digital transformation, and they cannot exist without each other.

Cloud infrastructures are becoming popular and are used in all areas of activity:

- remote use of estimated capacities;
- constant accumulation of information and storage of files;
- use of online software (accounting, office, CRM, etc.);
- dissemination of information and provision of access to it;
- use of e-mail;

- database hosting; - new knowledge transfer opportunities: online lessons, webinars, etc.

Many companies are striving to implement cloud computing technologies in their own enterprise and are moving towards this goal, but due to the pandemic, this process has been significantly accelerated, giving impetus to certain trends [130]:

- the popularity of the hybrid cloud, which combines private and public cloud solutions that are connected, is increasing. This is an opportunity, in the period of significant loads, to use external resources to go beyond the capacity limits;
- the use of multicloud is growing in popularity. Consumers "collect" an ideal set of services from the services of different providers, each of which has certain specific features regarding their configuration and management, and therefore it is necessary to create systems that will become a tool for simplifying the interaction between the consumer and the multi-cloud;
- The Internet of Things (IoT) is developing faster and faster, and cloud resources as its component are a convenient tool for transferring large data sets, as well as a place where data is processed and accessed. Cloud infrastructure allows processing big data in real time;
- cloud computing technologies revolutionize education, encourage all participants in the educational process to self-education and self-improvement. New forms of organization of the educational process appear;
- modern conditions require new automation technologies, companies are investing in machine learning, artificial intelligence. With the help of cloud computing technology, artificial intelligence becomes more efficient;
- the problem of data security, unfortunately, remains unchanged, and therefore companies continue to search for new and improved solutions that will help ensure maximum protection;
- edge computing aims to solve certain problems that arise when using cloud technologies, for example, to reduce delays that result from the process of computing and transferring data to the processing center.

Summarizing the issue of cloud computing technologies, the following should be noted:

First, it is a truly revolutionary technology that incorporates the basic principles of consolidation and virtualization, but with an adjustment for time.

Secondly, it should be mentioned that at the moment this technology is poorly standardized, especially in matters related to security. In this regard, it still has a long development ahead of it, and to understand what it already has now and how it can use it.

Cloud computing technologies solve important tasks of the digital economy, providing the necessary resources for the development of new technologies, optimization of business processes and facilitation of collaboration. They act as a key catalyst for innovation and growth in the age of digital transformation.

4.2 Main properties of cloud computing technologies

National Institute of Standards and Technologies in its document «The NIST Definition of Cloud Computing» [97] determines a number of the following characteristics of cloud computing technologies (fig. 4.2).

On-demand self-service. The consumer has the opportunity to access computing resources unilaterally as needed, automatically, without the need to interact with employees of each service provider [23].

Broad network access (Broad Network Access). The provided computing resources are available through networks using standard mechanisms for various platforms, thin and thick clients (mobile phones, tablets, laptops, workstations, etc.) [23].

Resource pooling. Computing resources of the cloud service provider are pooled to serve many consumers in accordance with the multi-tenancy model. Pools include various physical and virtual resources that can be dynamically assigned and reassigned according to consumer requests. It is not necessary for the consumer to know the exact location of the resources, but it is possible to specify their location at a higher level of abstraction (eg, country, region, or data center). Examples of this kind of resources can be storage systems, computing power, memory, network bandwidth [23].

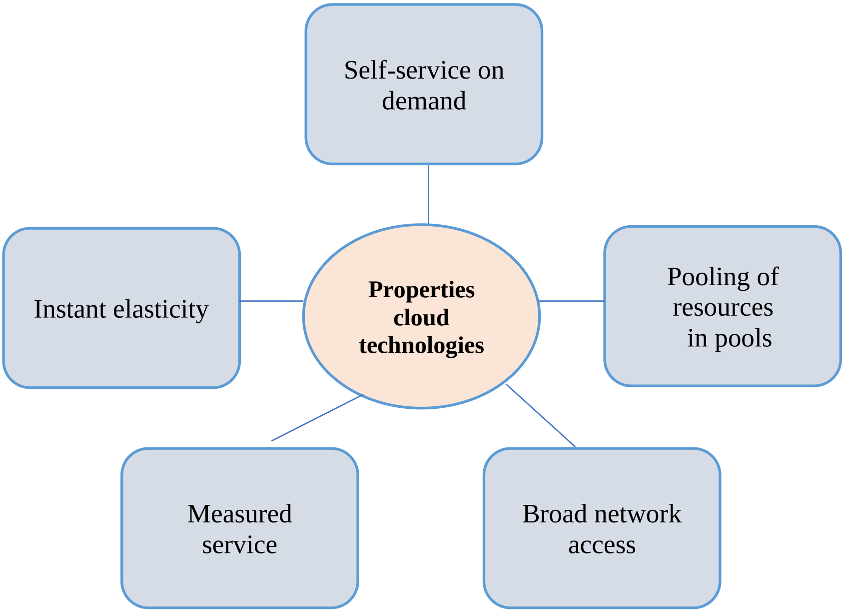


Figure 4.2. The main properties of cloud computing technology [based on materials 97]

Instant elasticity (Rapid elasticity). Resources can be easily allocated and released, in some cases automatically, to quickly scale in proportion to demand. For the consumer, the possibilities of providing resources are seen as unlimited, that is, they can be assigned in any amount and at any time [23].

Measured service. The cloud infrastructure automatically manages and optimizes resources with the help of measurement tools implemented at the abstraction level in relation to various kinds of services (for example, management of external storage, processing, bandwidth or active user sessions). Used resources can be tracked and controlled, which provides transparency for both the provider and the consumer using the service [23].

Having analyzed the main properties of cloud computing technology, we will move on to consider the development models of cloud computing technology and their features.

4.3 Development models of cloud computing technologies

There are three main service models of cloud technologies, which are also called cloud layers. We can say that these three layers reflect the structure not only of cloud computing technology, but also of information technology as a whole.

Infrastructure as a Service (IaaS) - can be attributed to a set of physical resources, such as servers, network equipment and drives, which are offered to customers as services provided. Infrastructure services solve the problem of properly equipping data centers, providing computing power as needed (fig. 4.3) [61].

That is, it is a service model in which customers rent computing power to deploy and use virtualized instances of operating systems and software products. Companies of all sizes can access state-of-the-art data centers, secure servers, and high-performance storage systems.

In the infrastructure as a service model, one component can be singled out: hardware as a service (HaaS). The user deploys his own infrastructure based on the equipment provided to him.

The underlying cloud infrastructure is managed by the provider, and the consumer has control over operating systems, storage systems, deployed applications, and possibly limited control over the selection of network components. With such an interaction, the protection of platforms and applications is provided by the consumer, and the provider is responsible for the protection of the infrastructure. Virtualization is often used to provide resources on demand [61].

According to IaaS, servers and other resources are provided to the customer, if necessary, through the cloud. This model provides self-service and on-demand access to IT resources. This means that developers need a minimal amount of time spent on creating the necessary tools without purchasing their own capacity.

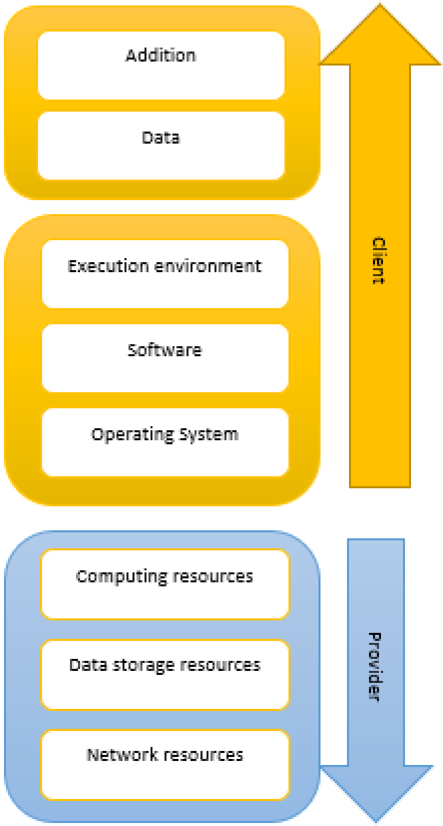


Figure 4.3. Infrastructure as a Service (IaaS) [61]

The consumer of industry solutions is provided with the basic infrastructure, in particular, the necessary equipment and data transmission channels. The consumer must configure the platform and applications himself, for example, install the operating system and necessary software components.

When renting virtual infrastructure, you can use services of various scales: a virtual server and a virtual network. In the first case, a single virtual server is rented, in the second - a pool of virtual servers with the possibility of combining them into a virtual network.

The equipment on which the virtual infrastructure is built is located in specialized data processing centers. These centers provide backup of communication channels, protection against power outages, and everything directly related to the functionality and availability of equipment.

When using the IaaS model, two pricing options are possible:

- sale of service provider resources. Payment is made only for the consumed capacity, which is monitored every hour. Such a resource reservation system is most optimal for companies with seasonal load peaks, when computing power is needed periodically or in spurts;
- guaranteed allocation of resources. In this case, a certain amount of resources is reserved, which is used by the customer, with a monthly fixed payment. This option of providing resources is less flexible in terms of payment, but more stable in terms of resource allocation and the operation of the customer's systems. Resources are always reserved regardless of whether they are loaded by other clients. Such a resource reservation system is best suited for companies with a normal load.

When using IaaS, the customer receives full administrative rights within the rented virtual servers, the provider is only responsible for organizing access to the server over the network and ensuring the functionality of the equipment and basic infrastructure software. The disadvantage of this model is that the service is focused on providing services to IT companies that independently develop software.

Advantages. Reduction of capital investments in hardware. Savings within the model are achieved through the most efficient use of resources, due to the use of virtualization. It is also the ability to scale and reduce the risk of losing investments.

Disadvantages Business efficiency and productivity are highly dependent on the supplier's capabilities, and may require long-term investments. Centralization requires new approaches to security measures.

Examples of infrastructure as a service are IBM SmartCloud Enterprise, VMWare, Amazon EC2, Windows Azure, Google Cloud Storage, Parallels Cloud Server, and many others [23].

Platform as a Service (PaaS) is a service model in which applications (created or purchased) are provided to the consumer as a set of services. It includes, in particular, middleware as a service, messaging as a service, integration as a service, information as a service, communication as a service, etc. (Fig. 4.4). The consumer gets access to the use of information technology platforms: operating systems, database management systems, connecting software, development and testing tools hosted by the cloud provider [61].

Payment for cloud resources may be charged depending on the level of consumption. The pricing of the service consists of the following elements:

- fee for computing power;
- fees for licenses of used software (virtualization programs, operating systems, applications);
- service provider allowance.

Most of the existing PaaS platforms are aimed primarily at satisfying the interests of developers. They allow you to create scalable web applications with lower costs compared to the IaaS model, but along with this, they have significant disadvantages: there is no free choice of technologies and control over low-level system components, and the system is not sufficiently productive, since when exchanging data with PaaS providers, it is recommended use data encryption, which requires additional processing power.

Data as a Service (DaaS) provides the user with disk space that he can use to store large amounts of information [23].

In other words, the PaaS model is a combination of IaaS with an operating system and an application programming interface [23]. A consumer has access to deployed applications and a specific set of environment parameters. It is the consumer who should take care of the protection of the applications deployed on the platform.

Applications can work both in the data center of the enterprise itself and in the cloud infrastructure. To achieve scalability, services are often virtualized.

Advantages. Smooth versioning, i.e. should not or should minimally experience software changes in the cloud.

Disadvantages Due to the centralization of functions, there is a need to find the most secure tools and implement the necessary measures to ensure it. Examples of platform as a service can be IBM SmartCloud Application Services, Amazon Web Services, Windows Azure, Boomi, Cast Iron, Google App Engine and others [23].

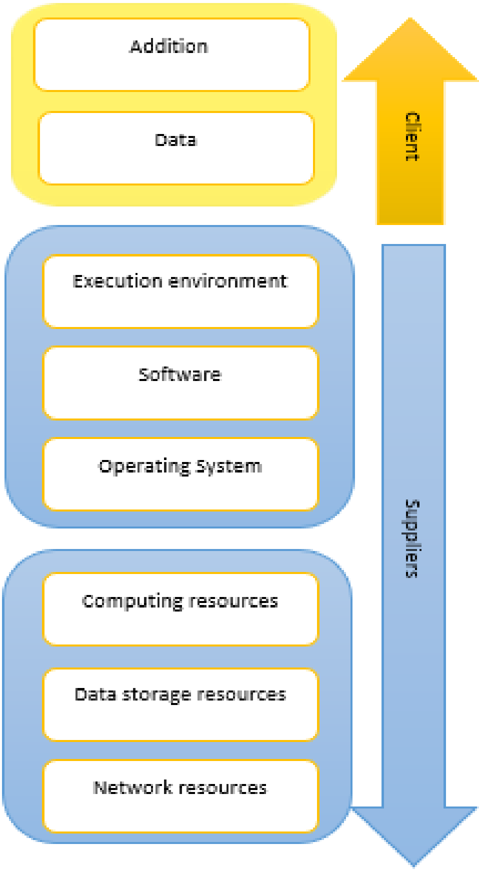


Figure 4.4. Platform as a Service (PaaS) [61]

Software as a Service (SaaS) is a service model in which subscribers are provided with ready-made application software that is fully serviced by the provider (fig. 4.5) [61].

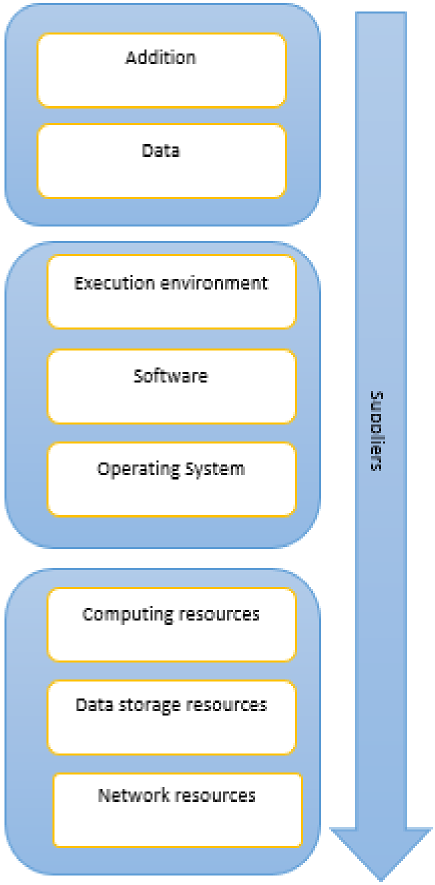


Figure 4.5. Software as a Service (SaaS) [61]

The provider in this model independently manages the application, giving customers access to functions from client devices, usually through a mobile application or web browser. The consumer gets access to the software deployed on the servers, and the issues regarding updates and licenses rest with the cloud service provider.

This model is characterized by a payment model where you pay for the software actually used. As with all forms of cloud computing, customers pay not for owning the software, but for renting it (the user does not need to install the software on their computer). Thus, in contrast to the classic software licensing scheme, the customer bears relatively small periodic costs, and he does not need to invest significant funds in the purchase of the application program.

Since providers have additional income from non-core activities (advertising), these services can be provided free of charge.

When using SaaS, the periodic payment scheme assumes that if there is a temporary lack of need for the software, the customer can suspend its use and freeze payments to the developer. The SaaS rental contract includes a fee not only for the use of the software, but also for all costs associated with maintaining its functionality, updating and data protection.

The basic cloud infrastructure is managed by the provider, and the consumer is in charge of the security of his own data (logins, passwords), as well as regarding the individual configuration of the service.

Software as a service is most familiar to the everyday user. The most common application of this type is e-mail services. There are many application services aimed at the corporate community. There is software that manages payroll, human resources, teamwork, customer and business partner relationships.

Despite the obvious advantage of this model, there are a number of restraining factors that limit its use. First, not all types of systems can be implemented as a SaaS concept. Secondly, SaaS-models are not profitable to implement for systems that require individual customization, due to the fact that the main source of savings for it is the effect of scale.

Advantages. Reduction of capital investments in hardware and labor resources; reducing the risk of investment losses, as well as reducing capital costs due to the absence of the need to own physical infrastructure.

Disadvantages As with the previous two models, centralization requires robust security measures. Examples of SaaS include Gmail, Google Docs, Netflix, Photoshop.com, Acrobat.com, Intuit QuickBooks Online, IBM LotusLive, Unyte, Salesforce.com, Sugar CRM, and WebEx. A large part of the growing mobile application market is also a SaaS implementation [23].

This distribution of cloud computing technologies is generalized. The Law of Ukraine "On Cloud Services" additionally distinguishes such categories as: security as a service and other services that correspond to the definition of cloud services [6].

Security as a Service (Secuity as a Service - SECaaS) is a cyber protection service provided to the user of cloud services using cloud resources. Enables users to quickly deploy products that enable secure use of web technologies, email security, and local system security. This service allows users to save on the deployment and maintenance of their own security system [23].

Having reviewed the models of cloud computing technologies, a number of common problems can be identified:

- the need to connect to the network, which causes dependence on the Internet service provider;

- the use of cloud computing limits the customer in the choice of software, and also does not give the opportunity to configure it for one's own purposes;

- the security of confidential information is not guaranteed, as today there are no technologies that fully ensure it.

Cloud services are provided in different ways. Let's consider them in more detail. Different forms of cloud computing allow for a variety of software, platform, and infrastructure services. Cloud data centers can be operated by service providers as well as private enterprises.

Public clouds are cloud infrastructure that is potentially available to an indefinite number of cloud service users and is controlled by the cloud service provider [6].

These are cloud services provided by the provider. They are outside the corporate network. Users of these clouds do not have the ability to manage these clouds or maintain them, all responsibility rests with the owner of this cloud. A cloud service provider assumes responsibility for the installation, management, provisioning, and maintenance of software, application infrastructure, or physical infrastructure. Customers pay only for the resources they use.

Anyone (individual or legal entity) can become a consumer, for whom various scaling capabilities for business systems and an understandable and affordable tool for creating websites will be provided.

Examples: online services Amazon EC2 and Amazon Simple Storage Service (S3), Google Apps/Docs, Salesforce.com, Microsoft Office Web.

It should be noted that services in this type of cloud are provided in the form of a specific, standard set of tools that meets the most common needs. Possibilities for individual selection of tools are limited. We should also note that since the consumer has little influence on the infrastructure, in case of the need to comply with certain regulatory requirements regarding strict security, obstacles may arise.

As business sensitivity to IT resource costs increases along with the demand for agility, we may see greater enterprise adoption of the public cloud, especially as more security measures are implemented. While many mission-critical workloads and some compute instances may reside in traditional data centers or in the private cloud, public cloud adoption is growing as it gains trust.

Private clouds are cloud infrastructure prepared for use by a single user of cloud services and controlled by him [6].

These are the company's internal cloud infrastructures and services. These clouds are located within the corporate network. An organization can manage the private cloud itself or entrust this task to an external contractor. The infrastructure can be located either on the premises of the customer, or at an external operator, or partly at the customer and partly at the operator. The ideal version of a private cloud is a cloud deployed on the organization's territory, maintained and controlled by its employees.

An important difference between private and public clouds is that in the first case, the infrastructure is installed and maintained at the expense of the enterprise. In this case, it is necessary to understand that the costs of implementation and maintenance can sometimes be higher than the cost of a public cloud, and it is also worth remembering the complexity of creating your own infrastructure and, accordingly, the need to involve experts in this process.

However, we should also note the advantages of this cloud model. In contrast to the publicly available one, in this case there is an opportunity to ensure compliance with the necessary standards of the security level, as well as the company, depending on its own needs, can choose a set of tools to perform the assigned tasks.

Hybrid clouds - a cloud infrastructure that is a composition of two or more different cloud infrastructures (private, collective or public), which are independent objects interconnected by technologies that allow data or computer programs to be transferred between these objects [6].

They are usually created by the enterprise, and the responsibility for managing them is shared between the enterprise and the public cloud provider.

Typically, this type of cloud is used when an organization has seasonal periods of activity. In other words, as soon as the internal IT infrastructure does not cope with current tasks, part of the capacity is transferred to the public cloud (for example, large volumes of statistical information, which in their raw form have no value for the enterprise), as well as to provide users with access to enterprise resources (to a private cloud) via a public cloud. A well-designed hybrid cloud can serve, in accordance with the standards required by security, critical processes, such as receiving payments from customers, as well as more secondary ones [23].

Such a cloud infrastructure requires the creation of such solutions that would allow various services to be combined into a single efficiently working system. From this follows a significant drawback of this cloud model - the difficulty of creation and management. In order to function comfortably and efficiently, this model needs the development of certain tools and recommendations.

A public (collective) cloud is a cloud infrastructure that is shared between a defined group of interconnected users of cloud services who have common needs and is controlled by users of cloud services themselves or their representatives [6].

It is a cloud infrastructure that is designed to be used by a specific community of users from organizations that share common goals (such as mission, security requirements, policies, and compliance). A public cloud may be jointly owned, managed, and operated by one or more organizations in the community or a third party (or some combination thereof). Such a cloud can be physically located both in and outside the owner's jurisdiction [97].

At the current stage, cloud services combine not only infrastructure and platform elements from one provider, but also various services collected from different providers. This model is called multicloud.

Multicloud is the use of several cloud computing technologies and storage services in one architecture adapted for this purpose, in contrast to the hybrid cloud, where different deployment models are combined [97].

The advantages of such a system are reduced dependence on a single provider of cloud services, economic efficiency, increased flexibility due to the selection of services, compliance with local policies that require the physical presence of certain data, geographical distribution, processing of requests from a physically closer cloud module, which, in turn, reduces delay and reduces the risk of failures.

Among the problems that arise in a multi-cloud environment: the issue of security, because it is more difficult to manage protection due to the large number of different parts.

In April 2019, Google announced the release of Anthos, which can manage workloads in third-party clouds, including Amazon Web Services and Microsoft Azure. Developers will be able to use each of the public clouds as efficiently as possible without being tied to them [81].

Cloud computing technologies open up new opportunities for optimizing the work of enterprises, helping to solve numerous tasks, optimizing business processes and facilitating their digital transformation, contributing to innovative development. Key capabilities of cloud computing technologies:

1. Effective use of resources. Businesses can use cloud computing to optimize the use of computing resources, reducing the cost of equipment and maintenance of their own infrastructure.

2. Scalability of business. Cloud technologies allow enterprises to scale their computing and other resources according to changing needs, making it easy to adapt to business growth or changing conditions.

3. Rapid introduction of new services. Enterprises can quickly implement new services using cloud platforms without the need for large infrastructure and resource costs.

4. Flexibility of the workplace. Thanks to cloud technology, employees can easily access work resources and data from anywhere, which supports mobility and allows work tasks to be completed from almost anywhere in the world.

5. Savings of funds. Businesses pay only for actually used resources, which allows for efficient use of the budget and avoidance of spending on unused resources.

6. Ensuring data security. Cloud service providers put significant effort into data security, including encryption, regular backups, and access control systems.

7. Development of innovations. Cloud computing simplifies research and development by providing access to powerful computing resources for high-tech experimentation and innovation.

8. Effective use of business analytics. Enterprises can use cloud platforms to analyze large volumes of data and obtain valuable information for strategic decision-making.

Cloud computing technologies have become a defining modern trend in the development of the digital economy, given their importance in solving challenges and ensuring innovative development. Providing shared access to computing resources, flexibility and scalability, cloud computing technologies are becoming a key factor in supporting business processes and developing new products and services. Their effectiveness lies in ensuring rapid implementation and flexibility in the use of resources, which contributes to innovative development and increased competitiveness. In addition, cloud technologies simplify management processes and support data security, making them a necessary element of a digital development strategy in the modern business environment.

4.4. Amazon Web Services (Amazon Web Services)

The Amazon Web Services (AWS) cloud is a collection of all servers connected to the network, on which its service platform is located, and an operating system that unites several servers into a single entity. For a group of computers anywhere in the world to be one cloud, the following conditions must be met:

1) They must be able to use virtualization (the ability of software to act as hardware) to combine the computing power of

multiple processors and multiple storage devices, as well as the networking of these components, into single, continuous units. In other words, they must gather their resources so that they can be perceived as one large computer, not several small ones.

2) The workloads running in these resource pools must not be tied to any physical location. That is, their memory, databases and processes must be fully portable in the cloud.

3) The resource pools running these workloads must be provisionable through a self-service portal. Thus, any client that needs to run a process on a server can provide the virtual infrastructure needed to host and support that process by ordering it over the Internet.

4) All services must be provided on a pay-as-you-go basis during the time intervals spent on the actual operation of the service, not on a one-time or renewable license basis.

World infrastructure. AWS serves more than a million active customers in more than 190 countries around the world. Amazon is constantly expanding its global infrastructure to provide lower latency and higher throughput for its customers and to ensure that their data is only stored in the specified region. As a customer's business expands, AWS provides the infrastructure that meets its requirements on a global scale.

The AWS cloud infrastructure is built around regions and availability zones. A region is a real physical location around which there are several Availability Zones. An availability zone consists of one or more individual data centers, each of which is equipped with redundant power supplies, redundant network and communication resources, and is located separately from other centers. Compared to using a single data center, such availability zones allow applications and databases to have a higher level of availability, fault tolerance and scalability.

Each Amazon region is designed to be completely isolated from other Amazon regions. This ensures maximum fault tolerance and stability. Each availability zone is also isolated, but communication between availability zones of the same region is carried out by channels with a very low delay. AWS allows you to host instances and store data in multiple geographic regions, and within each of them, multiple Availability Zones. Each zone is an independent failure zone. This means that accessibility zones are physically separated by a typical metropolitan area and in low flood risk zones (the specific categories of flood risk zones vary by region).

In addition to a separate uninterruptible power supply (UPS) and back-up means for power generation, each of them receives electricity through different networks from independent infrastructure facilities, which further reduces the probability of single points of failure.

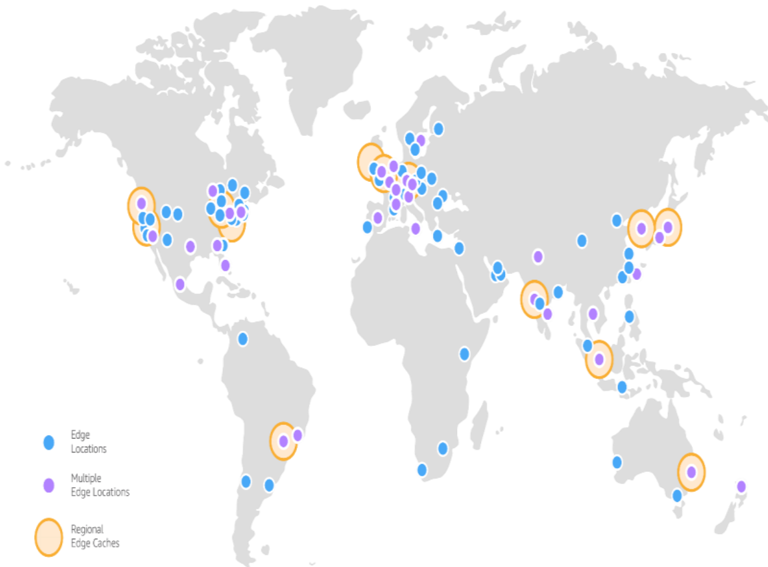


Figure 4.6. AWS Regions Global Infrastructure

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AWS cloud security and standardization. Cloud security is a top priority for AWS. AWS customers enjoy all the advantages of data centers and network architecture that were developed for organizations with increased security requirements. Security in the cloud is provided according to the same principles as in traditional local centers, with the difference that in this case it is not necessary to pay the costs of maintaining premises and equipment. When working in the cloud, there is no need to manage physical servers or storage. The client uses software security tools to monitor and protect the incoming and outgoing data flows of cloud resources.

One of the important advantages of the AWS cloud is that the customer can scale his system and implement innovations while maintaining a high level of security of the environment and paying only for the services used. This means that the required level of security can be provided at a lower cost than in an on-premises environment.

AWS customers inherit all the best practices implemented in the architecture and operational processes of AWS and are designed to meet the demands of the most demanding customers in terms of security.

The AWS cloud allows you to operate under a shared responsibility model. While cloud security is managed by AWS, cloud security is the responsibility of the customer. This means that by analogy with ensuring security in the local center, the data client determines what level of security must be implemented to protect its own content, platform, applications, systems and networks in the cloud.

AWS provides the customer with guidance and unique knowledge by providing access to online resources, its experts and partners. AWS provides advice on current issues. Additionally, if security issues arise, the customer can always work with AWS to resolve them.

The client gets access to hundreds of tools and capabilities to achieve their security goals. AWS provides specialized tools and components with security features for network security, configuration management, access control, and data encryption.

Finally, AWS environments are continuously audited and certified by accreditation agencies in various industries and countries around the world. In an AWS environment, you can use automated resource inventory tools and privileged access reports.

AWS Security Benefits:

1) Data security. AWS infrastructure uses effective security measures to protect customer data, all data is stored in securely secured AWS data centers.

2) Ensuring compliance with requirements. AWS infrastructure supports dozens of compliance programs. This means that part of the client's relevant compliance tasks have already been completed.

3) Economy. Customer reduces costs with AWS data centers maintain the highest security standards without having to manage their own data center.

4) Fast scaling. Security scales with the scale of AWS cloud usage. Regardless of the size of the customer's company, the AWS infrastructure is designed for data security.

The IT infrastructure provided by AWS to its customers is designed and managed in accordance with security guidelines and various standards in the field of IT security. A list of the main security programs that AWS meets:

- SOC 1/ISAE 3402, SOC 2, SOC 3
- FISMA, DIACAP and FedRAMP
- PCI DSS Level 1
- ISO 9001, ISO 27001, ISO 27018

AWS provides customers with various information about its IT control environment in the form of technical descriptions, reports, certifications and attestations from third-party organizations.

AWS products. The AWS cloud is a broad set of infrastructure services, such as the provision of computing power, various data storage options, networking solutions and databases, offered as a service (with availability within seconds when needed) on a pay-as-you-go basis. The customer has more than 200 varieties of AWS at his disposal: from data storage to deployment tools and catalogs for content delivery. New services can be prepared quickly and without initial capital expenditure. This allows corporations, startups, SMBs, and customers from other sectors to access the components they need to quickly respond to changing business requirements.

There are two lines of AWS development and delivery: products and solutions.

The Amazon website highlights such types of products as, for example, analytics, blockchain, contact center, Internet of Things, machine learning, media services, quantum technologies, robotics, and others.

In turn, each type of product has basic services, for example, for cloud financial management (Cloud Financial Management):

- AWS Coast Explorer is a cost explorer for analyzing costs and service usage (user);
- AWS Billing Conductor is an invoicing manager that simplifies the invoicing process thanks to the transparency of configurable costs and prices;
- AWS Budgets is a budget with which the user can set individual budgets for expenses and usage;
- AWS Coast and Usage Report – a report on costs and usage of services;
- Reserved Instance Reporting - report on reserved instances;
- Saving Plans – savings plans that allow you to save up to 72% on computing resources thanks to flexible pricing.

Such a type of product as a business application (Business Application) has, for example, such basic services as:

- Amazon Connect – a cloud-based contact center;
- Amazon Pinpoint – multi-channel marketing communications;
- Just Walk Out technology – technology of retail trade without cash registers;
- Amazon Honeycode – creation of mobile and web applications without programming;
- Amazon WorksDocs – secure storage and exchange of corporate documents;
- Amazone Chime – meetings, video calls and chats;
- Amazone Pinpoint API – flexible mobile SMS and push messages;

simple e-mail service;

- Amazone Chime Voice Connector SIP - tracking and advanced telephony functions.

A cloud services platform, such as Amazon Web Services (AWS), owns and maintains the networked hardware needed to provide these application services, while the customer deploys and deploys the required resources through an Internet application.

Six advantages of cloud services:

1) Fixed capital costs are converted into variables. Instead of investing heavily in deploying your own data centers and servers before the customer knows what they will be used for, you can pay only for the computing resources consumed.

2) Scale effect. When using cloud services, it is possible to achieve a lower variable cost than during the previous purchase of resources. With hundreds of thousands of customers using the cloud, providers like AWS can have impressive economies of scale and offer their customers more attractive pricing for resource consumption.

3) Optimization of own resources. The client - the customer saves himself from trying to guess or predict the amount of infrastructure resources needed in the future. If the resource volume decision has to be made before the application is deployed by the resource project, the customer is often left with unspent expensive resources or forced to work under limited resource conditions. When using cloud services, these problems disappear: exactly as many resources as needed are available to the client, and increasing or decreasing the amount of resources provided is a matter of a few minutes.

4) Speed of deployment and speed of response. The procedure for deploying new IT resources and using them with the help of cloud models and services is very simple and convenient for the client, which means that the developers of the customer's company will receive what they need not in a few weeks, but in a few minutes. As a result, the client's organization becomes much more flexible in relation to the factors of the external environment, since much less time and money is spent on experiments and development.

5) There is no need to spend money on the operation and maintenance of the data center. The customer - the customer can focus on projects that make his business more competitive, rather than on infrastructure. Cloud services allow you to concentrate on your clients, forgetting about the unmanageable burden: placement in racks, network management and server power.

6) Providing access to the world arena in a matter of minutes. The customer's client program can be deployed in several regions at once. This means that, for example, in the field of e-commerce, the business owner will be able to provide flawless service to their customers with minimal delays and costs.

TEST QUESTIONS:

1. *What are cloud computing technologies and how do they differ from traditional computing methods?*

2. Give examples of services or applications that use cloud computing technologies.

3. What are the main advantages of using cloud computing in the digital economy?

4. What are the main challenges and problems that may arise when implementing cloud computing technologies in the enterprise?

5. Explain how cloud computing technologies contribute to the development of digital transformation in various industries.

6. What security criteria should be considered when using cloud computing?

7. Define the term "cloud services". Types of cloud services?

8. How do cloud computing technologies affect the competitiveness of enterprises in the digital economy?

9. What trends in the development of cloud computing technologies are expected in the future and how can they affect the business environment?

10. Ways to provide cloud services?

CHAPTER 5.
BLOCKCHAIN TECHNOLOGY A BASIS FOR ECOSYSTEM DEVELOPMENT IN THE DIGITAL ECONOMY

5.1. The economic foundations of distributed storage registry technology (Blockchain). The history of blockchain emergence

Mechanism of blockchain (Blockchain) is a chain of formed blocks of transactions built according to certain rules.

All blocks are linked into a single chain - ***blockchain (block - block, chain - chain).*** Copies of blockchains are usually stored on all computers participating in transactions.

Blockchain can be used as a registry, access to which can be provided to any network participant

Blockchain can be used as a registry, access to which can be provided to any network participant.

The mechanism implements a decentralized management principle, and peer-to-peer (P2P) networks, coding, and cryptography are used to verify transactions. Transactions can be managed using programmable contracts.

Blockchain technology from a user's perspective is a distributed register used to record information about various objects: documents, money, property, services, etc.

From an information technology perspective, ***blockchain*** is a distributed database that operates on a global, corporate, or local network.

The database contains information about all transactions conducted by participants in the network. When a record is added to the database, it is grouped into blocks, and each block is added with a cryptographic signature that links it to the previous block.

The principle of blockchain technology:

– User A sends funds online to User B.;

– The transaction data is submitted in the form of a "block";

– Information about the transaction is transmitted to each participant in the blockchain system;

– System participants confirm the transaction;

– The confirmed transaction is added to the common "chain of blocks";

– Funds transferred from User A to User B.

Importantly, *blockchain* is not just a database, but also a system that allows you to prove the existence of information. This registry technology contains a code that characterizes the existence of a document, but not the document itself, in its classical understanding of doc, pdf formats, etc. Blockchain is a technology characterized by high transparency of information that can be seen and used by every user of the system

Advantages of applying blockchain technology include:

– Security of data storage due to its distribution.

– Mathematically justified control of inflation algorithmically or by increasing the block mining complexity.

– Reduction of financial and time costs.

– Authenticity of information obtained from remote and independent sources.

– Anonymity of network participants.

– Transparency of transaction information combined with impersonality of data.

– Strengthening trust between system participants.

– Absence of centralized authorization.

– Reduction of transaction costs.

– Shortening the time of transactions to several hours.

– Expense and cost trimming.

Problems of blockchain application include:

– The blockchain market is still in its development stage, and there are large-scale thefts of funds through hacking of trading platforms.

– Transactions in the blockchain are not regulated by a legal and regulatory framework.

– Transactions cannot be cancelled after they have been confirmed by users of the system.

– Criminals take advantage of the anonymity of transactions to create large criminal trading platforms.

– Transactions cannot be accelerated because they require confirmation.

Three main areas of application of this technology can be distinguished:

The history of Blockchain 1.0. begins in 1991, when the idea of blockchain technology was described by researchers S. Haber and W. Scott Stornett, who introduced computational solutions for digital documents with timestamps so that they could not be backdated. The system used a cryptographically secured chain of blocks to store timestamped documents. In 1992, Merkle trees were included in the development, which made it more efficient by allowing multiple documents to be collected into one block.

However, this technology was not used, and the patent was lost in 2004, four years before Bitcoin creation.

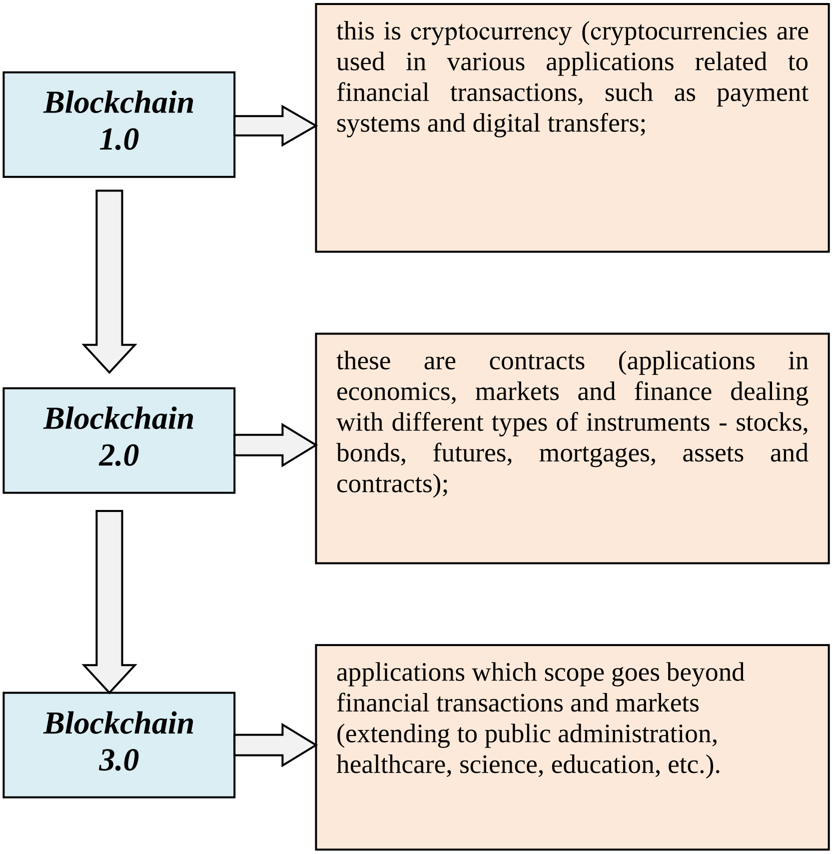

Figure 5.1. Evolution of blockchain technology

In 2004, computer technology researcher Hal Finney (Harold Thomas Finney II) introduced a system called RPoW (Reusable Proof Of Work). The system worked by receiving an irreplaceable or non-interchangeable Hashcash token based on proof of work and signed RSA, which could then be transferred from person to person.

RPoW solved the problem of double-spending by facilitating the retention of ownership of tokens registered on a trusted server. RPoW can be considered an early prototype and a significant early step in the history of cryptocurrency.

At the end of 2008, a white paper was sent via email to a person or group, using the pseudonym Satoshi Nakamoto, which presented a decentralized peer-to-peer (P2P) electronic cash system called Bitcoin. Protection against double-spending in Bitcoin was provided by a decentralized P2P protocol for tracking and verifying transactions. Instead of using the trusted hardware computing function RPoW, it is based on the Hashcash proof-of-work algorithm. In other words, Bitcoins are “mined” for a reward using the proof-of-work mechanism for individual miners and then verified by decentralized nodes in the network. Bitcoin appeared on January 3, 2009, when the first Bitcoin block was mined by Satoshi Nakamoto, who received a reward of 50 Bitcoins. The first recipient of Bitcoin was Hal Finney, who received 10 Bitcoins from Satoshi Nakamoto in the world first Bitcoin transaction on January 12, 2009.

In 2013, Vitalik Buterin, a programmer and one of the founders of the Bitcoin magazine, stated that Bitcoin needed a scripting language to create decentralized applications. When he did not receive community approval, Buterin began developing a new distributed computing platform based on blockchain called Ethereum, which demonstrated script functionality known as smart contracts.

5.2. Blockchain 1.0: Cryptocurrencies: economic essence, types and examples.

Cryptocurrency is a special form of electronic money that is stored not in a centralized account, but in the blockchain network. This technology belongs to the generation of ***Blockchain 1.0.***

Blockchain 1.0 is called a virtual database that records information about all transactions and how many coins are stored in each account. This technology enables to transfer assets between users and at the same time serves as an indisputable guarantee of ownership of these assets.

To store and transfer digital money between users, special wallets are used. They provide access to a virtual account through two sets of codes – open and closed keys. Transactions are created and signed using them, which are made in the blockchain.

Thanks to its characteristics, cryptocurrency has become a popular tool for exchange almost without restrictions. Most cryptocurrencies have open source code, allowing new virtual assets to be created on their basis.

Cryptocurrencies classification:

– ***convertible currencies (Bitcoin, E-Gold, Liberty Reserve, etc.)*** that have an equivalent value in fiat currency on separate exchanges and can be exchanged for fiat currency and back;

– ***non-convertible currencies (Q Coins)*** that are only used in virtual spheres and cannot be officially exchanged for fiat currency.

– ***centralized currencies that have a single issuer (E-Gold, Liberty Reserve, Perfect Money)*** controlling the entire system. The administrator issues the currency, introduces rules for its use, maintains a registry of transactions, and can withdraw the currency from circulation. The exchange rate of such a currency may be floating, determined by supply and demand, or fixed, tied to fiat currency or gold;

– ***decentralized currencies (Bitcoin, Ethereum, Litecoin, Ripple)*** that have no single administrator and no centralised control. Information about the transfer of ownership rights is transmitted through the network in a way that provides confirmation of transactions, security, and integrity of the transfer of value after a short period of time

Cryptocurrencies type:

All cryptocurrency assets can be divided into different categories. Bitcoin is the first cryptocurrency, so it has a separate asset status outside of categories. Other blockchain projects in the field of creating cryptocurrencies can be divided into several types.

Altcoins. Altcoins are alternative cryptocurrencies that have their own blockchain, except for Bitcoin. Some of them are similar to Bitcoin, while others are oriented towards the implementation and use of new tools, as well as expanding capabilities. By modifying the open-source code of BTC, altcoin developers can speed up transactions, optimize the mining process, create various automated contracts, form a base for working with crypto applications, and more.

– ***Tokens*** perform the function of digital assets, but do not have their own blockchain like standard cryptocurrencies. Instead of mining, tokens are immediately issued in full emission. These assets are created by various companies to attract funds for the development of their projects or to ensure the functionality of their products. Investors, in turn, receive guarantees that the company will fulfill its obligations to them.

– ***Stablecoins*** are digital coins. Their value is tied to material assets such as dollar, gold, oil, and others. The price of Bitcoin and other similar cryptocurrencies changes throughout the day, week, and month. In contrast, the value of stablecoins is extremely stable. Of course, there may be fluctuations in the price, but they are much less than other cryptocurrencies. Stablecoins are suitable for those who intend to transfer their savings to digital assets with minimal risk. From a technical point of view, a stablecoin is a type of token.

– ***NFT (non-fungible token)*** is a type of cryptographic token that represents a unique asset in the blockchain system. They were created to transfer ownership rights of unique assets to the blockchain system. For example, to identify ownership rights of antiques, works of art, 3D models, gaming items, and other assets. Each token is unique and cannot be replaced by another. NFTs are particularly popular in the collector community.

– ***DeFi (Decentralized Finance. Decentralized Finance*** is a complex platform that combines different types of digital assets and their functions. It is not a separate cryptocurrency, but rather a decentralized financial service that revitalizes the cryptocurrency segment. The main feature of such services is that users can provide and receive various services directly, without intermediaries. All calculations are performed in a reliable decentralized network. One example of a decentralized network is ETHMakerDAO, a decentralized crediting protocol. Its main task is to become a more convenient and reliable alternative to banking services

Each type of digital currency and service can be useful for different tasks.

Examples of cryptocurrencies.

1) Bitcoin (BTC).

It is the first and most popular cryptocurrency, traded on many exchanges and is the main object of crypto investments. Currently, one

BTC coin is worth around $43,000. The capitalization of Bitcoin has exceeded the mark of $1.1 trillion

Bitcoin is traded on many exchanges and is the main object of crypto investments. It is the first and most popular cryptocurrency. The feature of this coin is that its exchange rate directly affects the value of many other digital currencies. At the same time, Bitcoin is less volatile compared to other cryptocurrencies. The advantages and disadvantages of Bitcoin are presented in tables 5.1. and 5.2.

Table 5.1 The advantages of Bitcoin

The advantages of Bitcoin	Characteristic
Decentrilization	One person, organization, or state cannot control Bitcoin. The blockchain is supported by hundreds of thousands of users around the world. This means that no one can block its operation.
Network stability	Distributed resources that support the operation of the system neutralize the risks of failures due to equipment breakdowns in a separate location, city, or region.
Low-cost and fast transfers	The commission does not change for any transactions - within the city or between remote countries. For example, sending 50 BTC in one transaction on the Binance exchange will incur a fee of only $10.
Deflationary features	The maximum number of bitcoins was initially limited. More than 21 million coins cannot be mined. This fact blocks the action of inflation on BTC and makes it one of the most convenient tools for capital preservation.
Defensive assets	The Bitcoin rate rises during various economic and political crises. During periods of turmoil, citizens lose confidence in national currency and try to transfer their savings to other types of assets. Bitcoin is one of the most popular options.

Table 5.2 The disadvantages of Bitcoin

The disadvantages of Bitcoin	Characteristics
High volatility	The price of Bitcoin changes very quickly and significantly. In one day, its value can fall or rise by tens of percent. For this reason, BTC is not suitable for those who are focused on stable investments.
State regulators	Governments of different countries do not like the anonymity and decentralization of Bitcoin. Therefore, government agencies block the ability to use BTC as a means of payment.
Risk of purchasing "dirty" coins	If an investor purchasess a cryptocurrency that was used in fraudulent schemes, these assets may be frozen when transferred to a regulated platform for the duration of the investigatio

Anyone can buy Bitcoin and other cryptocurrencies on the Binance exchange using bank cards and fiat money. To do this, you need to visit the “Credit/Debit Card” section

1) Ethereum (ETH)

This decentralized computing platform was created on a proprietary blockchain. Its work is based on the execution of smart contracts.

The Ethereum platform has its own cryptocurrency - ETH. It is used for calculations within the system and is traded on various exchanges. As of October 2021, there are more than 118 million of these coins. Unlike VTS, there is no limit on the volume of ETH. Its market capitalization exceeds the mark of $353 billion.

The Ethereum blockchain allows for fast and inexpensive transfer of digital money. If Bitcoin was created as a decentralized and anonymous payment system, then Ethereum was developed as a single decentralized virtual machine. The distinctive feature of Ethereum is the use of smart contracts. This is a virtual algorithm capable of automatically controlling the execution of the conditions of a transaction recorded in the blockchain.

In addition to this basic function, the system provides resources and convenient conditions for developing decentralized applications. At the same time, it remains flexible, since it can execute arbitrary code of applications of any complexity.

Table 5.3 Ethereum (ETH): advantages and disadvantages

Ethereum advantages:	Ethereum disadvantages:
– System decentralization;	– no deflationary properties (developers are trying to eliminate this deficiency);
– fast transactions;	– poor protection system;
– blockchain-platform allows for creating various decentralized applications;	
– constant adcancement;	
– applications can be created based on the platform, using simple programming languages;	
– open source code;	
– convenient and reliable smart-contracts.	

2) Binance Coin (BNB)

This is the main token in the Binance cryptocurrency exchange system, as well as in the Binance Chain and Binance Smart Chain blockchains.

This coin cannot be mined. The current BNB rate is $339. The market capitalization of the token is $56 billion1. BNB is valuable because it can be used as a means of payment both on the exchange itself and in many services beyond it.

Advantages of Binance Coin include:

–discounts for Binance services;

– convenient use as a means of payment – more transactions than in Ethereum;

– low commission;

– deflationary effect – every quarter, part of the tokens is burned to limit their quantity.

Today, BNB can be used for various tasks: payment of commissions on the Binance trading platform and blockchains; participation in Launchpad; staking; creation of smart contracts; payment as a reward; crediting; sending donations.

All of these benefits have made Binance Coin one of the most popular cryptocurrency assets.

3) Binance USD (BUSD)

The value of Binance USD is 1 dollar, as it is the digital analog of this fiat currency. The market capitalization of this asset has exceeded the level of $13.5 billion.

It is a regulated cryptocurrency that is pegged to the US dollar. It is backed by fiat currency - for every BUSD issued, Binance has $1 in reserve. This format of the steiblecoin allows it to be exchanged for dollars and vice versa.

The main task for which BUSD was created is to maintain a stable market rate. If the VTS jumps a lot, the digital analog of the dollar from the Binance platform has a stable value. On the Binance exchange, this stablecoin is traded to various currency pairs, replacing USDT.

The issuer of this cryptocurrency is Paxos company. It was specifically recruited by Binance to issue a stablecoin. Paxos also issued the PAX Gold (PAXG) steiblcoin. The value of this digital asset is pegged to the price of gold. The New York State Department of Financial Services regulates the operation of these two coins.

Paxos is now responsible for accomplishing 2 tasks:

– providing steyblockin;

– controlling the process of issuing and burning BUSD.

Besides being good for capital storage, BUSD cryptocurrency has other advantages:

– convenient profit taking. A trader can transfer his earnings into BUSD, thus avoiding losses due to a sharp decline in the value of the asset.

– possibility of arbitrage on the Binance Smart Chain blockchain.

The disadvantages include centralized management and accountability to inspection bodies.

4) Polkadot (DOT)

The current value of this cryptocurrency is $28.5 per unit. The market capitalization has exceeded the $29.5 billion mark.

Polkadot has its own token - DOT. It is used in several processes: staking; providing system security; and network management.

Polkadot's structure is one of the most complex among all assets in the crypto market.

Being an opensource protocol, DOT supports sharding technology and ensures the interaction of individual blockchains. Thus, Polkadot can be used to transfer any assets and data between different chains and platforms.

Some developers are convinced that on the basis of such technology it will be possible to create a completely anonymous and decentralized Internet. DOT is successfully competing with Efirium due to its new capabilities.

Polkadot successfully integrates the work of the following technologies:

– public circuits;

– private circuits;

– oracles.

To access the network, you need to install the Polkadot.js extension in your browser.

The centerpiece of the DOT blockchain ecosystem is the Relay Chain. Any blockchain that attaches to it is called a Parachain. These blockchains can have their own governance structure, their own consensus mechanisms and tokens. Also, using special bridges to Polkadot, blockchains such as Ethereum and Bitcoin can be easily connected.

An important advantage of Polkadot is that it solves the problem of project scalability by combining different blockchains into one system. This advantage is complemented by a high level of security, as well as the functionality and liquidity of DOT tokens.

Polkadot disadvantages:

– the project is not yet completed;
– high competition in the cryptocurrency platform market;
– insufficiently developed user base.

These cons can be neutralized in the nearest future, as a team of professional developers is actively working on Polkadot.

5) Litecoin (LTC)

It is a cryptocurrency which operation is based on the bitcoin code base. But Litecoin differs from VTS in the following characteristics:

– faster transaction speed;
– different hashing algorithm;
– the order of issuance has been changed.

The current price of Litecoin is slightly above the $148 mark. The market capitalization of the cryptocurrency has reached the level of $9.9 billion.

The main purpose for which Litecoin was created is to provide secure, inexpensive and fast payments in the blockchain. Various goods and services are easily paid for in the US and Europe with LTC. There are already many terminals around the world where Litecoin is exchanged for fiat currency.

Table 5.4 The advantages and disadvantages of Litecoin (LTC)

Litecoin advantages	Litecoin disadvantages
– reliability;	– high competition and no useful features;
– opportunity to mine cryptocurrency;	– decreasing position in the ranking of popular cryptocurrencies;
– easier scalability than VTS;	
– high liquidity.	

In general, Lightcoin is one of the most popular blockchain-based payment means. The appearance of the most popular cryptocurrencies is presented in fig.5.2.

	
Bitcoin (BTC)	***Ethereum (ETH)***
	
Binance Coin (BNB)	***Binance USD (BUSD)***
	
Polkadot (DOT).	***Litecoin (LTC)***

Figure 5.2. The appearance of the most popular cryptocurrencies

Legal regulation of cryptocurrencies in different countries. At the moment, there are no uniform standards in the regulation of virtual currencies and the central bank of each country uses its own approaches. The most typical of these are the following three:

– formal permission that includes recommendations for the use of virtual currencies (cryptocurrencies), taking into account the risks to the public;

– specifically designed laws regulating virtual currencies (cryptocurrencies);

– absolute prohibition of virtual currencies (cryptocurrencies) circulation in the territory of the state.

Countries that have officially recognized cryptocurrency and are developing legal norms to regulate it include Australia, Belarus, Great Britain, Germany, Canada, Norway, Russia, Singapore, Scandinavian countries, USA, Czech Republic, Sweden, Switzerland, Estonia, South Korea, and Japan.

Countries that consider cryptocurrency illegal and have banned its use are Algeria, Bangladesh, Bolivia, Ecuador, Indonesia, Iceland, Kyrgyzstan, Lebanon, Nepal, and Vietnam.

The prospects for the application of cryptocurrencies in the financial system of the state include the following:

– there is a tendency of gradual introduction of electronic money into the lives of ordinary people;

– decentralized systems will not become an alternative to banks, but will complement each other;

– certain benefits will have to be sacrificed to increase security;

– in the nearest future it will be possible to use all kinds of cryptocurrencies as an official means of payment. This prospect is becoming more and more real every day, and the increasing interest from political and banking systems from all over the world is favorable;

– the ever-increasing rate of cryptocurrencies is encouraging people to accumulate cryptocurrency, for profit. The possibility of speculative profits distracts investors from the real sector.

The risks of using cryptocurrencies in the government's financial system include:

– *volatility of cryptocurrencies*. Each growth is followed by collapses of the exchange rate, although not so strong, but still quite sensitive. In the real economy, a currency with such a volatile exchange rate has application problems.

– *race in terms of issuing cryptocurrencies*. Everyone issuing cryptocurrencies is trying to increase the power of their hardware. The costs of issuing cryptocurrency are covered by the issuance, but over time the number of cryptocurrency units mined will inevitably decrease, and then those who pay transaction fees will have to recover the cost of the equipment, or the price of cryptocurrency will significantly rise.

– *high energy costs of mining cryptocurrencies.* Bitcoin mining requires expensive and power-intensive computer equipment. Bitcoin mining consumes 73.1 terawatt-hours annually, which is 0.33% of the world's electricity consumption

Currently, the total energy consumed by bitcoin mining is: 1.8% of the energy consumed by the US; 7.5% by Russia; 22.1% by the UK; and 107.1% of that consumed by the Czech Republic.

5.3. Blockchain 2.0: Smart-contracts. Opportunities for the application of smart contracts

Smart contracts are programs or scripts that are applied and executed on the Ethereum Blockchain and can be used, for example, for a transaction if certain conditions are followed.

Smart contracts are computer programs that perform the function of implication, but Blockchain provides automatic implementation of such contracts without human intervention.

Smart contracts can monitor the fulfillment of conditions of long-term credits, as well as update data in Blockchain according to specified rules, for example, to transfer digital assets from one participant to another.

Smart contract is an innovative technology that allows optimizing various processes and ways of interaction between computers and people.

It first emerged in the depths of the cryptocurrency industry and became the basis for starting a large number of decentralized systems of various types. Also thanks to the spread of this technology, many existing projects received new opportunities for development.

History of the emergence of smart contracts. The idea of smart contracts appeared in the early 1990s. It was proposed by Nick Sabo, a programmer and scientist in the field of cryptography, as well as a specialist in the field of law. He described the concept of "smart contracts", which can be concluded with the help of electronic registers. In this case, there is no need for human control, it is enough that each counterparty automatically meets its obligations.

As an example, Sabo referred to the operation of an automatic vending machine:

– The owner sets up the terminal – specifies the terms of the transaction.

– The seller provides the goods – meets his obligations under the contract.

– The buyer deposits money – also meets his obligations.

– The machine issues the desired product to the buyer.

Thus, the transaction between the seller and the buyer was carried out automatically immediately after they met their obligations. As a result, the seller received money, and the buyer received the goods. No additional control was required.

In the mid and late 90s, various specialists created algorithms to implement the above concept. But these algorithms had one disadvantage – a centralized payment system that worked under external control. That is, there was an intermediary in the transaction who could prevent the execution of the contract.

The real opportunity to realize Nick Szabo's idea appeared in 2009. Then the first decentralized currency – *bitcoin* – was set up. Its basic protocol contains some functions of smart contracts, which, however, were limited by the developers' idea and did not become widespread.

The emergence of the first cryptocurrency was a step towards financial transactions without intermediaries. Later, higher-level protocols (overlays) began to appear, which perform the functions of full-fledged smart contracts.

Smart contracts gained wide popularity with the advent of the *Ethereum* platform, the concept of which was described by Vitalii

Buterin in 2013. He claimed that blockchain technology can be applied in many areas, not just for financial transactions.

V. Buterin first described the concept of a universal decentralized platform that allows anyone to start systems for storing and processing information. Based on this platform, smart contracts can be created, which must be described as mathematical rules.

Ethereum was co-founded by Gavin Wood, Charles Hoskinson, Anthony Di Lorio and Joseph Lubin. In 2014, they held a crowdfunding fundraiser to develop the project. The first Ethereum block was generated on July 20, 2015, and the full blockchain was launched on July 30. This platform almost immediately attracted the attention of banks, which began to investigate smart contracts applicability.

Smart contract technology. Ethereum smart contracts are part of its software code and work inside a decentralized network. One of the following programming languages can be used to develop them: Solidity; Vyper; Serpent; LL; Mutan.

Users, who make a transaction between them, sign a contract as a normal cryptocurrency transaction. At the same time, all the terms and conditions, as well as the logic of their execution, must be specified based on software in advance.

Once signed, the contract comes into effect, and information about it is stored in a distributed ledger. The blockchain then checks whether the contract clauses are fulfilled or violated and makes decisions on the terms of the prescribed algorithm. This means that a smart contract can only exist within a system that provides it with a persistent link to the executable code.

In addition, this system should implement the prerequisites for smart contracts:

– user tools (e.g., secure accounts);
– reliable (usually decentralized) sources of information;
– automated databases for transactions. Transactions here should be understood not only as financial transfers, but also as any other actions that can be performed in the system;
– possibility and necessity of using asymmetric encryption based on public and private keys;

– Turing completeness is a characteristic of the system, which means that any computable function can be realized if it does not contradict the this system logic.

Today it is possible to integrate smart contracts into external systems. This requires special oracle programs. They convert information from external sources into a suitable format for a smart contract.

A smart contract is designed to execute and maintain commercial contracts in blockchain technology.

Smart contracts can be executed on various blockchain platforms, for example:

– *Bitcoin* is the first cryptocurrency, but the ability to write smart contracts on it is very limited;
– *Side Chains* — this blockchain has more advanced smart contract capabilities than Bitcoin;
– *NXT* — an open online platform with a limited number of smart contracts that are written on blockchain templates. There is no way to create a unique contract;
– *Ethereum* — an open online platform where any smart contract can be written, but it must be paid for with the cryptocurrency of the given blockchain.

Smart contracts, as already mentioned, use blockchain technology. In other words, all logic is placed in a software container — a block. The latter combines all messages related to a particular smart contract. Messages can act as inputs and outputs of the smart contract program code and lead to some actions: buying and selling things, delivery, etc.

Characteristics of a smart contract:

– the use of electronic signature methods based on public and private keys held by two or more parties to an agreement;
– the existence of a private decentralized environment (e.g. Ethereum) in which smart contracts are recorded and which supports inputs and outputs for oracles that provide a link between the real and digital worlds;
– the subject of the contract itself and the existence of the tools necessary for its execution (cryptocurrency payment accounts, oracle programs, etc.);

- precisely described conditions of its execution, which the parties to the contract confirm with their signatures, as well as the authenticity of the digital data source.

In 2020, Binance launched the Binance Smart Chain (BSC) blockchain, which later became the foundation for the emergence of the independent BNB Chain ecosystem. Its basic blockchain has many useful features, including the ability to create and utilize smart contracts.

Many decentralized applications (DApps) have been launched based on this blockchain. Among them are DEX exchanges, financial services, games and other systems for using digital assets.

Many decentralized applications (DApps) have been launched based on this blockchain. Among them are DEX exchanges, financial services, games and other systems for the use of digital assets.

BNB Chain is designed for mass use and has extensive opportunities for integrating the blockchain into external systems.

BNB Chain is powered by applications from different segments: Web2; Web3; Metaview; DeFi; SocialFi; NFT; GameFi.

Smart contract technology is at the core of this entire ecosystem.

To use BNB Chain, you just need to follow a few simple steps:

- Create a wallet that supports BNB tokens, e.g. Binance Wallet or Trust Wallet.
- Deposit your account in BNB tokens.
- Connect to any application that runs on BNB Chain.

In such case anyone can use existing smart contracts, as well as create their own applications based on this ecosystem.

Smart contracts are gaining popularity and there are more and more ways to use them. This is conditioned by the opportunities they provide:

- optimizing and speeding up routine tasks;
- reducing or completely eliminating the involvement of intermediaries in transactions;
- reducing costs in the conclusion and execution of contracts;
- error elimination due to human error.

Owing to such capabilities, smart contracts are being implemented in many areas of social activity.

5.3.1. Crowdfunding. Popular crowdfunding sites in the world

The term "crowdfunding" is derived from two English words "crowd" and "funding", which means "crowd funding" or "public funding". The term crowdfunding is believed to originate in 2006 and its author is Jeff Howie.

It is the process of initial sale of digital assets before their floatation. Investors, crowdfunding participants, send funds to a smart contract address and in return receive startup tokens.

Therefore, many scholars agree that crowdfunding is an integral part of the crowdsourcing concept, which is understood as the use of not only monetary resources, but also creative, imaginative and other potential of a wide range of individuals. The main difference between crowdfunding and crowdsourcing is that it does not include joint creativity (collective efforts to create a project), but is focused solely on the financing of the target project. The study and analysis of scientific literature shows that at the present stage there is no consensus on the definition of crowdfunding essence.

Some of the popular crowdfunding sites in the world include the following:

1) GoFundMe

As of 2021, GoFundMe is the largest crowdfunding platform. Since GoFundMe was founded in 2010, the site has raised over $10 billion dollars through over 150 million donations. GoFundMe is the site most popular among people seeking to recover from medical expenses or natural disasters such as a house fire, natural disaster or unexpected emergency expenses. Startups and start-up companies typically use Kickstarter.

2) Kickstarter

Kickstarter is another popular crowdfunding platform. As of 2021, since it was founded in in 2009, Kickstarter has successfully funded nearly 200,000 projects, with over $5.7 billion dollars in funding for all Kickstarter projects.

Kickstarter is the most popular crowdfunding site for startups intending to raise capital and reach a wider audience. In fact, unlike GoFundMe, Kickstarter can only be used to create projects that can be shared with others.

In addition, Kickstarter has some serious limitations. It cannot be used to raise funds for donations to charity, projects cannot offer additional incentives such as equity stakes, revenue sharing, or other investment opportunities. Also, a project cannot include a list of prohibited products and services, such as "any product or service required to diagnose, treat, or prevent disease," fundraising for political causes, drugs or alcohol, any contests, coupons, gambling, or raffles.

3) Indiegogo

Indiegogo started out as a crowdfunding site, initially focused solely on raising money for independent films. But then a year after its launch in 2007, Indiegogo began accepting projects from any category.

Indiegogo is considered a less strict and more flexible platform than Kickstarter because it gives backers control over whether they want fixed or flexible models. Kickstarter only releases funds after a campaign reaches its funding goal. Indiegogo allows a campaigner to receive funding proportionally or wait until their goal is reached.

It can be easier and less risky for a campaigner to utilize flexible funding. However, regardless of the amount raised, campaigners still have to keep their promises. For the backer, fixed funding is more attractive because it involves much less risk.

5.3.2. Decentrilixed finances (DeFi)

Decentralized finance is an analogue of traditional financial services in the cryptocurrency market. They include DEX exchanges, lending platforms, distributed storage, protocols for issuing synthetic assets and other projects.

They function under the control of smart contracts that replace the work of specialists of various professions. An important advantage of such a system is that it allows synchronization of different services and thus simplifies the solution of many tasks.

The list of current DeFi projects is regularly updated. In 2023, 9 best decentralized DeFi-applications were identified, which include the following:

1. Yearn [128]

Yearn is a DeFi application that offers a number of crypto-farming strategies to profit from cryptocurrency assets. It is built on the Ethereum blockchain and operates as a decentralized autonomous organization (DAO), with decisions made by community members who own the YFI management token.

One of the main reasons the Yearn platform is on this list is its automated cryptofarming system, which involves lending and borrowing cryptocurrencies to earn interest and rewards. In addition, yearn's smart contracts automatically allocate user funds to the most profitable farming strategies, ensuring that users get the highest possible income on their investment.

Yearn's unique features such as automation and community management have made it one of the best DeFi apps in 2023. In addition, its user-friendly interface, security and reliability make Yearn an attractive option for users endeavouring to grow their cryptocurrency holdings in a decentralized and efficient way.

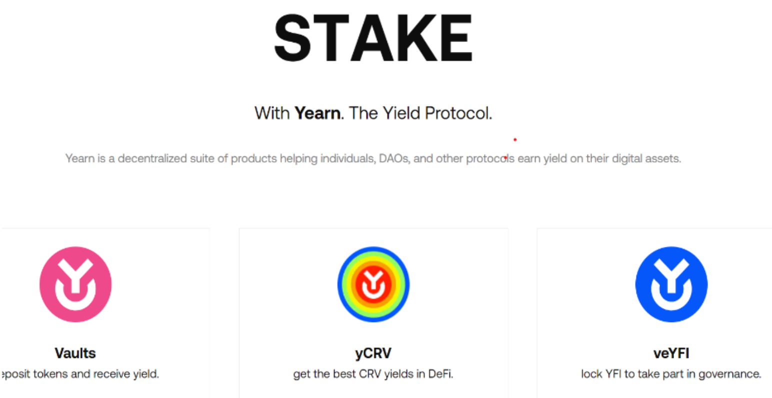

Figure 5.3. Yearn [128] DeFi-application

2. Alchemix [66]

Alchemix is a DeFi DApp that offers a unique way to access liquidity without necessity sell cryptocurrency. It is built on the Ethereum blockchain and operates as a decentralized autonomous organization (DAO) with decisions made by community members who own the ALCX management token.

The Alchemix platform allows users to deposit cryptocurrency, which is then used as collateral to issue a synthetic stablecoin called alUSD. This stablecoin can be used to borrow, with the amount borrowed increasing as the amount of cryptocurrency deposited increases. The borrowed funds can be used for any purpose, including buying another cryptocurrency or investing.

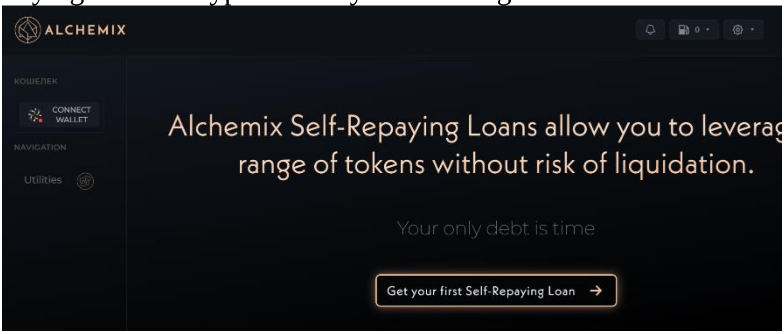

Figure 5.4. Alchemix [66] DeFi-application

Alchemix made the list due to its ability to provide users with liquidity without having to sell cryptocurrency, allowing them to capitalize on potential price increases without losing access to funds. Alchemix also offers low transaction fees and fast transaction turnaround times, making it quite an attractive option.

3. UniSwap [124]

UniSwap is a DeFi decentralized exchange (DEX) application built on the Ethereum blockchain. It allows users to trade cryptocurrencies without intermediaries, providing greater control and security of transactions.

UniSwap gives users access to a wide range of cryptocurrencies. It also provides a high degree of decentralization and has no centralized management authority. UniSwap operates using a smart contract system that guarantees transaction transparency and security.

Figure 5.5. UniSwap [124] DeFi-application

UniSwap offers low transaction fees and fast transaction turnaround times, making it quite an attractive option for crypto traders. A user-friendly interface and a wide range of trading pairs make UniSwap one of the most popular DeFi applications.

4. ENS [76]

ENS, or Ethereum Name Service, is a DeFi application that offers an easy-to-read Ethereum address system that allows users to send and receive cryptocurrency using easy-to-remember names instead of long and complicated addresses. ENS operates as a decentralized autonomous organization (DAO), with decisions made by community members who own the ENS management token.

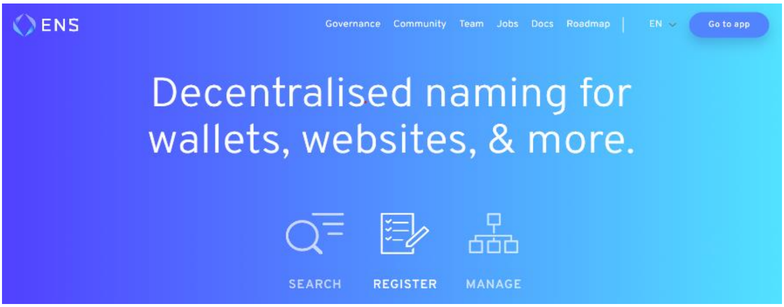

Figure 5.6. ENS [76] DeFi-application

One of the key benefits of ENS is its ability to simplify the process of sending and receiving cryptocurrency. Instead of memorizing and entering long, complicated Ethereum addresses, users simply use a legible name, such as "john.eth." This makes the process more convenient and reduces the disposition toward errors when entering an address.

ENS is listed as one of the top DeFi apps in 2023 due to its potential to become a major player in decentralized finance. As more users start using cryptocurrencies and DeFi, the need for a convenient address naming system will increase, making ENS an indispensable tool. Its user-friendly interface, security and reliability make it popular among users looking to simplify their cryptocurrency transactions.

5. Rocket Pool [106]

Rocket Pool is a DeFi DApp that provides a decentralized infrastructure for Ethereum 2.0 steaking. It is built on the Ethereum blockchain and operates as a decentralized autonomous organization (DAO) with decisions made by community members who own the RPL management token.

One of the key advantages of Rocket Pool is its system of secure and decentralized Ethereum staking and earning rewards without maintaining a minimum amount in staking or having technical knowledge. Rocket Pool allows you to contribute any amount of Ethereum and combine it with other users' funds, lowering the barrier to entry for staking.

Rocket Pool's place on this list is due to its unique features such as decentralization and accessibility. Its user-friendly interface, security, and reliability make it an attractive option for Ethereum steaking. In addition, Rocket Pool ability to adapt to new developments in Ethereum 2.0 such as shard chains and the transactions between them makes it a key player in the future of decentralized finance.

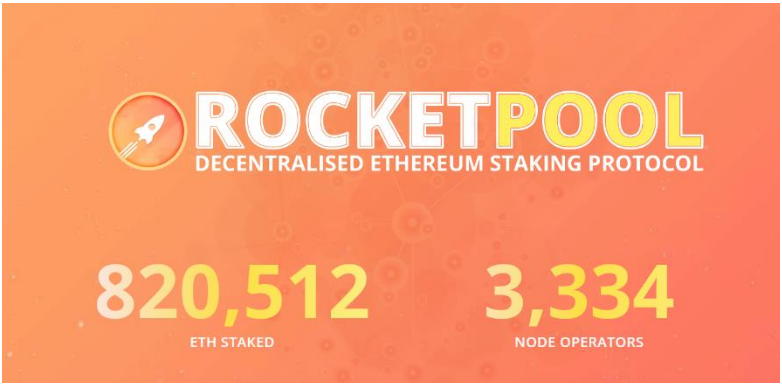

Figure 5.7.Rocket Pool [106] DeFi-application

6. Lido [89]

Lido is a DeFi application that allows users to contribute to Ethereum staking and receive rewards using stETH, a DeFi token that reflects the user's share of the staking pool. Lido is a decentralized autonomous organization (DAO) that runs on the Ethereum blockchain.

The Lido DAO provides users with a simple and efficient way of Ethereum steaking. Steaking on the Ethereum network requires significant technical knowledge and capital, which can be a drawback for many users. Lido removes these drawbacks by providing a user-friendly interface and managing the technical aspects of steaking on behalf of users.

Lido made the list because it provides high security: users' Ethereum is stored in a secure smart contract, the state of which is monitored by several audit firms at once. In addition, stETH can be used in various areas of DeFi (e.g. trading and cryptocurrency lending), providing users with additional income opportunities.

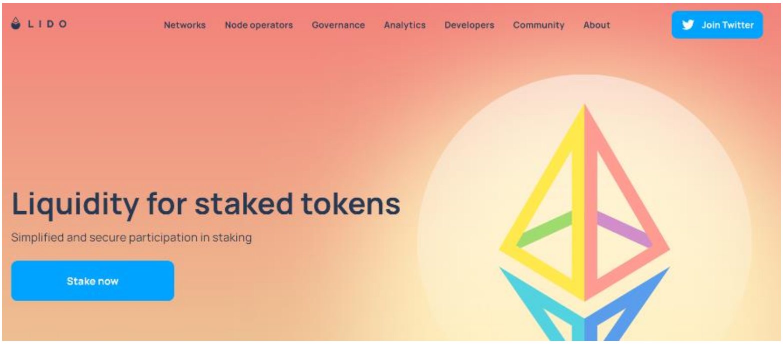

Figure 5.8. Lido DeFi-application [89]

7. Magic Eden [95]

Magic Eden is a DeFi application that offers a decentralized trading platform for trading interchangeable tokens (NFTs) and unique digital assets: art, music and collectibles. It is built on the Ethereum blockchain and operates as a decentralized autonomous organization (DAO), with decisions made by community members who own the MGE management token.

One of Magic Eden's key advantages is its secure and transparent NFT trading platform. Magic Eden platform allows users to buy and sell NFTs without intermediaries, providing increasing control and security of transactions.

Decentralized and user-friendly interface has made Magic Eden one of the best DeFi apps in 2023. This platform offers a wide range of NFTs for sale, giving users a huge scope to explore and discover new digital assets. In addition, Magic Eden focus on community management ensures that decisions are made with users' interests in mind, making it a truly decentralized and transparent NFT trading platform.

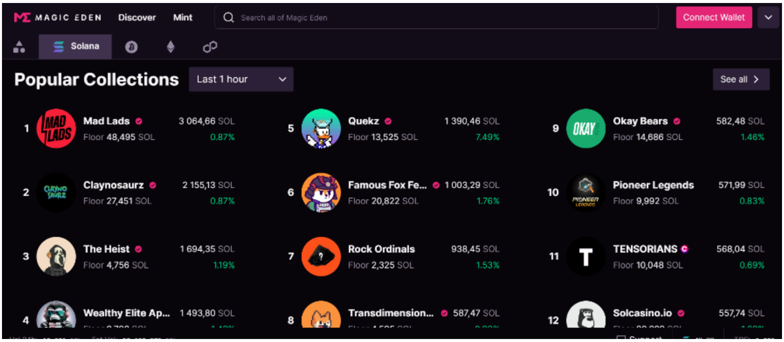

Figure 5.9. Magic Eden DeFi-application [95]

8. GMX [80]

GMX is a DeFi DApp that provides a decentralised insurance platform for cryptocurrency holders. It is built on the Ethereum blockchain and operates as a decentralised Autonomous Organisation (DAO), with decisions made by community members who own the GMX management token.

One of the key benefits of GMX is its ability to provide cryptocurrency owners with a secure and decentralised way to insure assets against volatility and hacking attacks. GMX also allows users to purchase insurance coverage for their cryptocurrency assets.

GMX place in this rating is provided by unique features such as decentralization and accessibility. In addition, the platform offers users a wide range of insurance options, including volatility and hacking coverage, making it an attractive option for cryptocurrency users looking to protect their investments.

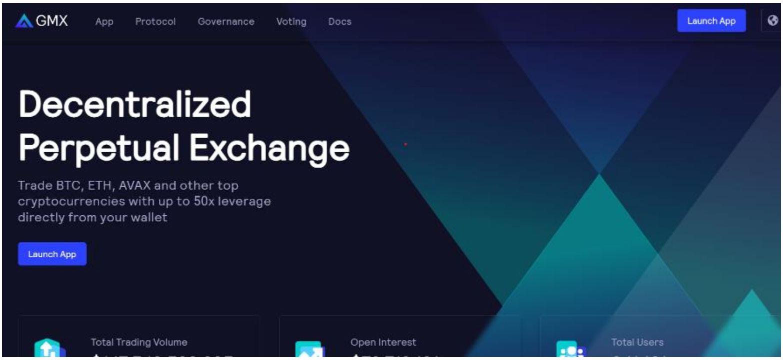

Figure 5.10. GMX DeFi-application [80]

9. Compound

Compound is a DeFi DApp that provides a cryptocurrency lending platform. It is built on the Ethereum blockchain and operates as a Decentralized Autonomous Organisation (DAO), with decisions made by community members who own the COMP management token.

One of Compound's key benefits is its ability to provide users with a decentralized and transparent way of cryptocurrency lending. Compound allows users to pledge their cryptocurrency assets as collateral and borrow other cryptocurrencies. This is done using interest rates determined by market supply and demand.

Decentralization and accessibility made Compound one of the best DeFi apps in 2023. In addition, the platform offers users a wide range of lending options, including stablecoins, making it attractive to users looking to earn interest on their cryptocurrency assets or borrow additional funds.

The DeFi ecosystem has grown significantly in recent years, and the best DeFi dApps in 2023 are expected to continue to offer users innovative and reliable services. DeFi dApps provide users with a wide range of decentralized and secure financial services, from steakablecoins to decentralized exchanges, lending platforms, oracle services and steaking pools.

5.3.3. A decentralized autonomous organisation (DAO)

In 2016 a group of developers, inspired by the decentralization of cryptocurrencies, proposed the idea of a decentralized autonomous organisation, or DAO.

A decentralized autonomous organisation (DAO) is a community that can be considered an analogue of a traditional enterprise. The activities of such an organisation, as well as the management of its resources, are carried out according to predetermined rules, using smart contracts.

DAO has no centralized management, its functions are performed by smart contracts. At the same time, the community may have a hierarchical structure in which each participant has its own rights and obligations. Such a system can automatically allow or prohibit users to perform certain actions. Records of all transactions are stored in a distributed blockchain registry.

DAOs rely heavily on smart contracts. These logically encoded agreements dictate decisions based on underlying activity on the blockchain. For example, depending on the outcome of a decision, some code may be implemented to increase supply, burn some amount of reserve tokens, or issue certain rewards to existing token holders.

The voting process in a DAO is hosted on the blockchain. Users must choose between mutually exclusive options. Voting rights are often allocated to users based on the number of tokens they own. For example, a user holding 100 DAO tokens will have twice as many voting rights as a user holding 50 tokens.

The theoretical basis of such a practice is that users who invest more in DAO in monetary terms have an incentive to act honestly. Imagine a user who owns 25% of the total number of votes. This user can participate in dishonest actions; however, by doing so, he will put the value of his 25% shares at risk.

DAOs often have treasuries that hold tokens that can be issued in exchange for fiat money. DAO members vote on how to use these funds, for example, those who wish to purchase rare NFTs may vote to refuse from treasuries in exchange for assets.

DAO advantages:

–*Decentralization.* Decisions affecting an organization are made by a group of individuals as opposed to a central authority that is often vastly outnumbered by its peers. Rather than relying on the actions of one person (CEO) or a small group of people (board of directors), a DAO can decentralize authority to a much larger number of users.

–*Participation.* Individuals within an organization may feel more needed and connected to the organization if they have a direct vote and the power to deal with many issues collectively. These individuals may not have strong voting rights, but the DAO encourages token holders to vote, burn tokens or use them in the best way for the organization.

–*Publicity.* Within DAO, votes are cast via blockchain and made publicly available. This requires users to act ethically, as their votes and their decisions will be made publicly available. This transparency of the process promotes self-control of DAO participants and discourages actions against the community.

–*Community.* The DAO concept encourages people from all over the world to come together to build a unified community. With only an internet connection, token holders can interact with each other regardless of their location.

DAO drawbacks:

–*Speed.* If a public company is run by a CEO, it may take one vote to decide on a specific action for the company. In a DAO, every user has the opportunity to cast a vote. This requires a much longer voting period, especially given the time zones of the voters.

–*Education.* It is logical to assume that token holders have different levels of education. A common problem with DAOs is that while they bring together diverse people, these people must learn to develop, strategise and communicate as a unit.

–*Ineffectiveness.* Partially summarising the first two points, DAOs are at great risk of being ineffective. Because of the time required to make decisions, disseminate initiatives, explain strategies, and recruit new members. A DAO may spend much more time discussing changes than implementing them. The DAO is at risk of getting bogged down in administrative tasks because of the need to coordinate the work of many more people.

– *Security*. A challenge faced by all digital platforms running on blockchain is security. DAOs require significant technical expertise to implement, without it, voting or decision making turns to be impossible. Because of the appearing issues, users can leave an organization if there are inconsistencies in its structure. Even when using multi-signature or cold wallets, DAOs are vulnerable to hacker attacks.

DAO tokens:

Different DAOs have their own tokens. Here is a list of the top 10 DAO cryptocurrencies that can be found on most trading platforms: Uniswap; Aave; Curve DAO; Maker; Dash; Compound; Sushi Swap; Decred; Synthetix; 0x.

5.3.4. Game finances (GameFi)

GameFi or game finance is a blockchain project that allows users to earn money through gameplay.

The model combines game mechanics, elements of decentralised finance (DeFi), non-fungible tokens (NFT), and meta-universes.

According to 2021 data, GameFi segment tokens have proven to be the growth leaders, with Gala Games (GALA), Decentraland (MANA), The Sandbox (SAND), and Axie Infinity (AXS) projects among them.

The term GameFi was first mentioned by Andre Cronje, founder of DeFi project yEarn Finance, in 2020. However, back in 2014, some online casinos were accepting bitcoin deposits, proviing their support to cryptocurrencies long before that.

Developers experimented by integrating bitcoin with the servers of Minecraft, a sandbox computer game. On the MinecraftCC server, players were rewarded in the first cryptocurrency for any action: placing blocks, killing monsters, building and more. In 2016, the programme became unstable and bitcoin support was removed, but the server is still active.

The CryptoKitties app, launched in 2017, was one of the first popular online games on Ethereum. In CryptoKitties, anyone could buy, grow and exchange digital kittens in the form of ERC-721 standard tokens.

The application aroused great interest among users: less than a week after its launch, CryptoKitties accounted for more than 11% of all transactions in the network. The game has repeatedly caused the Ethereum blockchain to overload.

Since early 2020, the GameFi sector has been growing rapidly. A large number of games using tokenised in-game objects appeared. This has been facilitated by the growing popularity of DeFi and NFTs.

The difference between GameFi and classic video games is as follows:

– The classic "pay to play" model obliges the user to pay for a subscription or licensed access, as well as for attributes that optimise gameplay.

– This category of video games runs on centralized servers of game companies. Therefore, in-game purchases and environments may not be wholly owned by the user.

For example, the user buys new armour or weapons that improve the performance of the game character. The items are usually restricted to a specific game platform or virtual environment. The player uses them only where they were purchased.

- GameFi is changing the traditional gaming industry. The projects combine fun with value by combining gameplay and monetization, and blockchain makes this model decentralized and transparent.
- The concept involves retaining ownership of digital items in the form of NFTs. Data about the owner of game artefacts is fixed in the blockchain. The information cannot be replaced or deleted.
- Users are rewarded for playing the game in project tokens. The player can sell tokenised rewards and exchange them for other cryptocurrency or fiat money on trading platforms.
- GameFi provides a wide range of genres: from classic lottery to complex multiplayer multiverse. Gala Games, a blockchain

game developer company, aims to create a holistic ecosystem with a single economy for different game genres in the future.

Types of blockchain used to create GameFi projects:

– The first GameFi were created on bitcoin and Ethereum, however, at the moment cheaper and faster solutions are predominantly used.

For example, Axie Infinity was originally released on Ethereum, but the full ecosystem was eventually deployed in the Ronin sidechain.

– There are other specialized blockchain platforms adapted for GameFi, such as Flow from the creators of CryptoKitties. Many games have been released on the Tron, BNB Chain, Wax and Polygon blockchains.

GameFi project categories:

– Free2Play (from English play for free) — projects that require no initial investment - you can start playing right away.
– For example, Gods Unchained is a blockchain-based collectible card game. It resembles Hearthstone in many ways, but it allows players to sell and trade NFT cards freely, as well as receive rewards for success in the game.
– Play2Earn (from English play to earn) — this category includes all blockchain projects that allow users to monetise their gaming experience.
– Move2Earn (in English, move to earn) — projects that reward users for physical activity rather than for gameplay.
– A well-known representative of the segment is the fitness application for mobile devices STEPN. The app tracks players' movements using GPS, and the user receives project tokens for walking or running. A pair of NFT digital running shoes is required to participate.
– Metaviews — a virtual world in the form of a three-dimensional game "sandbox" where users own not only digital items, but also plots of land represented as non-interchangeable tokens.

5.3.5. Metauniverses

Smart contracting opportunities: Metavuniverses

A meta-universe is a virtual space where people can create their own avatars, or characters, to interact with other users or digital objects. Metauniverses are similar to GameFi in the way digital space is organised, but with more features.

Each meta-universe is a separate digital world that exists in real time. It has its own society, economy, currency, various organisations, forms of ownership and other components of the traditional world. All processes are under the control of smart contracts, artificial intelligence and other software algorithms.

Currently, meta-universes are at the beginning of their development. It is obvious that this concept has colossal prospects. Many experts believe that in time the economy of meta-universes will surpass the real world economy in terms of volume. These huge virtual worlds will be controlled by smart contracts.

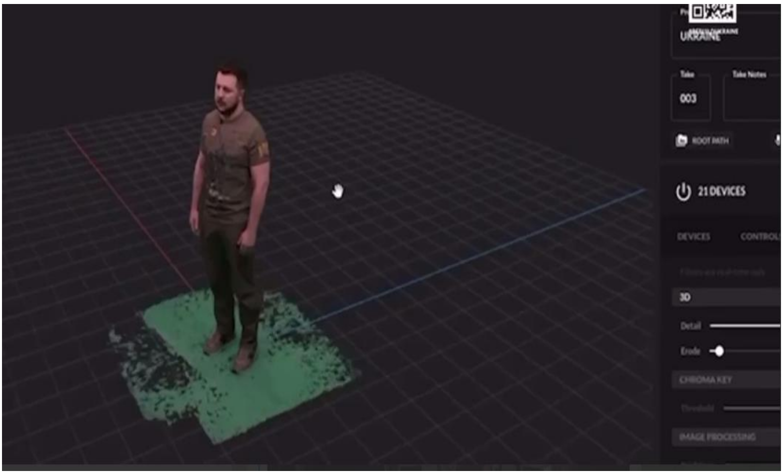

Figure 5.11. A digitized man for the meta-universe

Successful examples of creating digital assets in meta-universes include the following companies that promote their brands using NFT technology:

1) Nike launches virtual trainers for digital avatars. In autumn 2021, Nike signed an agreement with the Roblox platform to create a full virtual world of Nikeland.

2) Adidas is venturing into the Sandbox universe. Adidas is also promoting its own branded goods in the digital world. To do this, it had to partner with the Sandbox gaming platform and the Coinbase cryptocurrency exchange.

3) Louis Vuitton launched a digital game – a puzzle game. The user is invited to go on a journey through colourful locations, where he can learn the history of the luxury luggage manufacturer and find a collectible NFT from the famous crypto artist Beeple

4) Gucci celebrated its birthday in the metauniverse. For this purpose, a virtual exhibition "Gucci Garden" was opened on Roblox. Users of digital avatars will be able to stroll through the luxurious exhibition tasks and explore the company's fashion collections that were released in different years.

5) Gap brand launched selling NFT hoodies, Victoria's Secret launched selling NTF lingerie.

6) Procter & Gamble is engaged in eco-propaganda through metauniverses. The company has developed its virtual world BeautySphere, through which it broadcasts the principles of inclusivity and responsible beauty.

7) McDonald's has opened a virtual restaurant, and Domino's is already selling digital pizza in Decentraland, "going in" for free, thanks to enthusiastic developers.

8) Samsung and Dyson have set up branded home appliance shops in Decentraland.

NFT is the basis for the creation of digital assets of Metavolutions, which can be seen in the following features of its application:

– NFT is based on the use of blockchain technologies, along with being the result of creative solutions with the aim of generating additional revenue.

– The value proposition of NFT is based on the expectation that buyers will be willing to pay more for a digital artefact because they belong to a community of people with similar values and interests.

– NFT is a technology that enables to create the commonwealths of consumers who share common needs and are united by a common, shared, lifestyle.

– With the help of NFT technology, digital brands can be formed and existing brands can be digitised.

5.4. Blockchain 3.0: Corporate blockchains. Controlled blockchain Amazon

The technological capabilities of blockchain technology enable the formation of digital ecosystems operating on the basis of corporate blockchains.

The emergence and development of corporate blockchains concern the need to ensure the confidentiality of work with information. In addition, the corporate blockchain is specifically designed to meet all the needs of enterprise management in the digital economy.

The key features of enterprise blockchain for enterprises are as follows:

- decentralized nature of the blockchain, enabled by a peer-to-peer networking system;
- permanency, which is ensured by the legger firewall system;
- high level of transparency, which is ensured by the accessibility of ledger information to network users. At the same time, blockchain offers an authentication process and access level to protect certain sensitive information for businesses;
- low cost, which offers a cost savings to developers or network managers, and an enterprise blockchain solution comes with network management. This is a feature that many enterprises can use to upgrade their internal network;
- fast login to optimize the use of the blockchain technology quick withdrawal feature.

This is the feature that enables blockchain for enterprise projects.

Corporate blockchains can be implemented as private, public and federated. The main differences between them are reflected in Table 5.5.

Table 5.5. Classification of corporate blockchains

	Unique features	Specifications of theuse
Private blockchain	– read or write access depends on the node; – faster form logout; – can be used by any type of asset on the network; – does not offer anonymity; – is cheaper compared to a public blockchain.	– retains confidentiality; – energy efficiency compared to public blockchain; – less volatile network; – organizational authority.
Publis blockchain	– any peson gets an access to the network; – can upload and add nodes; – fully decentralized nature; – slow form logout; – provides anonimity.	– high transparency; – truly decentralized structure; – expanding of user rights and possibilities; – permanency.
Federative blockchain	– extremely fast output; – highly scalable; – energy efficiency; distributed power.	– saves a lot of costs; – offers lower transaction fees; – network rules; – no criminal access.

Some of the most successful corporate blockchain projects include the following blockchain projects:

1) Ethereum Enterprise Alliance (EEA)

The Ethereum Enterprise Alliance (EEA) brings together several technology companies, financial institutions, startups and academics to promote the use of Ethereum technology and new business opportunities around the world.

Its global community also includes multinational companies and startups. The EEA includes companies such as JPMorgan Chase, Microsoft, Intel, Accenture, EY and BP.

The alliance members have created a forum where they can share knowledge and promote widespread adoption of Ethereum among institutional players.

Response stopped

The EEA activity is based on the following main directions:

- consideration of business requirements and the creation of standardized specifications that address these requirements;
- developing in the context of the Ethereum public blockchain;
- achieving overall compatibility (interoperability) through certification programmes.

Ethereum's technology is still in its early stages and will have to overcome several technical and regulatory drawbacks before it becomes fully functional for business transactions.

Ethereum has upgraded its blockchain to Proof-of-Stake, which means it will be able to process many more transactions per second than it does now.

The Ethereum Enterprise Alliance (EEA) enables to use blockchain technology to improve food safety at every stage of the supply chain. In addition, this type of blockchain enables to tokenize a wide range of assets, including real-world assets such as real estate. It is widely used in the medical field, allowing for the storage of patient data.

EEA is located in the US but has offices in China, France and Japan.

2) Corda

R3's enterprise blockchain platform Corda is the commercial version of this platform. The open source platform is clearly suited for financial use cases. R3 claims that the platform can be multi-purpose and integrated.

Corda is a distributed Ledger for storing, managing and synchronising financial obligations between different financial institutions.

Main features of Corda and its uniqueness among other blockchains:

– Corda does not have its own cryptocurrency;
– Corda does not use the concept of mining or Proof-of-Work;
– data transfer occurs only between the participants of a transaction or contract. There is no global broadcasting to all nodes of the network;
– no central controller managing all transactions;
– Corda supports various consensus mechanisms;
– consensus is reached between participants at the level of an individual agreement or contract, not at the level of the entire system.
– a transaction is only confirmed by the participants relating to it;
– Corda offers a direct relation between formal human legal language and smart contract code.

Corda provides quality and good network infrastructure and can act as the ultimate security system along with providing scalable solutions.

The concept of ledger in Corda is subjective. There is no single central data storage (vault). Instead, each node maintains a separate database of facts known to it. To get into a ledger, a transaction must reach 2 consensuses: for validity and for uniqueness. The validity of a transaction is decided only by the parties directly involved in the transaction. Notary nodes verify the transaction for uniqueness, preventing double spending.

3) Ripple

Ripple key product is RippleNet, a global network of cross-border financial transactions used by banks, payment services and other financial organizations. RippleNet provides users with real-time messaging, clearing and settlement of financial transactions.

RippleNet was launched in 2019 and brings together three of the company's core products:

1. xCurrent, a cross-border payment processing solution embedded in banking infrastructure. It improves the efficiency of

traditional payment message formats while having similar security standards and meeting regulatory requirements.

2. On-Demand Liquidity (ODL) - service of providing liquidity for fiat currency transactions. For international transfers, banks need to store different local currencies. ODL allows them to free up this capital by converting fiat money into XRP. In this case, the cryptocurrency is used as an "intermediary" for the payment. First, the bank's main currency is exchanged for XRP, and after the transaction is successfully processed by another bank, that bank exchanges XRP for its own currency. This product used to be called xRapid.

3. xVia is an API interface designed specifically for the convenient use of individual components of the entire RippleNet ecosystem. xVia requires no installation, functioning as a browser extension, and can be embedded in software already in use.

Security issues and security protocols are two of the most important factors of Ripple's corporate blockchain platform.

Ripple was created as an alternative payment system for banks, with the help of which financial companies can quickly and cheaply transfer various assets (currencies, exchange-traded commodities, etc.). In fact, the Ripple project should replace SWIFT, the most popular bank payment system that has been operating since the 70s.

The Ripple ecosystem works taking into account the decentralized network XRP Ledger (XRPL). Among its advantages are high speed (the average block production time is 3-4 seconds) and low transfer fees. According to the official website, XRP Ledger is suitable for microtransactions in applications, NFT and DeFi protocol deployments, as well as for the issuance of stablecoins and CBDCs. In addition, traditional assets such as securities or fiat money can be tokenized in XRPL.

According to the company's official website, Ripple provides commercial services to hundreds of companies in more than 50 countries. Notable clients include Australia's National Australia Bank (NAB), Canadian Imperial Bank of Commerce (CIBC), Japanese financial giant SBI Holdings, and the National Bank of Egypt (NBE).

4) Hyperledger

Hyperledger was founded in 2015 and has gradually become a cross-industry open source for companies. All solutions of this ecoplatform have multi-purpose industry integrations. The main direction is a modular enterprise blockchain platform. They collaborate with many organizations and enterprises, always keeping track of all their projects.

Hyperledger ecosystem has many solutions specifically designed for any institution. They collaborate with many vendors. In addition, all vendors offer the Hyperledger platform solution at a low price.

Popular Hyperledger vendors include: Accenture; IBM; Alibaba Cloud; Oracle; Microsoft Azure; Samsung SDS; AWS.

Organizations and enterprises that are implementing Hyperledger-based blockchain technology:

– *U.S. Food and Drug Administration (FDA)*. The FDA protects healthcare data using blockchain. They are currently using the Hyperledger Fabric platform. These health records can cover genomic data, EMRs, clinical trials, etc.

– *Sichuan Hejia Co. Ltd.* Yijian Blockchain Hejia project includes a bank, a pharmaceutical network and a hospital. They collaborate to solve financial problems using Hyperledger Fabris.

– *London Stock Exchange*. The London Stock Exchange Group uses Fabric to build a financial business network. Functional interoperability (compatibility) across their systems is the top priority of the project.

– *TenneT*. TenneT wants to use the Hyperledger Fabric to provide a constant supply of electricity to ordinary people using idle car batteries and generators.

– *SAP*. Another great example of using Hyperledger Fabric is SAP cloud platform. They want to offer this platform for blockchain application development.

– *ANZ, Westpac and Scentre Group*. ANZ, Westpac and Scentre Group have joined up for a blockchain project. Here they are using Hyperledger Fabric to digitize bank guarantee processes for property leases. The aim is to eliminate banking paperwork to reduce fraud.

– *UBS*. UBS, along with other companies, are using Hyperledger Fabric to support their consortium trading platform Batavia.

– *Change Healthcare*. Change Healthcare uses Fabric to fuel its intelligent Healthcare Network™. This network provides transparency into claims management. Using this, they can track the status of claims submissions and money orders.

– National Bank of Cambodia. Bakong is a banking system operating on Hyperledger Iroha. The National Bank of Cambodia wants to offer a financial system for asset management for all banks in Cambodia.

– *Sompo Japan Nipponkoa Holdings Inc*. Sompo Japan uses Hyperledger Iroha to manage weather derivative contracts.

– *Alfa Bank* became the first Russian bank to join the CLSNet system developed by IBM using the Hyperledger Fabric enterprise blockchain.

– Soramitsu. Soramitsu uses Hyperledger Iroha to offer enterprises solutions to manage their digital assets. However, they are the original developer of this Hyperledger project.

– *T-Mobile*. T-Mobile created Hyperlink Sawtooth using Hyperledger Sawtooth to provide access and identity management solutions.

– *State Bank of India*. State Bank of India is using Hyperledger Sawtooth in a consortium of banks called BankChain to implement KYC / AML protocols.

5) Amazon Managed Blockchain (AWS)

Amazon Managed Blockchain (AWS) is a fully managed service that allows you to easily connect to public networks or create and manage scalable blockchain networks using popular open source platforms Hyperledger Fabric and Ethereum.

Amazon Managed Blockchain is a fully managed service that allows you to create a blockchain infrastructure in just a few clicks. Amazon Managed Blockchain eliminates the overhead required to create a private blockchain network or create node(s) to connect to a public blockchain network.

Enterprises intending to build a private blockchain network can create a Hyperledger Fabric blockchain on Amazon's managed blockchain in minutes and invite partner organizations into the network via an AWS account ID.

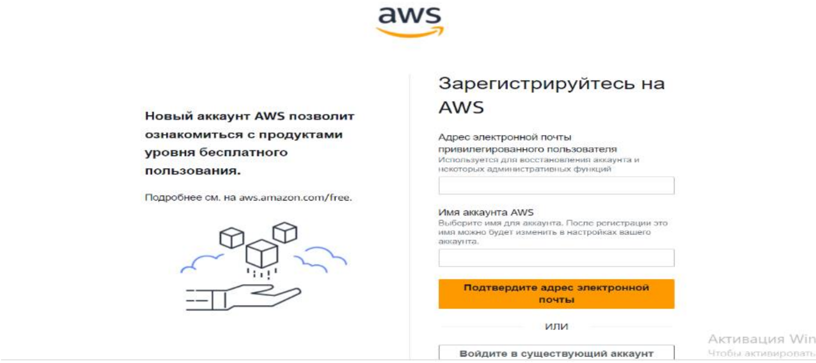

Figure 5.12. Creating an AWS account ID

The network running, a managed blockchain simplifies the management and maintenance of the blockchain network by automating tasks such as managing certificates and maintaining the availability of peer nodes.

Hyperledger Fabric private blockchains are suitable for use cases that require privacy and access control in a decentralized network environment, such as data exchange in supply chains and for traditional financial tasks.

In addition, Amazon's Hyperledger Fabric managed blockchain is supported on GovCloud, enabling government agencies and contractors to deploy in environments specifically designed to host sensitive data and meet the most exacting security and compliance requirements of the U.S. government.

A managed blockchain allows for Web3 developers to provide dedicated Ethereum full node(s) to connect to the public Ethereum mainnet and test networks to read data, subscribe to events, and broadcast transactions on the blockchain. The managed blockchain manages the Ethereum full node maintenance process, including automatically updating the node's client software as updates are released to the community.

For example, on September 15, 2022 06:42:42 UTC, a merger was completed on the block 15537393, moving the Ethereum public blockchain from Proof of Work (PoW) to Proof of Stake (PoS). The

Ethereum Mainnet nodes of Amazon's managed blockchain run on the Ethereum PoS network.

Moreover, the Ethereum nodes deployed with the Amazon Managed Blockchain are monitored and automatically replaced when needed to provide 24/7 access to the blockchain. Using Ethereum nodes on the Amazon managed blockchain, it is possible to build an NFT trading platform or analyze Ethereum blockchain data using your own dedicated node as the primary interface to the blockchain.

The advantages of Amazon blockchain are:

– *Fully managed infrastructure.*

With the Amazon Managed Blockchain service, it is possible to quickly create blockchain networks that span multiple AWS accounts. This allows a group of participants to make transactions and share data with no central authority required. Unlike self-hosting blockchain infrastructure, Amazon's Managed Blockchain service eliminates the need for manually provision hardware, configure software, and network and security components. Using Managed Blockchain's voting API, network participants can vote to add and remove participants. Once a new participant is added, Managed Blockchain allows that participant to launch and configure multiple peer-to-peer blockchain nodes to process transaction requests and store a copy of the registry. Additionally, Managed Blockchain monitors the network and automatically replaces low performance nodes.

– *Choose between platforms*: Hyperledger Fabric or Ethereum.

– *The Amazon Managed Blockchain service supports two popular platforms:* Hyperledger Fabric and Ethereum. Hyperledger Fabric is very well suited for applications with strict privacy requirements and permission controls, with a known set of participants, such as a financial application in which certain trade data is shared only with selected banks. Ethereum is well suited for highly distributed blockchain networks where data transparency to all participants is important, such as a customer loyalty blockchain network that allows any retailer on the network to verify the actions of all users to take advantage of benefits. Ethereum can also be used to connect to the public Ethereum blockchain network.

– *Reliability and Security*

The Amazon Managed Blockchain service can easily scale any blockchain network as application utilization rates grow across the network. When a network participant needs additional bandwidth to create and verify transactions, they can quickly add a new peer node using the Managed Blockchain API. Managed Blockchain provides instance types that include various combinations of components such as CPU and memory, allowing you to select the appropriate set of resources to base the workload on. In addition, Managed Blockchain protects network member network certificates using AWS Key Management Service (KMS) technology, eliminating the need to set up your own secure key storage.

Amazon Managed Blockchain service improves the reliability of the "order service," a component of the Hyperledger Fabric platform that guarantees transactions on the blockchain network. The Hyperledger Fabric order service does not store the entire transaction log by default, making it difficult to track and restore the transaction log when needed. The Managed Blockchain ordering service is built on Amazon QLDB technology and has an immutable change log that stores an accurate and complete history of transactions on the blockchain network, ensuring that this data is stored securely.

Amazon Managed Blockchain is widely used in areas such as:

– *Trade and Asset Transfer*

Trade requires many organizations such as importers, exporters, banks, shipping services and customs to work together. Using Amazon Managed Blockchain, financial and trade consortia can easily create a blockchain network where all parties can make transactions and process trade documents electronically without the need for a central trusted authority. Unlike other processes that require the transfer of trade documents between stakeholders, which takes 5-10 days, transactions on a blockchain network using Managed Blockchain can be processed instantly.

– *Retail trade*

Retail trade enterprises are often looking for ways to improve customer loyalty programs by partnering with other retail firms, banks and third parties to provide a more complete selection of customer free rewards available through an extensive network of partners. Using a central authority as an intermediary to process rewards transactions often delays the process, which takes 5-7 days to complete. With Amazon's Managed Blockchain service, a group of retail trade enterprises can easily implement a blockchain network that allows them to share and verify rewards information quickly and transparently, without the need for a central authority to process transactions between retailers.

– *Supply Chain*

Smaller businesses often use distributed supply chain networks where there is no single authority that controls the end-to-end movement of goods through the network. For example, jewelry stores often need to track the origin of gemstones to ensure their authenticity and value.

Using Amazon Managed Blockchain, such businesses can quickly implement blockchain in their supply chain network, providing greater transparency and real-time recording and tracking of the goods movement between parties. Each supplier or distributor can be a participant in the blockchain network, maintain its own distributed ledger (blockchain), and independently track all information related to the goods movement, including time tags, port of arrival, and volume of goods received. Considering that all participants have independent copies of the distributed ledger, all parties can trust destination of data origin and encounter without the need for a central authority.

5.5. Non-financial applications of smart contracts

In addition to the digital economy, smart contracts have found their application in non-financial fields, namely:

– *Elections.* Accounting for every vote and the absence of the possibility to change the results can ensure maximum objectivity of electoral processes and protection against falsification.

– *Medicine and healthcare.* The formation of a distributed registry that contains medical records, information about the treatment received and other details about patients can provide medical professionals with convenient access to these necessary data, while reliably protecting them from unauthorized access.

– *Property Rentals*. Selection process optimization, booking, paying and returning any rental property.

– *Arts & Media*. Copyright protection for any content or work, as well as automating payments for viewing, copying, editing and distributing materials.

– *Internet of Things*. Creating a unified system that synchronizes electronic devices, connected to the world wide network, with each other and with the external environment.

– *Supply Chain and Logistics*. Creating an infrastructure to process information about suppliers, recipients, carriers, routes, places of storage, and other links in the logistics chain.

– *Gambling.* Implementation of an algorithm that guarantees transparency and integrity of the game, randomness of its results, as well as automation of bets and payouts.

– *Education.* Creation of a united database of students and teachers, which stores information about all stages of the educational process, including credits, exams, research, diplomas, degrees, etc.

– *Decentralized Science (DeSci).* Creating an automated system for scientists to collaborate without borders and intermediaries, and to finance scientific and research developments.

The application of blockchain in non-financial markets is shown in fig. 5.13.

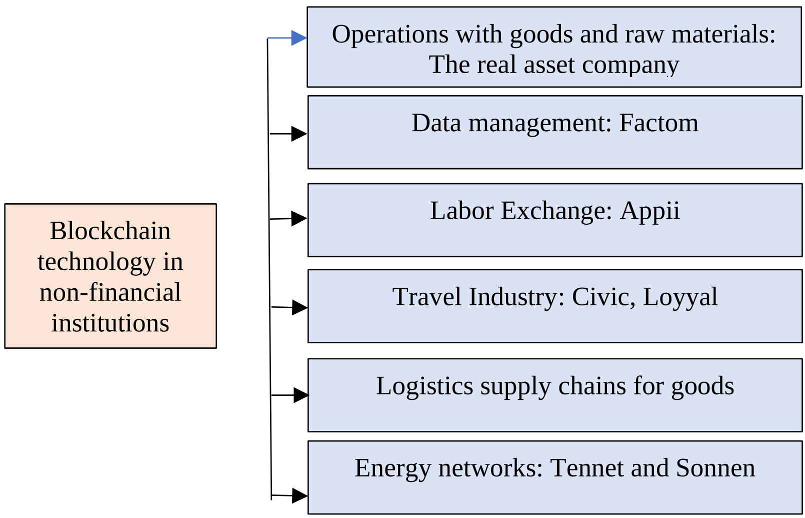

Figure 5.13. The application of blockchain in non-financial markets

5.6. Global examples of Blockchain technology application in different countries of the world

China. According to a report by analysis center 01Caijing and patent consulting firm PatSnap, China accounts for 84% of blockchain patents in the world. China's leadership believes that blockchain is accelerating integration with the economy, human condition services, smart cities and administrative services. In 2019, President Xi Jinping said that blockchain will play an important role in the next stage of technological innovation and industrial transformation.

On February 1, 2022, Chinese authorities announced the launch of a program to integrate blockchain into the national economy and private sector. The government intends to establish 15 pilot zones where new technologies will be designed, tested and implemented into everyday life. The initiative covers 15 government departments and more than 164 private organizations — from banks and IT companies to leading automobile manufacturers.

Despite Beijing's keen interest in blockchain, China intends to strictly regulate cryptocurrencies, using blockchains as a non-financial system. The Chinese government have already established a complete ban on all cryptocurrency transactions and mining, explaining its decision by the danger of invisible economy. Instead of decentralized digital currencies, the authorities plan to use the digital yuan - stablecoin, the operation of which is fully regulated by the Central Bank of China.

Malta. In July 2018, Malta introduced cryptocurrencies and distributed ledger technologies in an effort to turn the island nation into a blockchain capital. The Maltese Parliament passed three bills to establish a regulatory framework for blockchain technologies and incentivize their development and funding. These technologies allow for secure and fast money orders without interference or control by third parties, reducing transaction costs.

Analysts note that such act by the Maltese government will make the country incredibly popular for the development of innovative technologies. This approach will make Malta a hub for innovative tech startups and blockchain companies, which will certainly boost the state economy. Malta has passed a number of laws relating to blockchain and cryptocurrency, creating a regulatory environment that has proven to be attractive to businesses. Competing with London, Berlin and Zurich, (Switzerland), the country has quickly become a major European blockchain and cryptocurrency center.

El Salvador. El Salvador became the first country in the world to recognize bitcoin as a means of payment on par with the U.S. dollar. The country legislation obliges all sellers to accept bitcoin for payment for goods and services, and also allows to pay taxes with this cryptocurrency.

On June 9, 2021, the Legislative Assembly of El Salvador passed the "Bitcoin Law", which contains ten main points. According to the law, all prices in El Salvador can be set in both US dollars (the country's official currency since 2001) and bitcoins. Any participant in economic relations is obliged to accept bitcoins as payment for goods and services if requested by the customer. It will also be possible to pay taxes in bitcoins. Bitcoin as a means of payment will be exempt from capital gains tax, says another point of the law.

According to the law, the government will provide citizens and companies with the means to conduct transactions in bitcoins and automatically exchange to and from dollars, but will implement them in a way that does not interfere with private alternative services. A press release on the parliament's website notes that El Salvador will partner with the bitcoin-backed payment system Strike

Central African Republic (CAR). The Central African Republic (CAR) has legalized bitcoin as a means of payment on par with the Central African franc. Thus, CAR became the first country in Africa and the second in the world after El Salvador to legalize cryptocurrency as a means of payment.

The Central African Republic (CAR) plans to use bitcoin as a reserve asset as part of the country's efforts to implement cryptocurrencies and blockchain technology as tools to support the economy.

CAR's decision to place the main cryptocurrency as part of its national reserves follows a policy aimed at legalizing bitcoin in the country.

The country became the first jurisdiction in Africa to approve bitcoin as legal tender back in April 2022.

The CAR supplemented its bitcoin legalization bill with a project called Sango, a blockchain platform to support the adoption of cryptocurrency in the country. Sango is reportedly a bitcoin sidechain built similar to Liquid Network. Sango is scheduled to launch on July 25 and is expected to function as a digital monetary system.

Ukraine

Ukraine is gradually integrating Blockchain into various industries. For example, in 2016, the NBU board approved and presented the Cashless Economy roadmap, which laid out plans for the use of Blockchain technology for the first time.

In 2017, the Ministry of Agrarian Policy and Food implemented Blockchain technology in the State Land Cadastre.

In addition, in the same year, the State Agency for Electronic Government of Ukraine and Bitfury signed a memorandum of cooperation on the integration of Blockchain technology in basic registers and in the system of confiscated property sale "SETAM".

In 2021, Ukraine also joined a pilot project of the international organization Forest Stewardship Council to track the movement of timber on international markets using blockchain technology.

Ukraine is the leading country in cryptocurrency adoption and has the highest transaction volume. Between July 2019 and June 2020, more than $8.2 billion in cryptocurrency was sent and $8 billion was received. Experts estimate that daily transaction volume in Ukraine reaches $150 - $200 million and capitalization is over $2 billion.

The Ukrainian blockchain community is considered one of the strongest in the world. From 2017 to 2019, Ukrainian crypto startups attracted $171.4 million in investments. At the moment, about 100 companies in the cryptocurrency and blockchain sector are already operating in Ukraine. Such startups as Bitfury, Hacken and Propy are known worldwide.

Securitize is a platform for securities tokenization. Ukrainian engineers from IdeaSoft participated in the creation of Securitize — a platform for securities tokenization. By 2019, it has become the only SEC registered securities transfer agent operating on blockchain. The authors of the project decided to use blockchain as a way to provide automation and liquidity to limited partners.

Weld Money is a cryptocurrency card service. Weld Money is a Ukrainian startup and issuer of Visa fiat cards. They can be easily connected to any cryptocurrency exchanges and wallets to make purchases in stores around the world. When paying via Google/Apple Pay, the bank releases the fiat transaction into overdraft (interest-free credit), and Weld instantly transfers the required amount in cryptocurrency from the user's balance to their corporate account on the same exchange.

Global Ledger is a solution that eliminates risks when dealing with cryptocurrencies. Global Ledger helps banks to work with cryptocurrencies, preventing cybercrime in this sphere. The startup was founded three years ago by Ukrainians Oleksandr Fisun and Dmytro Bilokon with the support of IdeaSoft business incubator. This year, the startup signed a strategic partnership agreement with the Swiss group Promethiem AG, thanks to which the company will get $3.5 million in funding and access to new markets.

Ukrainian engineers from Avenga helped design and build a digital system for processing COVID test results. This solution guarantees the protection of personal data through storage on the blockchain. Also, the system is able to provide only a certain part of information to different parties, while ensuring its accuracy and confidentiality.

As for cryptocurrencies and virtual assets, they still do not have a special status in Ukraine. The concept of "cryptocurrency" and regulation of transactions with it in Ukraine fall outside the regulatory regime money circulation, currency legislation, electronic money circulation and use of means of exchange, civil legal relations on regulation of activities with securities. Despite attempts to establish rules, the regulatory position was not adopted. However, the use of virtual assets is by no means prohibited, so Ukraine can be considered as a jurisdiction with a neutral attitude towards virtual assets.

Community formation and systemic initiatives to develop the industry in Ukraine started in 2014 with the opening of Satoshi Square, the first Bitcoin Embassy in the CIS and Bitcoin Foundation Ukraine. Back then, the Bitcoin Embassy employed a few people, and enthusiasts and experts exchanged ideas at meetings in the square. Today, the amount of information and educational content created in Ukraine on blockchain and cryptocurrencies is huge, with events held on average every week, and the community and all comers have the opportunity to meet at the new physical location of Blockchain Hub Kyiv.

The majority of companies were founded in 2017 - 32% of respondents, less, 20%, in 2016, 14% in 2018, 12% in 2015 and 8% each in 2014 and before. The majority of company founders came to the blockchain industry from development and programming, finance and investment, and cryptography and cryptocurrencies, indicating the strong expertise of company founders.

The State Service for Special Communications and Information Protection of Ukraine has developed a program complex of the basic blockchain system using domestic cryptography with high post-quantum resistance. This was reported to ForkLog by the press service of the agency.

The technology can be used to hold various votes, create a national cryptocurrency, use smart contracts and provide fault-tolerant electronic document management.

Currently, a prototype of the electronic voting system is deployed on the basis of blockchain.

Earlier, the National Bank and the Ministry of Finance of Ukraine approved the strategy for the development of the financial sector until 2025, one of the directions of which was the development of blockchain technologies

Government programs to support the development of Blockchain technology:

- Concept of Development of Digital Economy and Society of Ukraine for 2018-2020;
- Program of Ukraine "State in Smartphone": DIA, 2019;
- Postwar Plan "Digitalization" for 2025.

Ukraine has an EU-supported digitalization program - EU4Digital.

EU4Digital is an initiative of the European Union, which supports the digital reform program in Ukraine by offering a series of activities to promote key areas of the digital economy and society in accordance with EU norms and practices. The goal of the program is to ensure economic growth and job creation, improve the living conditions and promote business development.

EU4Digital complements the EU's bilateral support to Ukraine in applying e-government solutions for local authorities and in enhancing the interoperability of administrative services, as well as in building cyber resilience, especially before elections.

Ukraine has identified digital transformation as a priority of its policy, which is confirmed by the success of the implementation of ProZorro and HelSi e-health systems, 4G mobile network and introduction of e-services in the public and private sectors. Digitalization in Ukraine is carried out by joint efforts of the expert and business communities, which is fixed in the Concept and Action Plan for the Development of Digital Economy and Society of Ukraine for 2018-2020.

Priorities for the development of digitalization in Ukraine are focused on the expansion of legislation on digital economy and telecommunications, digital infrastructure, including: broadband strategy; cashless economy program in the field of e-commerce, e-trust and cybersecurity; Smart Cities – Smart Regions initiative focused on decentralization and introduction of e-skills; e-health; e-commerce in all regions of Ukraine.

The EU4DigitalUA – Ukraine European project aims to promote digital transformation in Ukraine and harmonization with the Digital Single Market of the European Union. In addition to digital transformation, it contributes to strengthening cybersecurity and data protection, implementation of the EU-Ukraine Association Agreement and broadband development. The project will run from 2020 to 2024. The investment from the EU is €25 million.

The EU4DigitalUA program consists of the following six components:

– Interoperability and Digital Government Infrastructure.
– Institutional strengthening and capacity development.
– Communication and public awareness.
– Development of e-services.
– Cybersecurity and data protection.

The EU4DigitalUA project is a continuation of the EGOV4UKRAINE project, which resulted in the development of a base for state e-services, “Trembita” system and the modern information system “Vulik” for public service delivery by administrative service centers.

TEST QUESTIONS:

1. What are the economic foundations of distributed storage registry (Blockchain) technology?

2. Explain the history and background of Blockchain.

3. What is the economic and technological nature of cryptocurrencies? Blockchain 1.0.

4. Characterize the differences between the cryptocurrencies types: bitcoin, altcoins, and stablecoins.

5. Characterize the applications of smart contracts.

6. What are the features of decentralized finance (DeFi)?

7. What are the features of decentralized autonomous organizations (DAO)?

8. Characterize the capabilities of an enterprise blockchain. What are the main advantages of Amazon's managed blockchain?

9. What are non-financial uses of smart contracts?

10. What global examples of Blockchain technology application in different countries of the world do you know?

CHAPTER 6.
ASSETS AS A TOOL FOR FINANCIAL ASSETS MANAGEMENT IN THE DIGITAL ECONOMY

6.1. Digital assets and their economic and legal nature

A digital asset is any object that has value and is represented in a digital or computerized form. It can be a financial asset (a bond), a tangible asset (a work of art), or an intangible asset that is created in a digital environment.

Ecosystems of digital assets have three characteristics:

- *tokenization*, in which ownership of an asset is converted into a digital token using software. The token can be kept, sold or used as collateral;
- *distributed ledger*, or blockchain, is an immutable unique computer record of ownership and transfer of ownership rights to tokens;
- *encryption* -the use of advanced cryptographic technologies that ensure the security of operations with tokens.

Digital assets are broadly defined as any digital security of value that is recorded in a cryptographically secured distributed ledger or any similar technological system. However, digital assets have value unlike other uses of the distributed ledger. Digital assets include (fig. 6.1.).

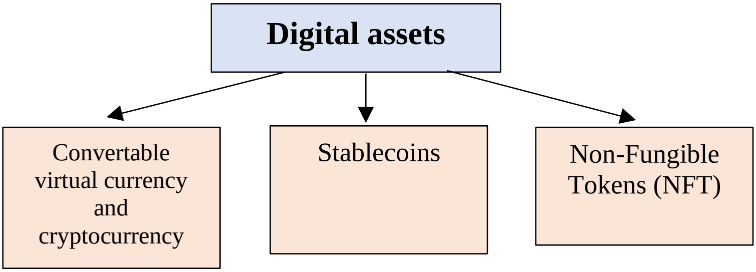

Figure 6.1. Components of digital assets

Digital assets are not real currency (also known as "fiat money") because they are not US or other country coins and paper money and are not digitally issued by a central bank of a nation.

A digital asset that has an equivalent value in real currency or acts as a substitute for real currency is called convertible virtual currency.

Cryptocurrency is an example of a convertible virtual currency that can be used to pay for goods and services, conduct digital commerce between users, and exchange for real-world currencies or digital assets.

Transactions with digital assets, as a rule, must be indicated in the tax return.

Sources of digital assets are formed from the following areas:

- sale of a digital asset for fiat money;
- exchange of digital assets for property, goods and services;
- exchange of digital assets or their purchase/sale;
- receiving a digital asset, such as payment for goods or services;
- obtaining a digital asset as a result of a hard fork (a method of making significant changes to the protocol code of a blockchain project);
- obtaining a new digital asset as a result of mining or staking;
- receiving a digital asset as a result of an airdrop (transferring digital assets of a crypto project to several wallets);
- any other alienation of a financial interest in a digital asset;

- receiving or transferring a digital asset for free, despite the fact that such a transfer is not considered a gift from a legal point of view;

- the transfer of a digital asset as a gift from a legal point of view, if the donor has exceeded the appropriate annual gift tax-exempt amount.

A digital asset is an information resource derived from a right to value, which has a unique identifier in a distributed ledger.

In a broad sense, the concept of a digital asset is represented by the following four components:

1) The economic component is interpreted in the context of the definition of the concept of "digital asset" and is represented in the financial sphere by the presence of a unique identifier.

2) The legal component in the context of the definition of the concept of "digital asset" is derived from law. A digital asset is not a right to value in its interpretation, but it has the properties of a derivative of a right to value.

3) The information component in the context of the definition of the concept of "digital asset" is represented in the IT sphere by an information resource that addresses the distributed registry (Blockchain).

4) The value component reflect***s*** the value of the asset in the digital economy.

A unique identifier is used in information systems and is intended to identify a certain object in the network, and also allows to exclude any possibility of duplication of this object and confirms its validity (fig. 6.2.).

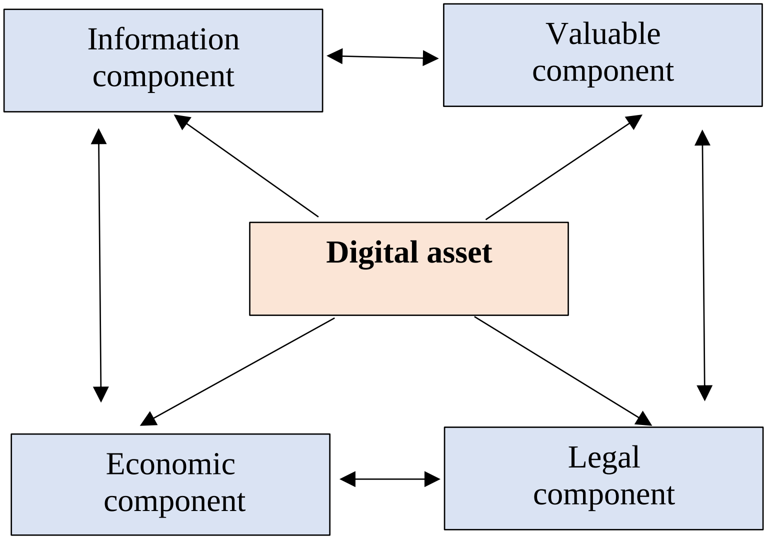

Figure 6.2. Essential characteristics of the concept of "digital asset" in the economic and legal aspect

The property of the uniqueness of a **digital asset** became possible with the advent of distributed ledger technology, the structure of which guarantees the preservation of information and the ability to verify the asset.

Any changes in the distributed ledger (Blockchain) automatically lead to the generation of a new unique identifier, which eliminates the possibility of duplication and misuse of the asset.

Information about a digital asset contains the following characteristics:

- the location of the digital asset;
- registration;
- legal restrictions and other distinguishing features and properties.

Blockchain provides the conditions for identifying a digital asset by assigning a unique hash code that allows such an asset to be assigned to a specific entity.

Tokenized legal relations are legal relations between users of digital assets as subjects of law regarding the object of law, which is the object of accounting carried out using a distributed ledger token.

At the same time, some rights and obligations of the parties arising in the process of such legal relations, as well as their sequence, provided that they have an accurate algorithm of events, can be programmed and performed automatically. All tokenized legal relationship events are accounted for, as they are displayed in real-time in the distributed ledger token accounting system.

The main advantages of tokenized legal relations compared to ordinary ones include the following:

- verification of the parties to the legal relationship;
- transparency;
- instant operations;
- availability 24/7;
- a technologically guaranteed level of security and social trust between participants when they carry out transactions through a distributed ledger token;
- the indisputability of events by participants in legal relations and their sequence;
- automation of elements of legal relations that have a precise algorithm of events, programmability of actions and their sequence;
- other aspects.

Tokenization of legal relations allows modernization of existing legal relations, which greatly simplifies their adaptation to the legislation of different countries of the world.

Tokenization of legal relations creates conditions for the formation and development of a new market — the market of tokenized assets, the functionality of which depends on the attributes and properties of tokenized assets and on the environment of their circulation.

A tokenized asset is a type of virtual asset that exists in the distributed ledger token accounting system as a record with an identifier of information derived from the original asset.

According to international legal documents, a tokenized asset is part of virtual assets.

The Financial Action Task Force (FATF) defines a virtual asset as "a digital expression of value that can be traded digitally or that can be translated and used for payment or investment purposes." Since the FATF Recommendations are a generally recognized international standard for combating money laundering and terrorist financing, the attention of financiers and regulators around the world further focused on the term "virtual asset", which became the basis for research by scientists from different countries.

In Ukraine, the law "On Virtual Assets" has also been enacted, according to which a virtual asset is an intangible good that is the object of civil rights, has value and is expressed by a set of data in electronic form. The existence and liquidity of a virtual asset is ensured by the system of ensuring the turnover of virtual assets. A virtual asset can testify to property rights, in particular, rights of claim to other objects of civil rights [3].

A digital asset, by its legal nature, acts as a way of disposing of property.

The disposal of property in civil law is one of the rights of the owner, which allows him, at his own discretion, to take any actions regarding the property belonging to him, which do not contradict the law and other legal acts and do not violate the rights and interests of other persons. Including the alienation of property to other persons (sell, change, gift, etc.), transfer to them, while remaining the owner, the right to own and use the property, transfer to them the right to dispose of the property, pledge the property, dispose of it in another way.

A digital asset unit is a tool for implementing the property management method chosen by the owner. Each unit of a digital asset has a technological and information-application component. The technological component is presented in the form of a unit of account of the token of the distributed registry and its data, and the informational and applied component is presented in the form of correlating data of the original asset and data of the primary asset. When events occur with the property (primary asset), changes and its data occur at the same time, which cause changes in the data of the original asset. These changes are recorded as transactions of the distributed ledger token unit of account. Thus, all events with property, which are reflected in the contract at his disposal, are recorded in the form of an entry in the distributed register (fig. 6.3).

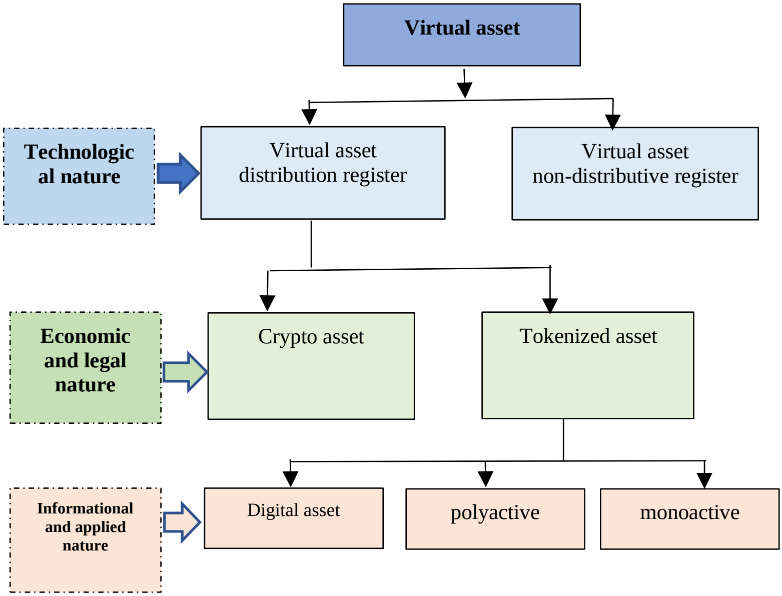

Figure 6.3. Structural components of virtual assets

6.2. Tokenomics - as a functional environment for managing digital assets

The digital environment in which tokenized assets circulate is called tokenomics.

Management of digital assets, which are presented in the form of tokens, is carried out on specialized digital platforms and ecosystems.

The most common digital ecosystems on which it is possible to host and manage digital assets include the following:

1) Opensea;
2) Rare;
3) SuperRare;

4) Foundation;

5) BakerySwap;

6) Oracle Content Management.

1) Opensea is organized as a marketplace that was created in 2017. Today, Opensea is one of the most popular platforms for buying, selling and creating tokenized assets in the form of NFTs. Unlike many other similar services, OpenSea does not focus on one specific niche, but offers a space where creators and collectors can buy, sell and create any kind of NFT [101] (Fig. 6.4.).

Figure 6.4. OpenSea Digital Ecosystem Page [101]

To manage digital assets on OpenSea, you need to set up an Opensea account. When creating an account, you need to create a wallet to store cryptocurrency and NFT. OpenSea offers over 150 different payment tokens. The most popular token used to sell NFTs on OpenSea is ETH/WETH. The most convenient and easiest platform for selling cryptocurrency is Coinbase.com. After setting up your account, you'll need to enter your card or bank account details into your Coinbase account for verification. After receiving confirmation, you can buy ETH and other cryptocurrencies on Coinbase.

In order to create your own NFT token, you should follow a series of sequential steps: log in to your profile; select "Create" or "Collection" if you want to create a collection; give the name of the NFT / collection; download media; configure OpenSea URL; add a description; assign a category; introduce a percentage of royalty - up to 10 percent.

Creators can earn income every time their NFT is sold on OpenSea, then choose a blockchain to mint - Ethereum or Polygon and click Create.

Later, new NFTs can be added to the created collection. But you cannot change the metadata of an already created token. Metadata is everything listed above. Therefore, it is worth carefully checking the entered information before coining.

1) Rarible

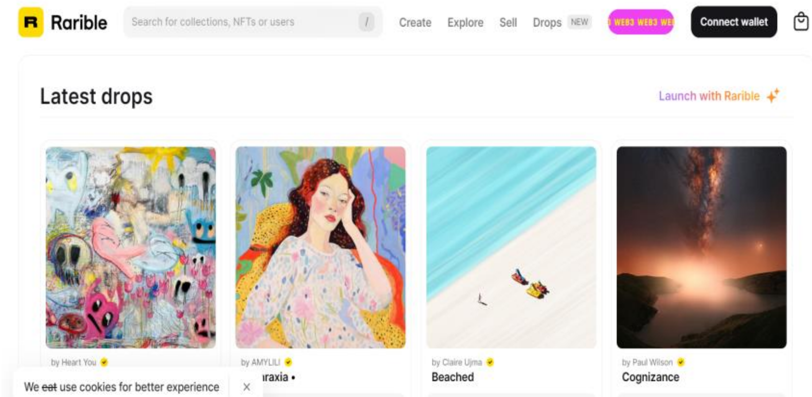

Figure 6.5. Rarible Digital Ecosystem Page [105]

Rarible is one of the most popular marketplaces that runs on the RARIChain blockchain. Rarible was founded by a Los Angeles-based startup that developed a non-fungible token (NFT) trading platform for creating, selling and buying digital art based on blockchain technology.

The blockchain project solves the task of authenticating digital works of art, collectibles and gaming items, music and other multimedia.

In June 2021, the Rarible company announced the closing of the Series A investment round, in the framework of which it managed to attract $14.2 million. The American funds Venrock, CoinFund and 01 Advisors invested in the project. Rarible's proceeds were used to expand the IT team and marketing department, develop a mobile application and open source network protocol Rarible Protocol. With this protocol, users will be able to create their own NFT projects, such as other marketplaces.

The protocol and marketplace in the Rarible ecosystem are separate products handled by different teams. According to the plan of the founders, in the future Rarible will become a decentralized autonomous structure, the principle of construction of which will be in the form of a DAO.

At the beginning of 2021, celebrities came to the Rarible site, including singer Sean Ono-Lennon (son of John Lennon and Yoko Ono), rap group Wu-Tang Clan, actress Lindsay Lohan, bloggers Ilya Varlamov and Ruslan Usachev.

In June 2021, the biggest deal took place in the marketplace — NFTs from the collection of boxer Floyd Mayweather were sold for $286,000. Rarible reports that about 460,000 unique users visit the marketplace every month.

As of early February 2021, Rarible supports two token standards: ERC-1155 and ERC-721. Both are used almost exclusively in NFT markets, while Ethereum's growing decentralized finance (DeFi) markets use the most common ERC-20 standard

3) SuperRare

SuperRare is an NFT market, the system of which was combined with the classic format of a social network. A distinctive feature is the decentralization of the platform.

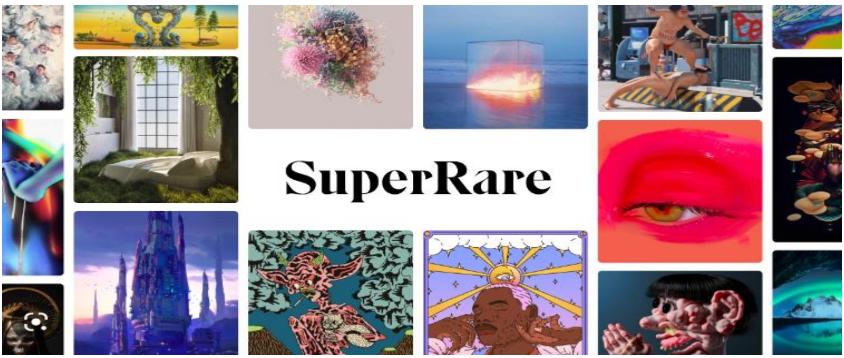

Figure 6.6. SuperRare Digital Ecosystem Page [111]

The basis of his work was the Ethereum blockchain, since it was this network that suited the main criterion for a social network - security and the ability to process and store a large amount of data. All NFTs on SuperRare are built on the ERC721 standard.

The social network format reveals the features of the SuperRare platform - here you can like, communicate with other system participants who create or collect irreplaceable tokens. It also makes it easier for users to navigate thanks to the posts with the most activity on the site among different categories of users. On the main page of the project you can find a list of the best artists, collectors and the largest collections.

The project is owned by the Pixura company, which during the first round of venture financing was able to attract USD 9 million as investment. The creators are considered to be John Crane and Jonathan Perkins.

SuperRare is the first project of its kind, the potential of which is revealed through the possibilities provided by the social network format:

1. Events – a news feed is displayed here, which is selected for each user individually, based on his interests.

2. Features – projects, exhibitions and much more can be held publicly and on one platform. The idea is still in a rather raw form, so these functions are just beginning to be implemented in the smooth operation of the system.

3. Market – already today creators can convert their images, videos and text into NFT format. All created tokens can be sold directly on the platform inside the ecosystem. To search for interesting NFTs, special filters have been added based on the creator and value of the token.

4. Community – thanks to the functionality of the social network, the platform acquires the ability to create communities based on interests

All NFT trades are conducted through their marketplace. You can go to it by clicking on the corresponding Market button at the top of the site page.

The sale of NFTs on the platform is available in three ways:

1. Auctions. There are two types. The first is the reserve, when the amount of the reserve is set, reaching which the timer is started for the day before the end of trading. It is best suited for those sellers who are not in a hurry to sell the product, but want to receive a certain amount for their lot. After the set time expires, the user who offered an amount exceeding the reserve parameter becomes the new owner. The second type is a planned auction. For this purpose, the starting amount of the lot and the validity period of the trades are selected. The auction will in any case end when the set time has passed, and the owner of the NFT will be the one who bids the most other users.

2. Classic offer. Each user can offer his amount to purchase a particular slot. The seller is not obliged to give his work until the price suits him. No special actions need to be taken, all NFTs automatically enter the common database where the item can be found by the collector.

3. Buy now. The seller sets a fixed amount, but at the same time he can receive any offers above the specified level, and the user is not obliged to agree to the terms of the potential buyer

The maximum RARE supply is 1 billion tokens, but currently only 10% of them are in circulation (101.8 million). The market capitalization is 145.5 million USD, but with a full issue this figure will increase to 1.4 billion USD. Coins can be purchased on gate.io, Uniswap (V2) and (V3) exchanges. The rate and price of RARE can be tracked on the interactive quote graph below.

The main advantage of SuperRare over competitors is the unification of the marketplace in a real social network. Each user can find any art, and then try to purchase it. There will be no situation when it is simply impossible to write to the owner of the art and offer him a good price for the lot. This makes SuperRare useful for both buyers and sellers who will be able to receive offers without even putting their NFTs up for sale.

4) Foundation

Foundation is a digital platform designed to enable artists and collectors to interact with each other. Artists digitize their works by creating NFT, and any other user can become the owner of this token by paying with cryptocurrency. The system of auctions, buying, selling and creating applications in the Foundation digital ecosystem works on the Ethereum blockchain, the coin of the same name is used as the main currency.

Marketplace was incorporated as a legal entity in 2020 in San Francisco, California, USA. The founder of the project is Kaivon

Tegranian, who currently holds the position of general director. The co-founder was Matt Vernon, who owns the Neue Goods project - a clothing brand designed by people from the NFT sphere.

Funds are transferred directly from one user to another, the platform does not store cryptocurrency and the digital works of art themselves.

Foundation is just a service provider that connects interested parties, where all financial transactions are done through smart contracts.

Smart contracts are required for the marketplace to work, thanks to which all transactions are permanently stored in the blockchain in an unalterable form. Only in this way can the platform prove that neither it nor anyone else has control over the NFT and does not manage the process of the transaction itself.

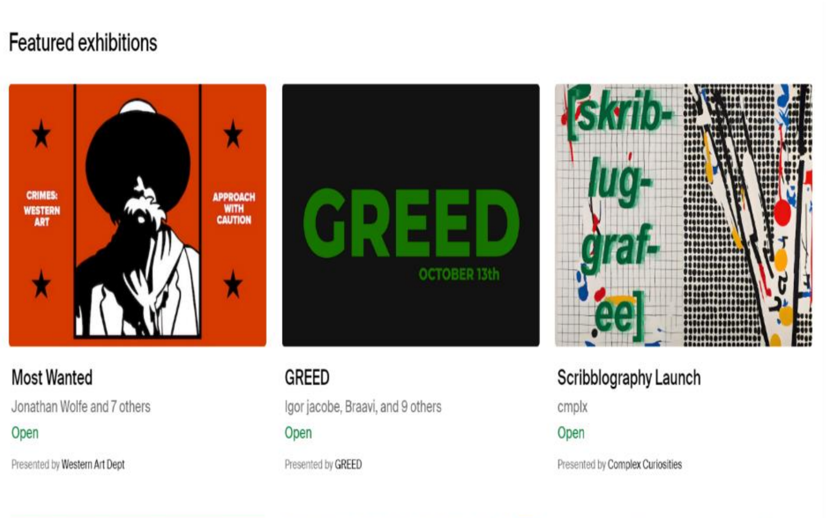

Figure 6.7. Foundation Digital Ecosystem page [77]

Registration is not enough to access the NFT sale. Only people who have received approval from the platform can become creators on Foundation. Some users try to get around this rule by buying and selling pre-invites. Such actions are strictly punished by the marketplace, as a result, all participants of such an agreement are restricted from accessing the Foundation.

To receive an invitation, you need to go to the Discord channel of the Foundation marketplace and open the #intros-invites channel section. Only an artist approved by the company can issue an invitation. It is on the Discord channel that any user can request to receive an invitation in the appropriate section. Other creators have the opportunity to familiarize themselves with the application, after which a decision is made to issue an invite.

There is also an alternative way to receive an invite. Community Upvote is a place where potential authors can submit their own applications for public voting. For better promotion, each participant should complete a complete profile on the Foundation so that each voter can go in and see detailed information about the artist.

To join Community Upvote, you need to take the following steps.

1. Create a profile on Foundation.
2. Fill it out: upload your avatar, cover and tell a little about yourself.
3. Verify Instagram and Twitter accounts.
4. Add a link to the portfolio, where an extended list of the best works will be collected.
5. Go to the Upvote section.

All information about voting will be sent to the specified e-mail address. If the artist is approved, all further instructions will be sent by e-mail.

5) BakerySwap

BakerySwap is a large service that works as a decentralized exchange on which NFTs are traded. The operation of the BakerySwap ecosystem is based on the Binance Smart Chain blockchain. The exchange is good for trading, charging only 0.3% of each transaction. The commission on the Binance Smart Chain network for carrying out a transaction varies in the range of a few cents.

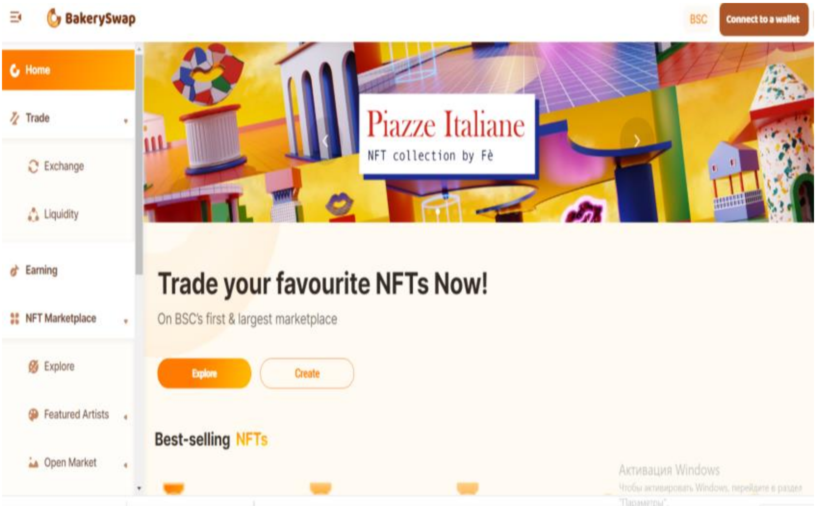

Figure 6.8. BakerySwap Digital Ecosystem Page [68]

BakerySwap operates on the basis of the AMM (automated market-making) blockchain protocol. The system has a BAKE token that allows participants to increase passive income. The BEP20 standard used by the platform allows you to significantly reduce the commission during trading.

To work with the service, MetaMask, Binance Chain Wallet, Trust, Rainbow and other wallets that work on WalletConnect technology are used. Immediately after connection, you can start exchange operations or any of the listed ways of earning.

Initially, the developers aimed to make a faster and cheaper DeFi version of the Uniswap exchange. Its main drawback was considered to be the incredibly high cost of transactions. While it was often acceptable for large investors, for novice digital artists the cost of registering or transferring an NFT token was more expensive than the cost of the work itself. This situation led to the stagnation of the NFT community.

To solve the problem, the new exchange was moved from the Ethereum network to the Binance Smart Chain, in which the cost of a transaction is only a few cents. BNB became the base currency, which can be instantly exchanged for any of the 50 tokens circulating on the platform. Liquidity is represented by the native BakeryToken (BAKE).

BakerySwap's main competitors are Uniswap and PancakeSwap. Compared to them, BakerySwap has the following advantages:

- Bakery galery sales gallery for professional digital designers and artists;
- extended earning opportunities on NFT (farming, staking, resale, creation);
- cheap transactions (against Ethereum, where the cost of translation often exceeded the cost of the art object itself);
- possibility of arbitrage between BEP2 and BEP20 tokens;
- increased speed of transactions;
- the first AMM project on BSC, which offered a liquid pool for such altcoins as DOT, LINK, etc.;
- commission for exchange is only 0.3%;
- staking Bake is more profitable than Cake.

A small pool of liquidity and technical problems encountered when conducting an IFO can be singled out from the main disadvantages of a beginner.

The group of project developers outlined the following goals for the near future:

1. Open separate large sections for professional video clips, musical works, gif images.
2. Start your NFT aggregator.
3. Open a DeFi derivatives trading exchange.

The desire to take the first position in the world of decentralized finance due to quick response to the needs of the market and users is obvious.

6) Oracle Content Management

Oracle Content Management is a digital ecosystem that works like cloud storage and provides a centralized location for all digital assets, where they can be organized into repositories and collections and create rules to define how and where they are used.

In addition, Oracle Content Management provides advanced management and workflow features that allow you to manage assets as they are created and approved, and ensure that only authorized versions are available for use. To create a digital asset, you can upload or drag a new file to the Asset View in the Oracle Content Management web interface. You can also select an existing file in Oracle Content Management and add it to the repository as an asset. [102].

Figure 6.9. Oracle Content Management Cloud Storage Page [102]

Oracle Content Management asset types are divided into two families.

Content types define groups of data fields of different types (for example, text type to store string values, long text type to store rich text values, date type to store date and time values, and reference type to store references to other assets). For example, you can create a blog article content type in which each asset stores values for the title, body text, creation date, and a list of links to related articles. If an asset is created based on a content type, it is called a content element.

Digital asset types define which media file types (MIME types) can be stored in assets of that type, as well as attribute groups of different data types to describe the files. For example, you can create a digital photo asset type including only image/jpeg and image/png file types and attributes for copyright and signature. Oracle Content Management includes several digital asset types that are included in the delivery package: Image, Video, Video Plus, and File. If an asset is created based on a digital asset type, it is called a digital asset.

When using the Oracle Content Management Starter version, the user receives limited asset support and has the following features:

- the ecosystem has more than 5,000 assets;
- includes standard asset types for images, videos and files;
- has 5 types of assets;
- no editing of user images (support for automatic views);
- there is no support for archiving and storage;
- no support for Video Plus;
- no support for Adobe Creative Cloud Extension.

TEST QUESTIONS:

1. What is a digital asset?

2. What are the components of digital assets?

3. What sources of formation of digital assets do you know?

4. What are the essential characteristics of the concept of "digital asset" in the economic and legal aspect?

5. What is a tokenized asset?

6. What is the essence of tokenized legal relations?

7. What is the difference between a digital asset and a virtual asset?

8. What are the structural components of virtual assets?

9. What are the most common digital ecosystems where digital assets are distributed do you know?

10. What is the fundamental difference between Oracle Content Management and other digital ecosystems?

CHAPTER 7.
E-BUSINESS AND E-COMMERCE IN THE DIGITAL ECONOMY

7.1. Theoretical and practical aspects of the formation and development of the digital economy

Digital technologies open up unique opportunities for the development of our economy and improvement of the quality of life of citizens [57].

«Digitalization» should be considered as a tool, not as an end in itself. With a systemic state approach, «digital» technologies will significantly stimulate the development of an open information society as one of the essential factors in the development of democracy in Ukraine, increasing productivity, economic growth, creating jobs, as well as improving the quality of life of Ukrainian citizens [57].

Digitalization is the introduction of digital technologies into all areas of life: from interaction between people to industrial production, from household items to children's toys, clothes, etc. This is the transition of biological and physical systems into cyberbiological and cyberphysical ones (combination of physical and computing components). Transition of activities from the real world to the virtual (online) world [54].

Digital technologies: Internet of things, robotics and cyber systems, artificial intelligence, big data, paperless technologies, additive technologies (3D printing), cloud and fog computing, unmanned and mobile technologies, biometrics, quantum technologies, identification technologies, blockchain, etc. [54] .

Consumers of digital technologies are all - the state, business, citizens [54].

Digitization is one of the main factors in the growth of the world economy in the next 5-10 years. In addition to the direct productivity gains that companies receive from digital technologies, there is a chain of indirect benefits of digitalization, such as saving time, creating new demand for new goods and services, new quality and value, etc. [54].

Digitization will be the main tool for achieving Ukraine's strategic goal of increasing GDP by 8 times to $1 trillion. in 2030E, and ensuring the well-being, comfort and quality of life of Ukrainians at a level higher than the average in Europe [54].

In today's global electronic environment, the volume of information and knowledge is growing, the role of the digital economy and information and communication technologies is increasing, the economic status of information and the service sector is growing, and human life and activity are changing radically. Humanity is steadily moving towards digitalization, in which most of the economy and business are becoming electronic and are conducted on the Internet.

Intangible production, science and education, health, culture, which contributes to the development of industry on the basis of computerization, informatization, and automation of all production cycles, become more priority.

The digital economy is a type of economy where the key factors (means) of production are digital data: numerical, textual, etc. Their use as a resource makes it possible to significantly increase the efficiency, productivity, value of services and goods, to build a digital society [54].

A digital society is a society that intensively and productively uses digital technologies for its own needs (self-realization, work, recreation, education, leisure of everyone), as well as for the achievement and implementation of common economic, social and public goals [54].

The digital economy encompasses business in all sectors of economic activity, i.e. not only in the information and telecommunications sector, but also in basic industries, agriculture, construction, etc. The digital economy permeates all sectors in all categories: public and private; real, non-productive and financial; mining, processing and services sector [54].

The key advantage of the digital economy over the traditional one is the realization of the possibility of automatic management of the entire system (or individual components), as well as its practically unlimited scaling without loss of efficiency, which allows to significantly increase the efficiency of managing the economy (economic activities and resources of the country in various sectors) on micro- and macro levels [60].

The digital economy is a new type of economy based on the use of information technologies for the production, exchange and consumption of goods and services. Theoretical and practical aspects of its formation and development include a number of key concepts and directions:

Theoretical aspects:

Digital technologies: Using advanced technologies such as artificial intelligence, machine learning, Internet of Things, blockchain, etc. to optimize business processes and create new products and services.

Data as a resource: Processing large volumes of data (big data) to obtain valuable information about consumers, the market and trends, which allows businesses to make more informed decisions.

Innovations and startups: Support for innovative projects and startups in the field of technology, which contributes to the growth of competitiveness and the development of new ideas.

Practical aspects:

E-business and e-commerce: Conducting business transactions over the Internet, including the sale of goods and services, marketing, payment processing and customer service. The development of online commerce, electronic payment systems and electronic markets, which facilitates global access to goods and services.

Digital platforms: The development of online platforms where buyers and sellers can meet, collaborate and interact, such as marketplaces and social networks.

Electronic democracy: Application of electronic technologies in electoral processes, management of public affairs and ensuring openness of government activities.

Digital education: Implementation of online learning and distance learning formats to improve skills and access to education.

Cyber security: Providing protection against cyber threats and crime, in particular, with the help of data encryption and the use of modern identification methods.

The digital economy opens up new opportunities for business, society and the economy as a whole, promoting efficiency, innovation and growth. However, it also presents challenges related to data privacy, network security and inequalities in access to technology that need attention and solutions.

Characteristic features of the digital economy [39]:

- robotization of production;
- use of artificial intelligence in business processes;
- transition of business into virtual space;
- a single information space between participants of economic relations: business, state and citizens;
- digital identification – application of a single electronic system identity verification for secure banking operations, voting, access to social services, payment of utility bills, etc.;
- informational security;
- digital governance – service-oriented organization -functioning of the system of public governance (management) based on digital technologies;
- digital document flow;
- the growing importance of users and access to the end customer in value creation;
- intelligence-medicine;
- distance education.

Problems that hinder the development of digital trends in Ukraine and the transformation of the Ukrainian economy into a digital one [54]:

1. Institutional:

- low inclusion of state institutions regarding the implementation of the Concept of the development of the digital economy and society;

- inconsistency of specialized legislation with global challenges and opportunities (progressive drafted bills have not yet become laws);

- inconsistency of national, regional, sectoral strategies and development programs with digital opportunities.

2. Infrastructural:

- low level of coverage of the country's territory by digital infrastructures (for example, the EU goal by 2020E is to cover 100% of the territory with broadband Internet access, in Ukraine this indicator is about 60%);

- lack of separate digital infrastructures (for example, the infrastructure of the Internet of Things, electronic identification and trust, etc.);

- unequal access of citizens to digital technologies and new opportunities (digital divides).

3. Ecosystem:

- weak state policy regarding incentives and incentives for the development of the innovative economy;

- immature investment capital market;

- outdated education system, teaching methods, lack of focus on STEM education, soft skills and entrepreneurial skills, imperfect models of technology transfer and consolidation of knowledge and skills;

- a shortage of highly qualified personnel for the full development of the digital economy and digitalization in general.

4. In the field of electronic government and governance ("the state in a smartphone"):

- low level of automation and digitalization of public services due to weak motivation of government institutions (there is no full understanding of the potential benefits of total digitalization).

In the digital economy, the following areas of activity are developing, which use innovative technologies and digital solutions to improve the efficiency and quality of services:

Electronic commerce (e-commerce): the expansion of online commerce, electronic payment systems, and marketplaces that allow buyers and sellers to transact over the Internet.

EdTech: the use of digital tools and platforms to improve education, including online courses, distance learning, interactive learning, and other technological innovations in education.

GovTech (government technologies): using technology to optimize government services, ensure interaction between the government and citizens, improve electoral systems, create electronic platforms for service delivery, etc.

FinTech (financial technology): the expanding use of technology for financial services, including online banking, mobile payment applications, blockchain for money transfers, cryptocurrencies and other innovative financial solutions.

HealthTech (medical technology): the use of information technology and data to improve health services, including telemedicine, medical applications, and the collection and analysis of health data.

*AgriTech (*agricultural technologies): the application of technology in agriculture to optimize production, monitor plants, automate processes and reduce the impact of agricultural activities on the environment.

InsurTech: using technology to facilitate insurance processes, including online policies, using data to assess risk and improve customer service.

LegalTech (legal technology): the use of innovative technologies to improve and optimize legal services and processes in the field of law. LegalTech is used to automate the routine tasks of lawyers, improve the accessibility of legal services and ensure more efficient and accurate work in legal practices.

AdTech: the use of technology to optimize and manage advertising campaigns, including analytics, personalization and automation.

PropTech: using technology to streamline property management, including platforms for search, booking, market analytics and efficient building management.

GreenTech (green technologies): technologies aimed at protecting the environment and reducing human impact on nature, including renewable energy sources, waste disposal, water conservation technologies and other energy and resource conservation solutions.

MarTech (marketing technology): the use of technology to optimize marketing strategies and campaigns, including analytics, marketing automation, CRM systems, and other marketing tools.

RetailTech (retail technology): the use of technology to improve retail processes, including online sales, self-service checkouts, customer behavior analytics, and other solutions.

CivicTech: using technology to improve citizen engagement with government, including electronic voting, open data, online petitions, and other civic engagement tools.

TravelTech (travel technology): Using technology to optimize travel, including online booking, price comparison, navigation apps, and innovation in tourism and hospitality.

AITech (Artificial Intelligence Technologies): the use of artificial intelligence in various fields, including machine learning, natural language processing, computer vision, and other advanced algorithms.

IoT (Internet of Things): a network of physical objects that are equipped with sensors, software and other technological means that allow these objects to collect and exchange data.

CloudTech (cloud computing technologies): the use of cloud computing for data storage, calculations, providing access to programs and services via the Internet.

Virtual Reality (VR) and Augmented Reality (AR) Tech: using virtual and augmented reality to create immersive interactive experiences.

Cybersecurity Tech: development of technologies and tools to protect information from cyber threats, including antivirus programs, network security measures, and other cybersecurity solutions.

These terms represent modern technological trends and directions that are actively developing in various fields of business and society. Each of these areas represents innovations that affect many different aspects of life and business. These areas reflect only a part of how digital technologies affect various sectors of the economy and the activities of society, creating new opportunities and facilitating routine processes.

7.2. Basic concepts of e-business and e-commerce

In the world and in Ukraine, there is an active penetration of information and communication technologies into all spheres of society, as a result of which a global digital economy is being formed. The problem of our country's transition to a new economy is gaining particular relevance, with the approval of which scientific and technical progress in the modern information industry, the introduction of innovative technologies and electronic management will become widespread [40].

The concept of e-business originated in the USA in the 1980s. and was the result of the development of the idea of a global information economy, which was the theoretical basis for the creation of local and corporate information networks with a combination of the use of information technologies (IT) in companies.

Now business is becoming electronic, i.e. commercial actions between partners (purchase/sale of goods or services, operations on the stock market with securities, conclusion and execution of contracts, etc.) take place through the exchange of electronic documents in the information space - that part of reality that causes a person has a special interest and stands out from the general picture of the surrounding objective reality. The information sector of the economy is the basis for the specified transformation of traditional forms of management into a digital economic system.

Digital society is a socio-cultural and economic phenomenon that arises as a result of the use of information technologies in various spheres of life. Among the characteristic features of the digital society, the following are distinguished:

- *Global access to information:*

Internet: People can access information from anywhere in the world thanks to the Internet.

Social Networks: Massive use of social networking platforms to share information and communicate.

- *Big data:* the ability to store, analyze and use large volumes of data for business analytics and trend forecasting.

- *Mobile technologies*: smartphones and tablets: Increasing use of mobile devices (smartphones, tablets) and applications, which facilitates access to Internet resources.

- *Electronic commerce*: the ability to buy and sell goods and services via the Internet, the development of online trade.

- *Cybersecurity:* the number of cybercrimes and the need for security measures.

- *Electronic government* (E-Government): providing citizens with the opportunity to receive documents and services from government bodies via the Internet.

- *Internet of Things (IoT*): expanded use of connected devices that can exchange data and interact with each other.

- *Artificial intelligence and Machine learning:* the use of artificial intelligence algorithms to automate processes and make decisions.

- *Cryptocurrency and Blockchain:* Using cryptocurrencies and blockchain technology for secure financial transactions without intermediaries.

Electronic education (E-Learning): online courses and learning platforms that provide an opportunity to receive education at any time and in any place.

Changing economic models: the development of platforms that allow people to exchange services and resources without intermediaries (e.g. Airbnb, Uber).

These characteristics reflect various aspects of the impact of technology on modern society, from changes in the way we communicate to the transformation of economics and politics**.**

There is currently no generally accepted definition of the concept of «electronic business» (e-business). It can be formulated as:

Electronic business – business activity or economic activity of companies through global information networks, with the aim of making a profit.

One of the actively developing areas of electronic business is electronic commerce. Electronic commerce (e-commerce) is an important component of the digital economy, which creates opportunities for businesses to expand their boundaries and facilitates more efficient and effective interaction between businesses and consumers. E-commerce is what constitutes e-business, it is one way of doing it. E-commerce commerce is a component of e-business.

Electronic commerce – relations aimed at obtaining profit, which arise during the execution of transactions related to the acquisition, change or termination of civil rights and obligations, carried out remotely using information and telecommunication systems, as a result of which rights and obligations arise in the participants of such relations of a property nature [4].

Subject of electronic commerce – a business entity of any organizational and legal form that sells goods, performs works, provides services using information and communication systems, or a person who purchases, orders, uses the specified goods, works, services through execution of an electronic transaction [4].

The concept of «electronic commerce» is broader than Internet commerce, as it includes all types of commercial activities carried out using information and telecommunication systems.

Internet commerce is electronic commerce limited to the use of the Internet only.

Internet commerce does not include: providing banking services through «Client-Bank» systems, commercial activity using VAN networks, mobile commerce, enterprise resource management systems (MPR, ERP, CSRP).

Electronic trade is economic activity in the field of electronic purchase and sale, sale of goods remotely to the buyer by performing electronic transactions using information and communication systems [4].

Electronic information services are paid or free services for processing and storing information provided remotely using information and communication systems at the individual request of their recipient [4].

E-business is more than a simple electronic purchase or sale of goods, it requires the use of network communication technologies to carry out actions with the aim of obtaining profits inside and outside the enterprise. The development of electronic business means the transition to the information space of the main business processes and communication channels, and sooner or later this will affect the activities of all enterprises. Electronic business consists of four stages: marketing, production, sales and payments. If two or more stages of business are carried out using electronic systems, then the business is considered electronic.

Electronic business is the transformation of business processes with the use of Internet technologies, which allows to achieve higher productivity. A business process is a set of interrelated operations, procedures, by means of which a specific commercial (entrepreneurial) goal of the company's activity is realized within the framework of the organizational structure, while the functions of the structural units and their relationship with each other are clearly defined and fixed in advance. E-business is a very dynamic industry.

Nowadays, electronic business technologies are one of the important tools of modern competition. The impact of e-business is changing all forms of activity of large and small enterprises - from product development to selling goods on the market. The main source of market power is intelligence embodied in the organizational structures of research and market corporations that create new information technologies and maintain control over them.

E-business can include a variety of activities, from online shopping and electronic payments to electronic advertising and customer interactions through websites and mobile applications. E-business has become an integral part of modern business, helping businesses improve efficiency, expand audiences, and improve customer relationships.

In general, electronic business management covers the following components:

– e-commerce (online stores, electronic payment systems, electronic trading platforms, marketplaces);

– digital marketing;

– electronic banking and finance;

– Big Data analytics (use of large volumes of data to analyze customer purchasing habits and forecast trends);

– mobile business (development of mobile applications for smartphones and tablets to simplify shopping processes and interaction with customers).

Electronic business is based on the following important technologies:

– network technologies;

– corporate;
– Internet technologies;
– production IT;
– decision support system;
– artificial intelligence technologies.

The process of creating an e-business can be submitted through the following components:

– forecasting;
– synthesis of technological components;
– synthesis of commercial components;
– implementation principles and technologies;
– clearly defined strategies.

The following main types of electronic economic activity can be considered:

– virtual companies;
– electronic wholesale and retail trade, electronic marketing, pre- and post-sale customer support, electronic wholesale and retail financial services, in particular lending, and insurance;
– commercial research of the marketing type;
– electronic advertising;
– commercial operations (interactive electronic order, delivery, payment);
– general development of the product (goods, services);
– distributed joint production of electronic goods;
– electronic business administration (in particular, the field of tax administration);
– electronic trade of goods/services;
– electronic accounting;
– conclusion of agreements in electronic form;
– electronic arbitration administration (i.e. dispute resolution) and the like.

Reasons why companies are moving to the electronic space:

– development of new market segments;
– increasing the level of responsiveness;
– provision of new services;
– cost reduction;
– support of business processes in online mode;

– close partnership;
– round-the-clock access.

Globalization of markets, the emergence of regional economic connections (large electronic trade networks), integration processes open up new opportunities for enterprises. The evolutionary process of e-business development can be divided into several phases, each of which, based on the previous one, constitutes a new level of complexity of business operations and a way of business organization (fig. 1.1).

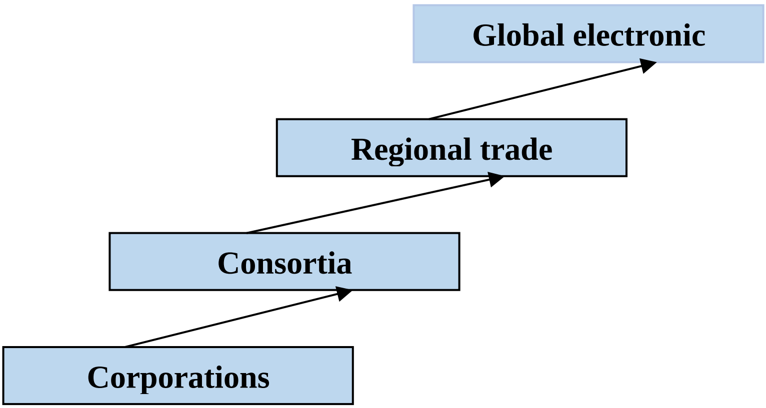

Figure 7.1. Cascade model of e-business development [on the materials 44]

7.3. Principles of e-business functioning

E-commerce operations are now becoming a major part of any business. Companies that actively use Internet technologies have significant advantages over competitors due to the prompt solution of tasks.

E-business is a company's for-profit activity based on the use of digital technologies and the benefits they provide.

Electronic commerce is a component of e-business, it is one of the ways of its implementation. Sometimes this economy is called a network economy (because the structure of the virtual economy is formed from separate segments that are interconnected by a network) or digital. It covers the industry of creating and using new IT products, telecommunications services, e-business, e-commerce, e-markets, e-marketing. M. Castells singles out five principles of the digital economy [71]:

– productivity mainly depends on the use of scientific and technical achievements, as well as on the quality of information and management;

– in developed capitalist countries, the attention of producers and consumers is shifting from material production to information activities;

– deep transformation of the organization of the production process (from standardized mass production to flexible production and from vertically integrated organization to horizontal network relations between divisions);

– the global nature of the economy, in which capital, production, management, markets, labor, information and technology are organized regardless of national borders;

– the revolutionary nature of technological changes, based on IT, which transforms the material basis of the modern world.

There are three components of the electronic economy:

– electronic commerce;

– IT infrastructure;

– e-business infrastructure.

K. Kelly [44] formulated the main principles of the functioning of electronic commerce:

The principle of unified system communication. Personal computers and other computer devices are interconnected through telecommunications and form a worldwide network.

The principle of completeness. In the electronic economy, the value of a product/service is determined by the variety of offers. This means that the more products there are in the network, the more valuable they become. However, this principle contradicts well-known axioms that reflect the relevant laws of traditional economics (the first axiom: the value is determined by the rarity of the product, since its quantity is limited; the second axiom: the excessive production of goods leads to a significant loss of its value). The exponent principle - the development of the electronic economy is exponential, which is connected with the non-linear nature of the increase in the number of its elements.

The principle of increasing effect. The arrival of new participants in the electronic economy leads to an increase in the size of the network. Thanks to the increase in Internet volumes, an increasing number of businessmen get to it. In the end, the volume of sales of goods (services) increases, which leads to an increase in the amount of profit received by a participant in business processes. Principle of reverse pricing. Its essence is that the prices of all the best goods (services) found in the electronic economy have a clear tendency to decrease from year to year. In order to survive in the fierce competition, Internet companies are forced to constantly deliver new products to the market. For this reason, the importance of banner advertising and the value of innovations are increasing in the Internet economy. The reverse pricing system applies to microprocessors, telecommunications, chips, and the like. Prices for telecommunication services are decreasing, and telecommunication capacity is growing very quickly.

The principle of «free of charge». In the electronic economy, the value of a product (service) is directly proportional to the scale of its distribution. Therefore, the increase in the number of copies provided to users (for example, software products) leads to an increase in the value of each of them. By selling product options that will be upgraded in the future, and additional service to it, the Internet company can constantly and quite earn enough. At the same time, it continues to distribute the initial version of the product for free.

Basic rules of operation of Internet companies.

1. It is necessary to deliver free services and products to the Internet market to expand the circle of future buyers of the modernized product.

2. Offering one product for free makes other products easier to sell.

3. In order to form in the future the volume of demand for the product required by the entrepreneur, it is necessary to offer the initial version of this product to interested buyers for free use. Compliance with the listed rules is the basis for ensuring a reliable presence on the

virtual market and successful functioning of the Internet company within the framework of the digital economy.

The principle of loyalty. The essence of this principle is that the commitment of buyers of a certain Internet company will be in the simultaneous use of the network and network platforms. If in the traditional economy the level of quality of life of each citizen mostly depends on the efficiency of the functioning of the national economy, then on the Internet the well-being of the citizen is determined by the level of prosperity of the network. The conclusion follows from this: in order to ensure the highest possible standard of living for every citizen, it is necessary to contribute in every possible way to the expansion and improvement of the network and the opportunity to work in it.

The principle of revaluation of values. It consists in the gradual replacement of material values by a system of knowledge and informational values. Part of the value of the information component in the value of modern goods is constantly growing. According to this principle, suppliers of products on the Internet make their offer catalogs taking into account a specific group of buyers or market segments.

The principle of globalization. The electronic economy is a set of closely related markets on a global scale. The geographic location of Internet companies is of no fundamental importance. Any business in the network spreads almost instantly to all countries of the world. Competitors appear at the same speed, which is associated with the growth of various types of risks. Powerful American Internet companies engaged in business in the field of telecommunications face very serious competition from similar companies in the European Union.

The principle of chaos. Its essence lies in the fact that the viability of companies in the electronic economy is provided with the help of a periodically and quite often emerging state of imbalance. When it appears, the old electronic business is destroyed and at the same time favorable conditions are created for the birth of a new, more efficient business. Practice has established that the term of existence of a new business in the network is much shorter than in the traditional economy. At the same time, with the destruction of old jobs, an incomparably greater number of new jobs appears. According to some experts, the electronic economy functions in conditions of periodic chaos.

The principle of decentralization. Anarchy is the basic mode of existence of the electronic economy. It does not have a central planning body that would coordinate and indicate the desired direction of movement of all network participants. The electronic economy is practically unregulated.

The principle of cloning. In the electronic economy, the real number of buyers, homogeneous groups of which form new segments of the virtual market, is growing at an exceptionally high rate every year. At the same time, trade borders disappear. The process of electronic commerce (ET) is becoming truly free on a global scale. If television needed 113 years to form a contingent of permanent users of 50 million people, radio - 38 years, then the Internet - only 5 years.

7.4. E-commerce as a component of e-business

E-commerce is a technology that provides a complete closed cycle of business operations, which includes ordering goods/services, making payments using digital technologies.

In general, the "electronic commerce system" provides a certain Internet technology that offers the following opportunities to system participants (Fig. 7.2):

- manufacturers and suppliers of goods and services of various categories - to present goods and services on the Internet (in particular, online services and access to information resources), accept and process customer orders via the Internet;
- buyers (clients) - view catalogs and price lists using standard Internet browsers.

Among the functional capabilities implemented by e-commerce systems are the following:

- placing orders according to catalogs and price lists (orders are stored in a single database);
- connection of Internet applications with the internal system of record keeping;
- self-registration of users;
- the possibility of selling products of various categories via the Internet;

- processing of orders according to the standard scheme (registration, delivery, reporting and financial documents);
- making online payments.

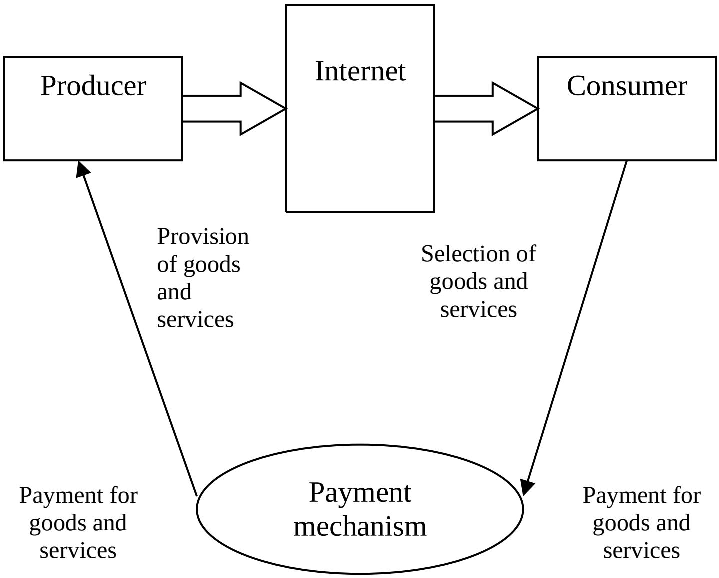

Figure 7.2. Scheme of e-commerce

The subject of e-commerce can be any form of commercial operations, for example, trade, distribution agreements, commercial representation and agency relations, factoring, leasing, construction of industrial facilities, provision of consulting services, engineering, purchase/sale of licenses, investment , financing, banking services, insurance and other forms of industrial or business cooperation [42]. All processes that make up the content of an electronic agreement, for example, market research, search for a commercial partner, payment operations, risk insurance, and the like, are also the subject of e-commerce.

E-commerce can be provided by various electronic devices, in this regard, it is divided into the following types:

M-commerce (Mobile commerce) – commerce using mobile communication services.

T-commerce (Televigion commerce) is commerce using interactive digital television.

V-commerce (Voice commerce) – voice commerce. These are automated transactions on the Internet, which are carried out through voice portals using a computer or phone thanks to voice commands. Voice portals, such as brokerage systems, can control home devices over the Internet.

U-commerce (universal commerce) – universal commerce is the ability to perform commercial actions with an electronic device at any time.

D-commerce (dynamical commerce) is dynamic pricing that allows sellers to achieve the highest transparency of operations and conduct electronic transactions on the most favorable terms.

China is also the leader in terms of the volume of market e-commerce, which is $562.66 billion, of the total number of online purchases, 33% are made from mobile devices (tablets and smartphones), 67% – from desktop computers [60].

The second place is occupied by the USA with a market volume of $349.06 billion. There are about 191.1 million Internet users in the USA, of which 13% are preferred by buyers using tablets, 15% – smartphones, and 72% – desktop computers. In general, more than half (57.4%) of American stores operate online [60].

The United Kingdom, with a market volume of $93.89 billion, is in third place, with online sales accounting for 13% of total retail sales. 12.1% of purchases are made from tablets, 16.5% from smartphones, 71.4% from desktop computers [60].

The world ranking of retail websites by the volume of visits is presented in fig. 7.3.

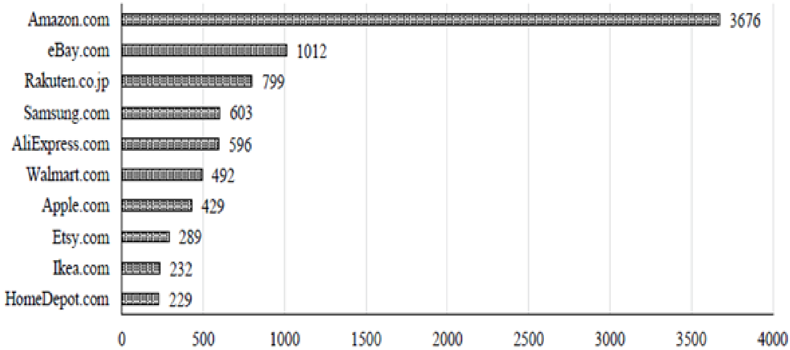

Figure 7.3. Leading retail websites in the world by visits in 2020, million/persons on average per month [74]

The most powerful companies in global e-commerce are Amazon, Google and Facebook. Each of these giants has played a role in shaping the e-commerce industry. And if earlier they each worked in their own niche, now they increasingly compete with each other and pose a threat to other brands and retailers. The main current trends in electronic commerce [60]:

1. Trade without barriers. Trading should become easier. Mobile commerce, social commerce, voice assistants, messengers, augmented reality are turning into a single and most important trend – trade without barriers. 83% of consumers use messengers to learn more about products;

2. Growth of subscription purchases. One of the popular types of e-commerce is subscription shopping. In particular, Amazon offers more than 150 options for this service. Its essence is that the client chooses a list of goods that he buys regularly and subscribes to them;

3. Purchase with one button. Satisfying consumer needs within the same mobile applications. They will allow shoppers to navigate apps with just one hand and make purchase decisions in seconds. The emergence of Google Shopping, Facebook Marketplace and Instagram Checkout reinforce this trend;

4. Direct sales from manufacturers. Back in 2017 more than half of Americans bought goods from manufacturers whenever they got the chance. For example, Nike in 2017 launched the sale of its products

on Amazon, but after two years turned this initiative and focused on direct sales to consumers through its stores. In 2020, direct sales from manufacturers is one of the most influential trends.

In the top of the largest marketplaces in Ukraine: Rozetka, Prom, Allo, Bigl and Epicentr (fig. 7.4). The most popular monetization model is sales commission.

Crowdsourcing is the newest form of e-commerce in the context of the deployment of Industry 4.0. According to J. Howe's definition, "crowdsourcing, crowd - crowd and sourcing - "use of resources" - is the transfer of some production functions to a certain circle of people, solving significant tasks by volunteers. Nowadays, crowdsourcing is a real phenomenon of the digitalized economy, thanks to which businesses are presented with the opportunity to obtain a synergistic effect through the use of the collective mind for the purpose of generating innovative ideas, including the masses in the production cycle of the production of goods and services, reducing costs, etc. [75].

The second newest form of e-commerce is crowdfunding, which is aimed at raising funds to finance innovative projects.

Figure 7.4. Top marketplaces, classifieds and aggregators in Ukraine [30]

Among the other newest forms of e-commerce in the digitalization of the world economy, we can single out virtualization, sensitive client technology, and cloud technologies that allow companies to strengthen their market leadership. In turn, virtualization serves as the basis for multifunctional services, the ability to order the necessary configuration of the computer infrastructure system with the necessary software for the company on remote access. Therefore, reducing costs and solving information system reliability problems is now available not only for large businesses, but also for small and medium-sized enterprises.

Therefore, the processes of digitalization of the world economy have opened opportunities for businesses to search for new ideas based on the analysis of operational business analytics and to provide quick feedback to customers, to instantly respond to the innovative expectations of potential consumers.

It should be noted that the e-commerce market is one of the most dynamic and promising in the structure of the information economy. For the further development of the information sector of the economy and the e-commerce market, the following is recommended:

- implementation of full informatization of the state sector of the economy in order to reduce the level of corruption;

- encouraging investment flows in the development of ICT and information infrastructure by providing tax incentives in the form of tax investment credits.

- stimulating the development of innovative activities at the state level, since ensuring the development of the digital society has a direct impact on increasing sales of intelligent products in the field of electronic commerce.

Ukraine is witnessing a rapid development of information and communication technologies and the e-commerce market. In particular, the growth of the e-commerce market, which is caused by such factors as: the increase in the number of Internet users and e-buyers under the influence of the availability of information and communication technologies, the quantitative increase of Internet stores and the expansion of their activities. In the global dimension, the creation of the regime of the greatest promotion of the development of e-commerce in

Ukraine is the foundation for increasing the competitiveness of Ukrainian entities on the world market.

The development of e-commerce in the digital economy is due to numerous trends that determine the direction of its growth.

Directions for the development of e-commerce in Ukraine in the conditions of the digital economy:

1. Growth of sales on the Internet, in particular the development of mobile commerce: development of mobile applications and optimization of websites for mobile devices.

2. Use of artificial intelligence technologies.

3. Implementation of new payment methods, such as digital money, crypto-currencies, use of braids by QR code.

4. Visualization of e-commerce (use of augmented and augmented virtual reality AR/VR technologies).

5. Development and distribution of the dropshipping business model for online sellers.

6. Using a personalized approach, taking into account the individual preferences and purchase history of each user to ensure a more satisfying shopping experience.

These trends not only shape the future of e-commerce, but also provide businesses with the opportunity to adapt to the rapidly changing digital environment and meet the growing expectations of consumers.

The development of electronic commerce has a stabilizing effect on the development of the world economy for the following reasons:

– acceleration of the pace of creation of a single information space: mechanisms of information interaction of almost all subjects of the world market are being developed;

– decentralization of resources, stimulating independent development of market entities;

– acceleration of the turnover of monetary resources through the use of electronic payment systems;

– decrease in the volume of speculative capital (of intermediaries who are not producers) and, therefore, increase in the volume of investments in the production sphere;

– creation of conditions for open competition in the markets of goods and services;

– acceleration of the process of promoting new goods and services to the market and bringing them to the consumer in a convenient form.

7.5. E-commerce models

Depending on the participants in the relationship, e-commerce is divided into sectors.

The main sectors are [44]:

B2B – (business to business) sector of interaction between legal entities and organizations.

B2C – (business to consumer) sector of interaction between legal entities and individuals.

B2G – (business to government) sector of interaction between legal entities and government organizations.

C2C – (consumer to consumer) – sector of interaction between individuals.

G2C – (government to consumer) is a sector of interaction between government organizations and individuals.

The entity identified by the first letter of the abbreviation acts as a seller or party providing services.

C2B, G2G, C2G, G2B – include the same participants, differing only in the nature of their interaction.

Models of relations between participants in the electronic commerce process.

B2B – (business to business) includes:

– trading and purchasing platforms;
– electronic showcases and catalogs;
– electronic trading lines;
– electronic stores;
– electronic exchanges;
– electronic auctions;
– industry trading platforms;
– full-cycle supplier support systems (SCM);
– distribution management systems;
– systems of the full cycle of customer support (CRM);
– outsourcing;

– electronic payment systems;
– virtual enterprises;
– Internet trading systems;
– Internet incubators;
– Internet advertising;
– mobile commerce systems;
– systems of insurance and reinsurance.

B2C – (business to consumers) covers:
– shopping rows;
– electronic showcases and catalogs;
– electronic stores;
– electronic auctions;
– Internet trading;
– electronic payment systems;
– Internet insurance;
– telework systems;
– Internet advertising;
– sponsorship programs;
– distance education;
– interactive television;
– electronic mass media;
– tourist services.

B2G – (business to government) covers:
– participation in electronic auctions for the purchase of products for state needs;
– execution of government orders;
– provision of tax, statistical, customs and other reporting.

C2B – (consumers – businesses) covers:
– private services;
– participation in surveys and other advertising promotions;
– participation in partnership and sponsorship programs.

C2C– (consumers to consumers) covers:
– bulletin boards;
– Internet auctions;
– B2B systems;
– viral marketing systems.

C2G – (consumers to government) covers:

– participation in elections;
– payment of taxes, fees, fines;
– participation in public opinion polls;
– submission of applications, complaints, appeals from citizens.

G2B – (power to business) covers:
– system of distribution of state orders;
– ensuring contact with tax, customs authorities, state certification and licensing authorities, administrations, etc.
– legal and information and reference services, including geoinformation systems.

G2C – (Government to Consumers) covers:
– social service systems (payments, benefits, benefits, etc.)
– utility service systems;
– legal and information and reference services.

G2G – (power to power) covers:
– automated systems of cooperation with customs, tax, law enforcement, etc.
– information and reference services.

The classification of e-commerce models is shown in fig. 7.5.

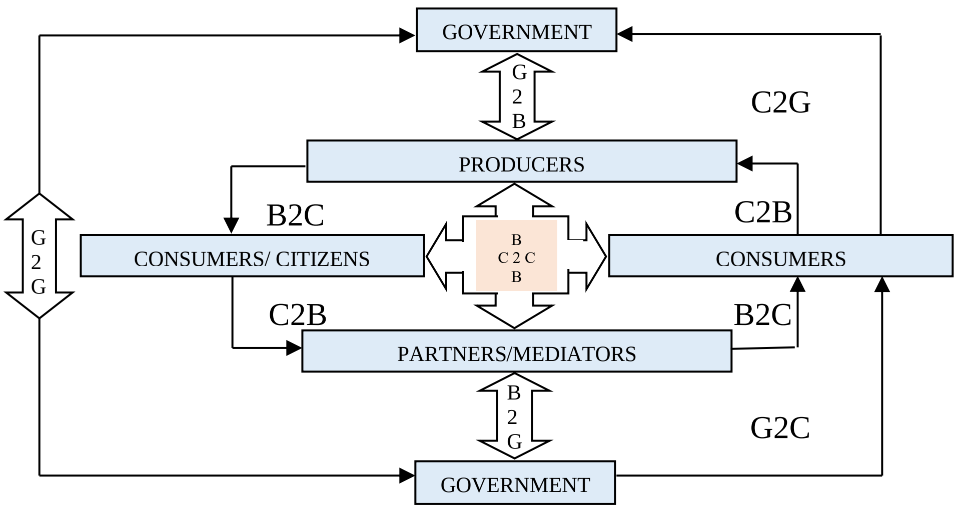

Figure 7.5. E-commerce models

7.6. Advantages and disadvantages of the development of e-commerce

E-commerce has a number of advantages [51]:

1. Offers global access to global markets. The company can expand its customer base, as well as the range of products.

2. Allows to improve business contacts. Sellers of industrial goods can establish closer ties with buyers (for example, B2B markets).

3. Availability of information about goods and services in online stores in real time. Allows buyers to get product samples quickly, easily and for free.

4. Allows to reduce costs. Electronic packaging significantly reduces the cost of operation, and this, in turn, leads to lower prices for consumers.

5. Allows you to receive high-quality services. E-commerce allows suppliers to increase their competitiveness by becoming closer to the customer.

6. Reduces the number of storage media required for data storage.

7. Reduces the time of the product's entry into the market and the process of the company's adaptation to market changes.

8. Absence of customs taxes related to electronic sales.

9. Emergence of new business models. New business models - virtual enterprises, virtual agents, outsourcing technologists and telerobots significantly increase the efficiency of commercial activity. In addition to transforming the market for existing goods and services, e-commerce opens up the possibility of completely new products and services. For example: insurance, brokerage services, electronic supply and support services.

10. Increases the level of consumer loyalty to the brand. The quality of service on the Internet is constantly improving: the consumer can get new information about the company and products at any convenient time.

We will also consider the advantages of e-commerce from different sides of participants in the formation and development of e-commerce [55, 74].

For consumers [55, 74]:

- lower prices compared to traditional stores (due to the reduction of non-production costs, e-commerce companies have the opportunity to optimize their pricing policy);

- availability of information about goods and services in online stores in real time 24/7.

- the use of trading platforms, online stores, aggregator sites of online stores for the purpose of studying the market of goods and services, comparing their characteristics, prices (in particular, openness of information, pricing policy does not allow unscrupulous sellers to unreasonably inflate prices, since the consumer can quickly compare prices and choose a more favorable offer);

- the opportunity to buy elite, rare goods in foreign stores, at auctions, reserve seats in hotels of different countries and receive other high-quality services of foreign companies;

- the availability of search systems that allow consumers to find information about the necessary goods and services (search services are provided either directly by manufacturers or by specialized sites that aggregate information from the sites of electronic stores);

- reducing the probability of making a transaction with unscrupulous, inexperienced sellers;

- the ability to quickly and simply get free samples and use the branded delivery of goods from the manufacturer;

- digital products, intangible goods can be immediately delivered to the consumer through network channels;

- the possibility of exchanging reviews about goods and services, as well as their search through social networks, communities, blogs, etc.

- greater openness of companies to consumers.

For manufacturers [55, 74]:

- reduction of the volume of initial investments in business (the need to buy or rent large retail spaces, retail equipment disappears), non-production costs (advertising costs, costs related to customer service and information support);

- reduction in the number of personnel and payroll, due to full or partial automation of processes, simplification of communication within the enterprise.

- reduction of the production and sales cycle, support of business processes in online mode;

- the convenience of conducting marketing research (in particular, qualitative customer segmentation, the use of CRM, Customer Relationship Management, Google Analytics, Yandex metrics, etc.);

- great potential for development of the system of working with customers, without the risk that the system will "find" another job, as often happens with experienced sellers;

- provision of new types of services and development of new market segments, global access to world markets;

- equality of terms of access to the market for both large corporations and small enterprises;

- targeted targeted impact on the consumer segment using individual electronic means of communication;

- the possibility of working in 24-hour access mode and interactive communication with the consumer;

- favorable terms of taxation and payment of customs payments;

- increasing the level of consumer loyalty to the brand.

For business partners [55, 74]:

- efficiency of obtaining information, including during international operations;

- improvement of business contacts (e-commerce - B2B), the possibility of cooperation with partners regardless of geographical boundaries.

For the state and society [55, 74]:

- a wide range of goods provided to the population in various areas;

- increasing the power of the national economy, inflow of investments, development of infrastructure, science and technology, raising the standard of living of the population, reducing the "digital" gap;

- creation of new jobs;

- increasing the level of national security;

Disadvantages and factors hindering the development of electronic commerce [55, 74]:

1. The Internet can destroy the institution of trade intermediaries;

2. Competition moves from the local to the global level;

3. Problems of copyright protection;

4. Problems of information security and cyber security;

5. Legal uncertainty.

5. The issue of transparency. Through means of identification of the user's identity, it is possible to control people, check their activities (the unique identification code of a person can become an object of threat to a person).

6. Some segment of the population that does not have access to the Internet remains unreached.

Electronic commerce has negative aspects, which were grouped according to the same principle as advantages [55, 74].

For consumers [55, 74]:

- through means of identification of the user's identity, it is possible to control it, check its activity;
- the segment of the population that does not have access to the network remains unreached, moreover, not all types of goods are represented in the network;
- consumers cannot fully verify the quality of the product or service before receiving it.
- the need to pay an advance payment in full or in part from the purchase price;
- complex procedure for returning goods in case the customer wishes to return the purchase;
- the logistics of order fulfillment has a speed, or productivity, inadequate to the speed of the Internet, in addition, the cost of small orders increases due to postal services, money transfer services;
- chaos, confusion and bulkiness of the Internet;
- lack of motives for visiting stores that are not directly related to making purchases.

For manufacturers [55, 74]:

- the e-commerce system misses the effect that is possible only with personal contact between the buyer and the seller and which is achieved due to the charm of the sellers, their intuitive abilities and the ability to sell even a product that is not too desirable for the buyer;
- increased competition, its transition to the global level, moreover, the low level of network coverage of the population is characteristic of developing countries;

- the need to provide a powerful technological basis for the functioning of e-commerce, its constant updating requires significant investments of financial resources;

- pricing problems, as due to the openness of information, manufacturers cannot raise prices;

- the complexity of organizing activities and developing an online storefront (high cost, the need to coordinate the work of the sales department, accounting, automation of the processing of payment bank cards and electronic money);

- due to the openness of information, the probability of violation of intellectual property rights, plagiarism, financial fraud increases, therefore the problem of information security arises;

- the uncertainty and complexity of the organization of accounting, internal control, the reorientation of information flows from traditional paper media to electronic form, which under the conditions of lack of knowledge of employees can make it difficult to make management decisions;

- insufficient awareness of employees with modern information technologies and systems, and highly qualified personnel usually require significant labor costs;

- the need to involve specialists who will administer the site and update the content of the information resource.

For business partners [55, 74]:

- under the conditions of existence of e-commerce, mediation loses its positions, and therefore may disappear altogether;

- the need for increased trust between partners, financial and other guarantees, since the real existence of the counterparty is uncertain;

- lack of familiarity of counterparties with the rules of conducting foreign business, lack of unified standards of interaction in the network can lead to misunderstandings and conflicts;

- the difficulty of coordinating economic relations that take place on the virtual market with the material aspects of these relations.

For the state and society [55, 74]:

- uneven development of e-commerce in different regions, industries and in different parts of production;

- for countries with not high economic development, e-business is not a priority area of development, in addition, it requires investments in the development of science, technology, and infrastructure;

- monopolization of markets, since the small business sector cannot always withstand the challenges of a competitive environment;

- as a result of the complication of control of commodity and cash flows in the network, legal uncertainty, favorable conditions are created, which are often used by unscrupulous taxpayers to carry out illegal activities, in particular, tax evasion or illegal minimization of tax payments, various types of fraud and abuse.

Electronic commerce, as the main component of e-business, is one of the most dynamically developing sectors of the economies of leading countries.

The annual increase in the volume of global retail trade carried out through e-commerce is from 15% to 30%. Such growth is due to the rapid development of the Internet and the development of information and communication technologies.

The economic basis of the global electronic business consists in the radical expansion of the audience, increasing the effectiveness of marketing, accelerating the processes of buying and selling various types of goods and services. Instead, e-commerce uses and develops business opportunities, shapes its new properties and directions, and transforms business.

The formation and development of the e-commerce market in Ukraine takes place during the period of development of the digital economy and elements of its infrastructure. This stage coincides with radical changes in the world economy, which are determined by the processes of globalization. These processes lead to a sharp increase in cross-border movements of goods, capital, services, technologies, and information.

7.7. Performance indicators of e-commerce development in the digital economy

The effectiveness of e-commerce development can be measured using various indicators that indicate the success of a business in the online environment. E-commerce performance indicators help assess how effectively an online store or e-commerce platform is working. Key performance indicators for e-commerce:

1. Conversion Rate: the percentage of website visitors who make a purchase. A high conversion rate indicates the effectiveness of the website's impact on visitors.

$$CV = \frac{Number\ of\ orders}{Number\ of\ visitors} * 100\%$$

2. Average Order Value, AOV: the average amount of money that customers spend during one order. An increase in the average check increases the amount of profit.

$$AOV = \frac{Total\ income}{Number\ of\ orders}$$

3. Number of purchases per customer (Purchase Frequency): the average number of purchases made by one customer in a given period of time. A high frequency of purchases may indicate customer loyalty.

$$PF = \frac{Total\ number\ of\ purchases}{Total\ number\ of\ unique\ customers}$$

4. Bounce Rate: the percentage of users who leave a website immediately after viewing one page. A low bounce rate indicates that users are finding what they need on the site.

$$BR = \frac{The\ number\ of\ visitors\ who\ immediately\ left\ the\ site}{Total\ number\ of\ visitors} * 100\%$$

5. Number of Unique Visitors (Unique Visitors): the number of unique users who visited the website during a certain period. An increase in this indicator may indicate an increase in the volume of the audience.

This indicator is calculated using analytical tools such as Google Analytics.

6. Number of Repeat Purchases (Repeat Purchase Rate): percentage of customers who made more than one order. A high number of repeat purchases increases customer loyalty.

$$RPR = \frac{Total\ number\ of\ unique\ customers}{The\ number\ of\ customers\ who\ made\ more\ than\ one\ order} * 100\%$$

7. Level of Out-of-Stock Rate (Out-of-Stock Rate): the percentage of goods that are out of stock and cannot be shipped to customers. A low out-of-stock rate improves customer satisfaction.

$$Out\ of\ Stock\ Rate = \frac{The\ total\ number\ of\ products\ in\ the\ assortment}{The\ number\ of\ products\ that\ are\ not\ in\ stock} * 100\%$$

8. Return on Advertising Spend, ROAS: a measure that indicates how much money a company received as a result of spending on advertising campaigns. A high ROAS indicates the effectiveness of advertising costs.

$$ROAS = \frac{Revenue\ from\ advertising\ campaigns}{Advertising\ campaign\ costs} * 100\%$$

9. Net Profit: the amount of money the company received after deducting all expenses. This is one of the main indicators of the financial efficiency of a business.

$$NP = Total\ income - General\ expenses$$

10. LTV або Lifetime Value: «user lifetime value». A metric that shows how much money, on average, one active user makes for the entire time of using the product. The metric indicates the customer's lifetime value, i.e. the total amount of money the customer spends during the entire time they remain a customer.

$$LTV = Average\ turnover\ per\ month\ from\ one\ client \\ * Average\ turnover\ per\ month\ from\ one\ client$$

Monitoring and analyzing these metrics helps LTV businesses determine the effectiveness of their e-commerce strategies, identify weaknesses, and develop strategies to increase profitability and customer satisfaction.

TEST QUESTIONS:

1. What is called electronic business?

2. What is e-commerce?

3. Describe the main areas of activity of the digital economy?

4. What is the difference between the tools of commercial activity in the traditional and digital economy?

5. How does the development of electronic commerce affect the development of the world economy?

6. Name the main models of electronic commerce?

7. Describe each of the e-commerce models?

8. Describe the current state of the e-commerce market in the world and in Ukraine?

9. What legal support for e-commerce exists in Ukraine?

10. Performance indicators of e-commerce development in the digital economy?

CHAPTER 8.
MANAGEMENT INFORMATION SECURITY IN THE DIGITAL ECONOMY

8.1. The role and place of information security in the development of the digital economy

Information security is one of the crucial components of global security, an integral condition of globalization, and a factor influencing global processes across all spheres of activity. The role of information security in the process of globalization is increasingly strengthened, and conversely, the impact of global processes on information security and its associated economic, national, and global security in the conditions of an information society – a new stage in human development.

The global process of informatization of society, reflecting the general laws of civilization genesis, has now encompassed all areas of human socio-cultural activity. The rapid development and widespread adoption of new information and communication technologies bring about fundamental changes in the management of economic systems at various levels. The formation and level of development of information, information resources, and the entire information space are the main characteristics of the development of any socio-economic system at macro and micro levels.

The features of unrestricted and uncontrolled influence, unauthorized access, as well as the emergence of computer viruses and other threats, necessitate ensuring information security. This is a crucial part of the economic security of a state and national security as a whole.

The life of society and its information security depend on the stable functioning, resilience, reliability, and readiness of electronic communication networks. Thanks to rapid technological progress, several critical issues arise regarding the organization of information processing, storage, dissemination, and protection in global information and communication systems. Information technologies and advanced telecommunications infrastructure play a decisive role in enhancing productivity in production, administrative and economic management, expanding information interaction among people, disseminating mass information, and the process of societal intellectualization.

Information security in the digital economy plays a significant role, given the enormous volume of data and information in the online environment. This has a substantial impact on businesses, government structures, and every internet user. Information security is a key element of the digital economy, providing a secure and reliable infrastructure for data exchange, thereby ensuring the stability and development of the digital world.

In the context of the digitization of modern society, information security becomes exceptionally relevant due to the following events:

1. Data volume increase: In the digital era, a vast amount of data is processed daily, including personal data, corporate information, medical records, and more. Ensuring the confidentiality of this data is a critically important task.

2. Growth in the number of threats: Digital transformation leads to an increase in cyber threats. Hacker attacks, phishing, ransomware, DDoS attacks – these threats become more inventive and aggressive.

3. Scale of attacks: Modern attacks can impact millions of users or large corporations simultaneously, significantly increasing potential losses.

4. Internet of Things (IoT): With the development of the Internet of Things, every aspect of our lives becomes vulnerable to attacks. From household devices to large industrial systems – all of them can be exposed to attacks if not properly secured.

5. National security: Cyberattacks on government structures, including governing bodies, critical infrastructure, and defense systems, can have a serious impact on a country's security.

6. Trust of consumers and business partners: In the virtual world, trust plays a crucial role. If users and business partners do not trust the security of your business environment, it can affect your reputation and customer relations.

7. Cost-risk ratio: Losses associated with cyber threats can be significant. Investments in information security are beneficial when compared to potential losses from attacks.

In general, information security is an integral part of digital transformation, and its relevance only increases in the context of rapid technological development and the growing number of connections in the digital space.

Information security is of vital importance for information technologies to meet the expectations of the business world, consumers, and governments and to genuinely provide all the potential benefits offered by information and communication technologies.

Information security in global processes acquires special significance, and due to its close interdependence with economic and national security, it makes a significant contribution to global security. Global security refers to a state of global processes and the forms of their realization in which the following are ensured:

- harmonious combination of interests of peoples, nations, states, and the interests of all humanity;
- effective resolution of tasks facing humanity and individual state, regional, and local administrations:
- comprehensive development and provision of the needs of every individual.

The impact of global processes on information security, its role, and its interrelation with economic, national, and global security in the construction of an information society are illustrated in fig. 8.1.

Global security has a fundamental nature and can be achieved through the necessary provision of its components.

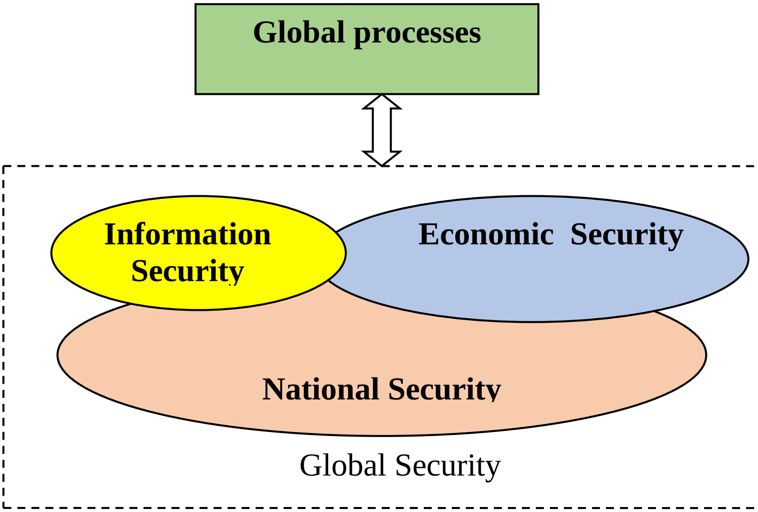

Figure 8.1. The role and place of Information Security in the globalization process

Components of global security include: national, economic, political, information, technical, physical, social, military, environmental, resource, food, energy, financial-monetary, price, demographic, fire, medical, psychological, mental, and criminal security (fig. 8.2).

The development of information, the possibilities of unrestricted and uncontrolled influence, unauthorized access, computer viruses, and other factors have posed challenges to society in terms of information security. Information security should be carried out comprehensively and systematically, utilizing a full set of measures (organizational, technical, hardware-software, etc.) to prevent information pressure and any other hazards altogether.

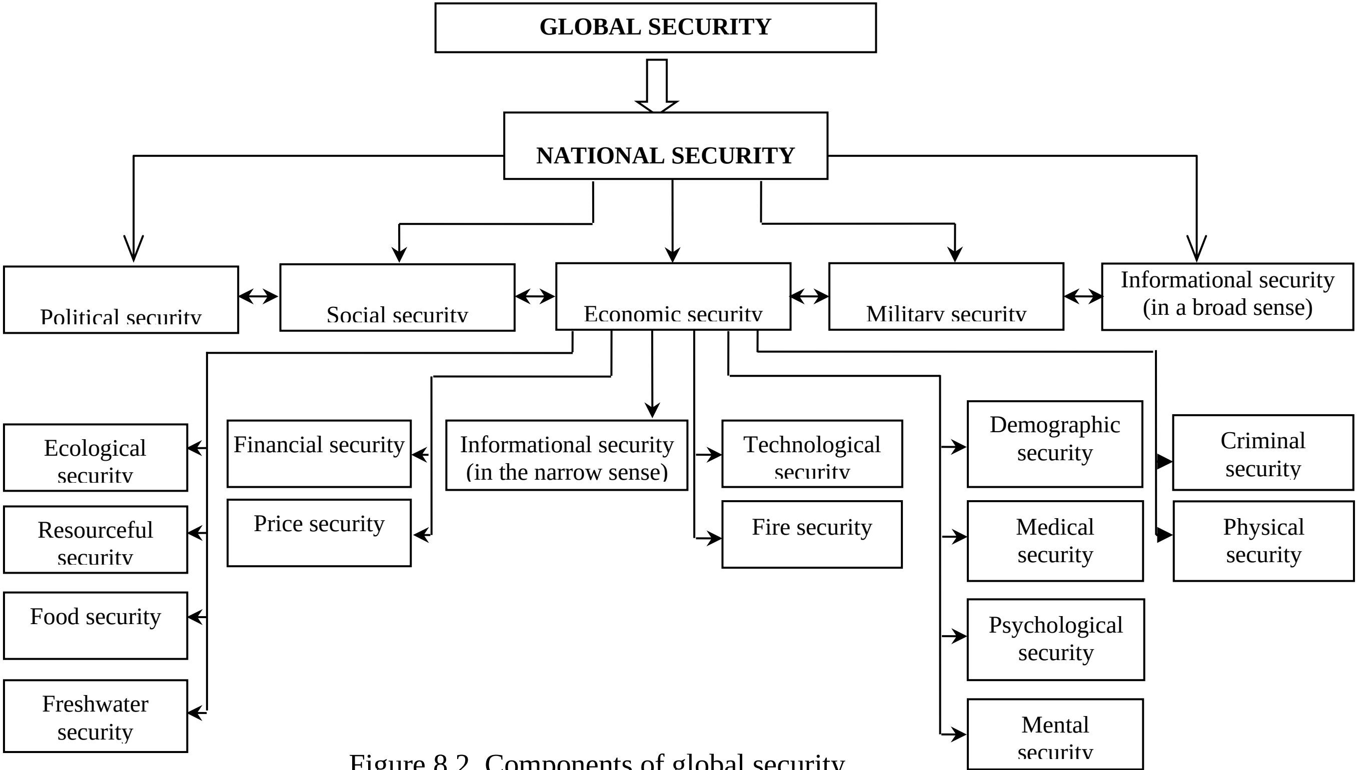

Figure 8.2. Components of global security

Clearly, the emergence of an information society raises critical questions about the information security of the state, individuals, and society, as well as the creation of an effective system to ensure the rights of citizens and social institutions to freely obtain, disseminate, and use information. This issue cannot be ignored, especially since it has become highly relevant for our country.

Information security is a narrower concept and is considered as a component of national security. Information security includes the protection of information networks, resources, software tools, intellectual property objects, and other intangible assets, including the property interests of business entities.

In the era of globalization, the significance of issues related to information security is increasing, specifically:

- the emergence and growth of cybercrime and cyberterrorism;
- the development of specific types of information weapons and the conduct of global information warfare;
- the loss of national culture or its fusion with others, influencing the cultures of countries worldwide and the mentality of other nations;
- the stimulation by informationally advanced states of the "brain drain" and capital flight;
- the emergence of phenomena such as «information explosion», «information hunger» and «information wars»;
- the complexity of addressing issues related to preserving state, commercial, service, and personal secrets, given the low level of domestic information technologies, leading to the construction of Ukraine's information infrastructure based on imported equipment and technology;
- the development of telebiometrics and sensor networks in the interaction between people and the environment.

Digitization and digital transformation of business allow for improving information security by implementing new technologies and strategies. Here are several ways to enhance information security in the context of digitization and digital transformation of business:

Data encryption: modern encryption algorithms protect data during transmission and storage, ensuring confidentiality and complicating unauthorized access.

Redundancy and backup of data: backing up data and using redundant storage systems help avoid data loss in the event of cyberattacks or technical failures.

Multifactor authentication measures: two-factor authentication and other multifactor methods enhance the security of system and application access.

Threat monitoring and analysis: monitoring and analysis systems identify unusual activity and potential threats to security.

Training and awareness of users: training staff to use new technologies and identify threats. Informed users can be the first line of defense against social engineering attacks.

Protection against mobile threats: given the increasing use of mobile devices, ensure their security against viruses, phishing, and other mobile threats.

Internet of Things (IoT) security: if your business uses IoT devices, make sure they are protected against attacks and have updated software.

Collaboration and information exchange: collaborate with other companies and organizations to share information about new threats and best practices in information security.

Continuous improvement: information threats are constantly changing. Constantly improve your systems and procedures.

Information security cannot be addressed without the introduction of new ideas, new knowledge, and new policies in the field of informatization. Conceptually, proposals for the broad involvement of domestic scientists and manufacturers in solving this problem as a component of national security are essential. The trends of development in the modern world are characterized by the creation of a single global information space on the planet, making the issue of information security a collective problem rather than that of an individual country.

8.2. Essence and content of concepts in the field of information security

The concept of «information security». There are numerous works [10, 12, 15, 24, 26] that explore various aspects of the concept of "information security" from different perspectives. The notion of information security can be considered in a broad and narrow sense.

Information security (in a narrow sense) is a necessary but non-negative component of other types of security. Information security is an inseparable part of political, economic, military, social, and other components of national security. Information security (in a narrow sense) is considered as one of the components of economic security because the information circulating within a enterprise has a commercial nature and affects the economic performance of the enterprise. Information security (in a narrow sense) is viewed as the information security of an enterprise – the state of protecting the information of the enterprise from destabilizing influences of external and internal threats.

Information security (in a broad sense) is an independent type of security alongside national, economic, military, social, and political security. Information security (in a broad sense) is seen as the information security of the state – a component of national security that characterizes the state of protection of national interests in the information sphere from external and internal threats.

The concept of «information security» characterizes the state (property) of information protection for individuals, society, and nature under possible threats and is achieved through a system of measures aimed at:

- preventing threats: preventing threats involves preventive measures to ensure information security by preventing the possibility of their occurrence;
- detecting threats: Detecting threats involves systematic analysis and control of the possibility of real or potential threats and taking appropriate measures to prevent them;
- localizing criminal actions: Localizing criminal actions involves taking measures to eliminate the threat or specific criminal actions;

- eliminating the consequences of threats and criminal actions and restoring the status quo.

As evident from the given definitions, information security is related to the process of protecting information. In other words, if information is protected, it is considered safe. We distinguish between the concepts of «information security» and «information protection».

The concept of «information protection». Information protection refers to activities aimed at preventing unauthorized actions regarding information in a system [5]. In a broader sense, information protection involves a complex of organizational, legal, and technical measures to prevent threats to information security and eliminate their consequences. The essence of information protection lies in identifying, eliminating, or neutralizing negative sources, causes, and conditions of influence on information. These sources pose a threat to information security. The goal and methods of information protection reflect its essence. In this understanding, information protection is synonymous with ensuring information security, a global issue for the safe development of world civilization, states, communities of people, individuals, and the existence of nature.

Preventing possible threats and illegal actions can be ensured through various means, starting from creating a climate of deep awareness among employees regarding the issues of security and information protection to establishing a comprehensive system of protection using physical, hardware, software, and cryptographic means. Preventing threats is also possible by obtaining information about planned unlawful acts, thefts, preparatory actions, and other elements of criminal activities. Information security services play a crucial role in preventing threats through information-analytical activities based on a deep analysis of the criminogenic state and the activities of competitors and criminals.

Detection aims to collect, accumulate, and analytically process information about possible preparations for criminal acts by criminal structures or competitors in the production and sale of goods and products.

Detecting threats involves actions to identify specific threats and their sources that cause damage in one way or another. Such actions include identifying facts of theft or fraud, as well as cases of disclosing confidential information or unauthorized access to sources of commercial secrets.

Termination or localization of threats involves actions aimed at eliminating the existing threat and specific criminal activities. The elimination of consequences aims to restore the state that preceded the onset of the threat. All these methods aim to protect informational resources from unauthorized intrusions and ensure:

- prevention of disclosure and leakage of confidential information;
- prohibition of unauthorized access to sources of confidential information;
- preservation of the integrity, completeness, and availability of information;
- compliance with the confidentiality of information;
- protection of copyright.

The information being protected contains data that constitutes state, commercial, official, and other secrets protected by law. Each type of information has its own specific features in terms of regulation, organization, and implementation of protection.

The most general principles of protecting any type of protected information include:

- information protection is organized and carried out by the owner of the information or individuals authorized by them (legal or natural persons);
- information protection enables the owner to safeguard their rights to own and manage information, aiming to protect it from illegal acquisition and use to the detriment of their interests;
- information protection is carried out through a complex of measures to restrict access to protected information, creating conditions that exclude or significantly complicate unauthorized, illegal access to classified information and its carriers.

Protected information, whether it is state or commercial secrets, like any other type of information, is essential for managerial, scientific, and production activities. Today, the task of information protection encompasses a broader scope: ensuring the security of information. This is due to various factors, primarily the increasing use of electronic data processing machines in the accumulation and processing of protected information, where information may not only leak but also be destroyed, distorted, falsified, blocked, and subjected to other interventions in information and information systems.

Therefore, information protection should also be understood as ensuring the security of information and information resources where protected information is accumulated, processed, and stored.

Thus, information protection is the activity of the owner of the information or individuals authorized by them, aiming to:

- ensure their rights to own, manage, and control protected information.
- prevent leakage and loss of information.
- preserve the completeness, reliability, and integrity of protected information, its arrays, and processing programs.
- maintain the confidentiality or secrecy of protected information, following the rules established by legislative and other normative acts.

Therefore, information protection is an activity aimed at ensuring the confidentiality, integrity, and availability of information during its receipt, storage, processing, and dissemination through organizational, legal, technical, and economic means.

The means for preserving and protecting information in a government organization, enterprise, or firm vary in scale and form, depending on the production, financial, and other capabilities of the enterprise and the significance of the secrets it protects. The choice of such measures should be made based on the principle of economic feasibility, adhering to financial calculations of the "golden mean," as excessive secrecy or careless preservation of information can lead to the loss of a certain portion of profit or result in irreparable losses. The lack of clear understanding among enterprise leaders of conditions that contribute to the leakage of confidential information can lead to its unauthorized dissemination.

The presence of a significant number of vulnerabilities in any modern enterprise or firm, a wide range of threats, and a fairly high technical equipment of attackers necessitate a well-founded selection of special solutions for information protection. The basis for such solutions can be considered as follows:

1. Application of scientific principles for ensuring information security, including legality, economic feasibility and profitability, independence and responsibility, scientific organization of work, a close connection between theory and practice, specialization and professionalism, program-target planning, interaction and coordination, combined with necessary confidentiality.

2. Acceptance of legal obligations by employees of the enterprise regarding the preservation of entrusted information.

3. Creation of administrative conditions that exclude the possibility of theft, embezzlement, or distortion of information.

4. Lawful involvement in criminal, administrative, and other types of liability that guarantee full compensation for damage from information loss.

5. Implementation of active control and verification of the effectiveness of planning and implementation of legal forms, methods of information protection in accordance with the chosen security concept.

6. Organization of contractual relations with state regulatory bodies in the field of information protection.

In implementing a comprehensive set of protective measures, the main goal is to restrict access to the places and equipment where confidential information is concentrated (while considering possibilities and methods of remote acquisition). Specifically, the use of quality locks, alarm systems, good sound insulation of walls, doors, ceilings, and floors, sound protection of ventilation ducts, openings, and pipes passing through these premises, dismantling unnecessary wiring, as well as the use of special devices (noise generators, etc.) will significantly complicate or render futile attempts to introduce specialized equipment.

For reliable protection of confidential information, it is advisable to apply the following organizational measures:

1. Determination of levels (categories) of confidentiality of protected information.

2. Selection of principles (local, object-oriented, or mixed), methods, and means of protection.

3. Establishment of the procedure for processing protected information.

4. Consideration of spatial factors:

- introduction of controlled zones.

- proper selection of premises and placement of objects within the controlled zone.

5. Consideration of temporary factors:

- limitation of the processing time of protected information, bringing the processing time of highly confidential information to a narrow circle of individuals.

6. Consideration of physical and technical factors:

- determination of the possibility of visual (or through technical means) observation of displayed information by third parties;

- disconnection of control and measurement equipment from the information object and its de-energization;

- maximum separation of information cables from each other and from supporting structures;

- crossing them at right angles.

To block potential channels of information leakage through technical means, ensuring the production and labor activity with the help of special technical means, and creating a protection system for the object regarding them, a series of measures should be taken:

- analyze the specific features of the location of buildings, premises in buildings, the territory around them, and utility lines;

- identify the premises inside which confidential information circulates and consider the technical means used in them.

8.3. Tasks and functions of information security management in the field of information and communication technologies

Tasks of information security management in the field of information and communication technologies (ICT). Ensuring information security of ICT enterprises is an auxiliary activity in the organization and includes the implementation and support of two processes: the process of creating, functioning and improving the information security system and the process of information security management.

The information security management system is part of the general management system of the organization and is intended for the creation, implementation, operation, monitoring, analysis, support and improvement of information security, taking into account all the risks of the organization. The information security management system includes:

1. Planning of events and development of a comprehensive system of information protection (KSZI) of the enterprise.

2. The organization of ensuring the information security of the enterprise (organization of the appropriate unit that ensures the protection of information at the enterprise, development of relevant tasks, policies and strategies for the protection of information). Application of scientific principles to ensure information security, including: legality, economic feasibility and profitability, independence and responsibility, scientific organization of work, close connection between theory and practice, specialization and professionalism, program-target planning , interaction and coordination, availability in combination with the necessary confidentiality.

3. Motivation of the personnel who ensure the information security of the enterprise (implementation of organizational and psychological means). Employees of the enterprise can be both the object and the subject of threats aimed at disrupting the economic stability of the enterprise. Personnel management activities are an important guarantee that the enterprise will live and prosper. The effectiveness of the information security management system largely depends on compliance and implementation of the rules of information security policies by all employees of the organization without exception.

4. Control of activities to ensure information security of the enterprise. Conducting effective control and checking the effectiveness of planning and implementation of legal forms, information protection methods in accordance with the chosen strategy and security concept.

Information security management functions in the field of ICT. Information security management is a part of information security functions, which are provided by the hierarchy of security services and security mechanisms.

Information security management functions include security services for communications and information systems, security event detection and reporting.

For communication security, services of authentication, access control, data confidentiality, data integrity, non-repudiation of (participation in) receipt or authorship in communication processes between systems, between users and systems, between internal users and systems are provided. In addition, pervasive security mechanisms are defined for event detection, audit log security controls, security recovery, and more.

Security event detection and reporting to higher security levels is the activity of identifying, analyzing, and remediating security breach incidents. An example of a security incident could be the detection of an unauthorized user, physical damage to equipment, etc.

Security management includes the following groups of functions:

– warning;

– detection;

– containment and restoration;

– security administration.

A set of warning features is necessary to prevent intrusion. This set includes security features:

– ensuring legal access to information resources;

– ensuring safe access by physical means (biometric, electronic access systems, etc.);

– protection of access facilities;

– personal risk analysis to check the reliability of employees;

– user security screening to support requests to confirm the reliability of the customer of the service, for example, solvency.

The set of intrusion detection features includes security features:

– investigation of significant changes in income that may indicate fraud or theft;

– protection of elements supporting the type of monitoring and analysis of emergency alarms: fire, flood, opening of doors, windows, etc.;

– customers' access to information about security breaches in their parts of the network;

– analysis and identification of anomalies and irregularities in user data that may indicate security breaches or theft of services;

– analysis of user data that characterizes his characteristic behavior;

– investigation of theft of official services based on the data of its characteristic behavior;

– investigation of internal traffic, behavioral data and control log information to detect security breaches or theft of services due to personnel actions;

– network security signaling;

– audit of program intrusions, such as viruses;

– support for reports of violations of security elements.

A set of deterrence and recovery functions is necessary to deny access to an attacker, eliminate violations made by an attacker, and restore the protection system. This set includes protection features:

– secure storage of business data, service customer data, network configuration data and network end elements;

– support for requests for reports of security breaches and requests for actions to limit or isolate equipment or data, exclude access rights, as well as requests for restoration of distorted data or equipment;

– support of court cases against violators and their delay;

– support for requests to backup files to restore services, network configuration, endpoint after detecting a security breach;

– administration of revocation lists for access to lists of all keys and certificates of the customer of services, network configuration, access control, which are suspected to be inoperable due to a security breach;

– support for requests to disconnect external or internal connections to attempt to save data or the system upon detection of a security breach.

A set of security administration functions is required to plan and administer security and business information security policies. This set includes protection features:

– a security policy that provides access to company directives for establishing and maintaining a secure environment for personnel, technical equipment, and software;

– supporting access to means and procedures used to restore the network and corrupted data in the event of a security breach;

– analysis of control log information to identify possible or potential security violations by individuals or groups of users;

– analysis and evaluation of security violations with the help of monitoring directives;

– assessments of the integrity of corporate data sets to protect against unauthorized access;

– administration of internal and external requests and responses to identification, access control, issuing certificates, coding and keys;

– management of a security breach of the customer of the service to detect a security attack in his part of the network;

– testing of control log mechanisms;

– management of the network audit log, violations of network security and endpoints;

– administration of keys and support of requests for generation of keys used in communications between endpoints and other network elements. Such keys can be used for identification, integrity and confidentiality.

At a specific object of information activity, scenarios for the consistent use of security functions are established to detect, contain and eliminate information security violations.

8.4. Main goals and tasks of ensuring information security

The main goals of ensuring information security are determined on the basis of stable national security priorities that correspond to the long-term interests of social development, which include [15, 50]:

– preservation and strengthening of Ukrainian statehood and political stability in society;

– preservation and development of democratic institutions of society, provision of rights and freedoms of citizens, strengthening of law and order;

– ensuring a worthy role of Ukraine in the world community;

– ensuring the territorial integrity of the country;

– ensuring progressive socio-economic development of Ukraine;

– preservation of national cultural values and traditions.

According to the specified priorities, the main goals of information security are:

– protection of Ukraine's national interests in the context of globalization of information processes, formation of world information networks and the desire of the USA and other developed countries for information dominance;

– provision of state authorities and management bodies, enterprises and citizens with reliable, complete and timely information necessary for decision-making, as well as prevention of violations of integrity and illegal use of information resources;

– implementation of the rights of citizens of organizations and the state to obtain, disseminate and use information.

The main tasks of ensuring information security include [15]:

– identification, evaluation and forecasting of sources of threats to information security;

– development of the state policy of ensuring information security, a set of measures and mechanisms for its implementation;

– development of the normative and legal framework for ensuring information security, coordination of the activities of state authorities and management and enterprises to ensure information security;

– development of the information security system, improvement of its organization, forms, methods and means of preventing, repelling and neutralizing threats to information security and eliminating the consequences of its violation;

– ensuring Ukraine's active participation in the processes of creating and using global information networks and systems.

The goals of information security are to ensure uninterrupted operation of the organization and to minimize damage from events that conceal a security threat, by preventing them and minimizing their consequences. Information security management allows the collective use of information, while ensuring its protection and protection of computing resources. Information security includes three main components: confidentiality (protection of confidential information from unauthorized disclosure or interception), integrity (ensuring the accuracy and completeness of information and computer programs), availability (ensuring the availability of information and vital services for users when it is necessary).

Information exists in various forms. It can be stored on computers, transmitted over computer networks, printed or recorded on paper, as well as voiced in conversations. From the point of view of security, all types of information carriers (paper documentation, films, microfilms, models, magnetic tapes, diskettes, conversations, etc.) that are used to transfer knowledge and ideas require proper protection.

Information and its supporting information systems and networks are expensive production resources. The extent of their availability, integrity and confidentiality can be of particular importance for ensuring competitiveness, cash flow, profitability, compliance with legal regulations and the image of the organization. Information owners may face a growing threat of security breaches from a variety of sources. Information systems and networks can be threatened by such dangers as computer viruses and hackers, as well as other sources of failures and accidents. It is assumed that such threats to information security will become more dangerous and sophisticated over time. At the same time, the growing dependence of information owners on information systems and services makes its security more vulnerable to threats of security breaches. With the spread of computer networks, new opportunities are provided for unauthorized access to computer systems, and the tendency to switch to distributed computer systems reduces the possibility of centralized control of information systems by specialists. Protective measures turn out to be much cheaper and more effective if they are built into information systems and services at the stages of setting requirements for their design. The sooner measures are taken to protect their information systems, the cheaper and more effective they will be for her in the future.

The analysis of the state of affairs in the field of information security shows that in some developed countries, a fully stable infrastructure of the information security system (IS) has been developed and is successfully functioning, that is, a system of measures that ensure such a state of confidential information, which excludes its disclosure, leakage, unauthorized access (external threats), as well as distortion, modification, loss (internal threats).

However, malicious actions on information not only do not decrease, but have a rather stable tendency to increase. Experience shows that in order to successfully counteract this tendency, it is necessary to constantly improve protection systems.

Since information is a product of an information system (IS), that is, an organizationally ordered set of information resources, technological means that implement information processes in traditional or automated modes to meet the information needs of users, the material objects of information security are elements of such IS as consumers and personnel; material and technical means (MTS) of informatization; information resources (IR) with limited access.

Information security objects of Ukraine include:

– information resources, regardless of the forms of storage, containing information that includes state secret and restricted access, commercial secret and restricted access, commercial secret and other confidential information, as well as open (publicly available) information and knowledge;

– the system of formation, distribution and use of information resources, which includes information systems of various classes and purposes, libraries, archives, databases and data banks, information technologies, regulations and procedures for collecting, processing, storing and transmitting information, scientific and technical and staff;

– information infrastructure, which includes information processing and analysis centers, channels of information exchange and telecommunications, mechanisms for ensuring the functioning of telecommunication systems and networks, in particular systems and means of information protection;

– the system of formation of social consciousness (worldview, political views, moral values, etc.), based on means of mass information and propaganda;

– the rights of citizens, legal entities and the state to obtain dissemination and use of information, protection of confidential information and intellectual property.

The information security of all the above-mentioned objects creates conditions for the reliable functioning of state and public institutions, as well as the formation of public consciousness, which corresponds to the progressive development of the country.

In the field of information security, it is important to note the following:

– the object of protection is not just information as any information, but an information resource, i.e. information on physical media (documents, databases, patents, technical documentation), the right to access which is legally reserved for its owner and him is regulated;

– information security of users, in contrast to physical security, ensures protection of their rights to access IP to meet their information needs;

– from the point of view of economic expediency, only that information should be protected, the disclosure (leakage, loss) of which will inevitably lead to material and moral damage.

8.5. Key factors influencing the state of information security

The transformation processes currently taking place in the political life and economy of Ukraine directly affect the state of its information security. At the same time, new factors arise that must be taken into account when assessing the real state of information security and identifying key problems in this area. They can be divided into political, economic and organizational and technical [15].

Political factors include:

– a change in the geopolitical situation as a result of fundamental changes in various regions of the world, minimizing the probability of world nuclear and conventional wars;

– the formation of a new Ukrainian statehood based on the principles of democracy, legality, information openness;

– the destruction of the previously existing command and administrative system of state management, as well as the existing system of ensuring the security of the country;

– Ukraine's desire for closer cooperation with foreign countries in the process of carrying out reforms based on maximum openness of the parties;

– low general legal and informational culture in Ukrainian society.

Economic factors include:

– Ukraine's transition to market relations in the economy, the emergence of numerous domestic and foreign commercial structures - producers and consumers of information, means of informatization and protection of information, inclusion of information products in the system of commodity relations;

– the critical state of domestic branches of industry that produce means of informatization and information protection;

– cooperation with foreign countries in the development of Ukraine's expanding information infrastructure.

Organizational and technical factors include:

– insufficient regulatory and legal framework in the field of information relations, including in the field of ensuring information security;

– weak regulation by the state of the functioning of the development of the market of informatization, information products and services in Ukraine;

– wide use in the sphere of public administration and the credit and financial sphere of imported technical and software means for storing, processing and transmitting information, which are not protected against leakage of information;

– growth in the amount of information transmitted through open communication channels, including data transmission networks and inter-machine exchange;

– aggravation of the criminogenic situation, increase in the number of computer crimes, especially in the credit and financial sphere.

8.6. Components of enterprise information security

The activity of business entities in the conditions of the formation of market relations requires the rapid identification of factors that determine the information security of the enterprise and its adaptation to the dynamics of the external environment by eliminating emerging threats. As is known, the market economy is based on the principles of competition between market participants, which is a constant source of risk.

Thus, information security management can be considered as an integral part of the enterprise management system aimed at countering external and internal threats to its functioning. The implementation of measures to ensure the information security of the enterprise is necessary for the protection of its activity from the negative effects of the external environment and to maintain the state of the most efficient use of all types of resources in order to prevent threats and ensure the stability and stable functioning of the enterprise at the present time and in the future.

We will present a general scheme of the main components of the information security of the enterprise (fig. 1.3).

Components of an enterprise's information security are a set of main areas of its information security, significantly different from each other in their content. Let's consider each of the components of information security in detail.

1. Technical component. The most researched and the main one in the entire set of components of information security is the technical one, which in turn consists of means of protection and leakage channels.

The entire set of technical means of protection is divided into physical, software-technical and hardware and includes electrical, mechanical, electromechanical and electronic devices. Physical means are implemented in the form of autonomous devices and systems that perform the functions of general protection of objects on which information is processed. Software and technical means are software security that performs information protection functions.

Hardware is placed directly in computing equipment, in telecommunications equipment or in devices connected to similar equipment using a standard interface

Channels of information leakage, in turn, are divided into acoustic, vibroacoustic, electroacoustic, radio-electronic, channels due to PEMVN, channels due to RF imposition and optical channels.

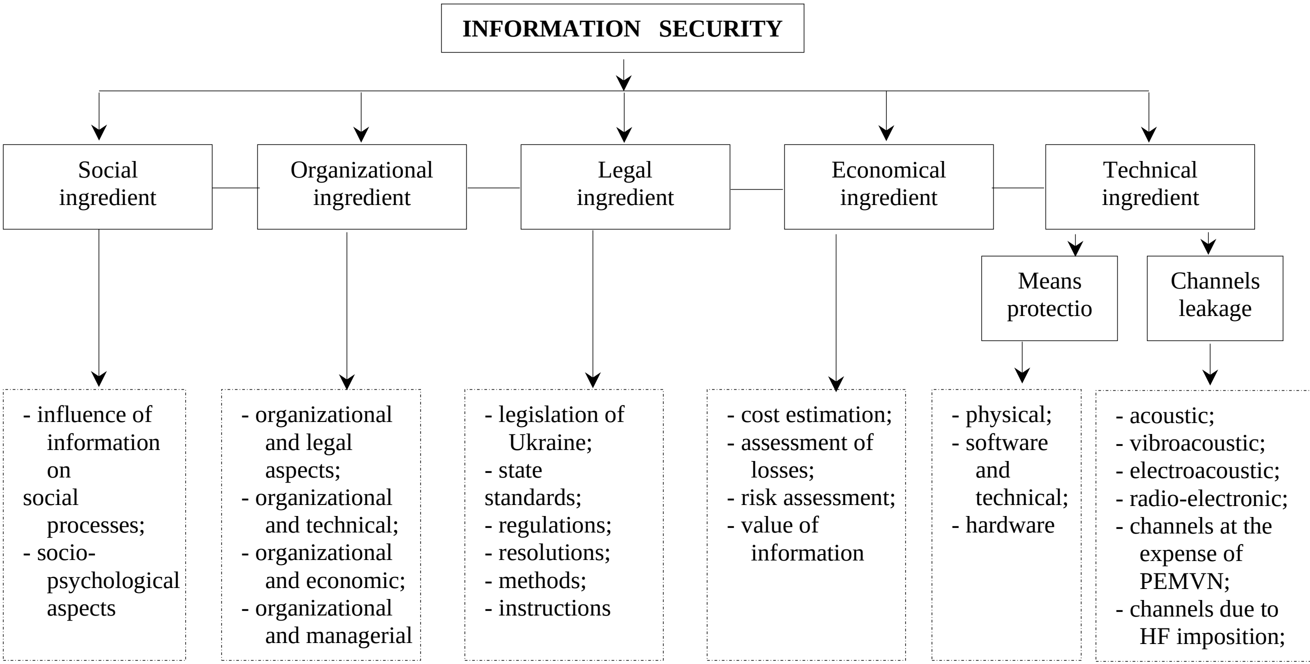

Figure 8.3. Components of enterprise information security

Acoustic. A direct acoustic channel usually means the possibility of listening to premises through natural and artificially created holes and cracks in walls, ceilings, through various air ducts and ventilation shafts, etc. At the same time, a sound-amplifying and recording apparatus can be used, but in the middle you can do without it.

Since the presence of such channels of direct information leakage is related to the quality of construction and repair, as well as the features of building structures, few people imagine that it is direct acoustic channels that usually bring the biggest surprises.

Vibroacoustic. The vibroacoustic channel of information leakage is the possibility of listening to premises with the help of electronic stethoscopes, which will transform the vibrational oscillations of building structures into an electrical signal. After amplification and the simplest processing, this signal can be listened to, recorded on a tape recorder or transmitted on a radio channel.

In this way, information can be removed from walls, ceilings, doors, window frames and glasses, heating and water supply pipes, various boxes, etc.

This is one of the most convenient types of information capture for an attacker.

Firstly, it does not require penetration into the interested premises, secondly, stethoscopes are relatively inexpensive, easy to install and remove, and can be used repeatedly.

The use of such channels by an attacker leaves no traces and practically remains at the level of speculation. The distance from which the room can be listened to in the case of connecting the stethoscope to pipes or other metal constructions is tens of meters.

Electroacoustic. Electroacoustic technical channels of information leakage arise due to electroacoustic transformations of acoustic signals into electrical ones and include the interception of acoustic vibrations through auxiliary technical means and systems, which have an inherent «microphone effect», as well as by high-frequency imposition.

Interception of acoustic vibrations in a certain channel of information leakage is carried out by directly connecting to the connecting lines of auxiliary technical means and systems that have a «microphone effect», special high-sensitivity low-frequency amplifiers. For example, by connecting such devices to the connecting lines of telephones with electromechanical pagers, it is possible to listen to conversations that take place in the premises where these devices are installed.

Radioelectronic. During the transmission of confidential information, currents of informative (dangerous) signals flow in the elements of schemes, structures, supply and connecting wires. The resulting electromagnetic fields can affect random antennas. Signals received by random antennas can lead to the formation of information leakage channels.

Channels due to side electromagnetic radiation and guidance. Electromagnetic radiation and guidance are a by-product of the functioning of technical means and can be information carriers. During the transmission of an informative (dangerous) signal by one circuit, currents induced by electromagnetic influence appear in neighboring circuits - during their parallel run. The transition of electromagnetic energy from one circuit to another is a possible channel of information leakage.

Channels due to HF imposition. During the arrival of high-frequency signals in non-linear (or parametric) circuits carrying confidential information, modulation of the high-frequency signal occurs. Thus, high-frequency oscillations become carriers of informative (dangerous) signals and create a channel for information leakage.

Optical channels. For covert interception of voice messages from premises, devices can be used in which information is transmitted in the optical range. The infrared range of radiation, invisible to the naked eye, is most often used.

The most complex and expensive means of remote speech interception from premises are laser devices. The principle of their operation consists in sending a probing beam in the direction of the sound source and receiving this beam after reflection from any objects, for example, windows, mirrors, etc. These objects vibrate under the influence of surrounding sounds and modulate the laser beam with their vibrations. By receiving the beam reflected from them, it is possible to restore the modulating oscillations.

2. Legal component. The legal component includes the legislation of Ukraine, state standards, regulatory documents, resolutions, methods and instructions that regulate and control the provision of information security in the country. The main tasks of the legal component include the creation of regulatory and legal foundations for ensuring information security, coordination of the activities of state authorities and management, institutions and enterprises for the implementation of information security policy.

The analysis of the legal component of information security includes the analysis of legislation in the field of information security. Based on the analysis of the laws of Ukraine, state standards, regulatory documents of the technical information protection system, the main problems of information security of telecommunication systems are determined.

3. Organizational component. The organizational component consists of organizational-legal, organizational-technical, organizational-economic and organizational-management aspects.

To protect the interests of the subjects of information relations, it is necessary to combine measures of the following levels: legal (laws, normative acts, standards, etc.); management actions of a general nature, organizations carried out by management; and specific security measures dealing with people; technical (specific technical measures) and economic measures.

Organizational and legal aspect. The legal or legislative level is the most important for ensuring information security. Most people do not commit illegal acts, not because it is technically impossible, but because it is condemned and punished by society, because it is not accepted to behave like this.

We will distinguish two groups of measures at the legislative level: measures aimed at creating and maintaining a negative (in particular, punitive) attitude in society towards violations and violators of information security and coordinating measures that guide and contribute to the improvement of the sphere of information security created by society , which help in the development and distribution of means of ensuring information security.

In the world of global networks, the legal framework must be aligned with international practice. We would like to pay special attention to the desirability of bringing Ukrainian standards and certification regulations into compliance with the international level of information technologies in general and, in particular, information security. There are many reasons why this should be done. One of them is the need for secure interaction with foreign organizations and foreign branches of Ukrainian organizations. The second (more significant) is the dominance of hardware and software products of foreign production. The issue of relation to such products should be resolved at the legislative level. Here it is necessary to highlight two aspects: independence in the field of information technologies and information security. The use of foreign products in some critically important systems (primarily military) may pose a threat to national security (in particular, information security), since the possibility of embedding embedded elements cannot be ruled out. At the same time, in the vast majority of cases, potential threats to information security are exclusively internal in nature. Under such conditions, the illegality of using foreign developments (given the difficulties with their certification) in the absence of domestic analogues makes it difficult to protect information without serious grounds. The problem of certification of hardware and software products of foreign production is really difficult, but, as the experience of European countries shows, it can be successfully solved. The certification system developed in Europe in response to information security requirements made it possible to evaluate operating systems, database management systems, and other developments of American companies. The entry of Ukraine into this system and the participation of Ukrainian specialists in certified tests are able to remove the existing contradiction between independence in the field of information technology and information security without any reduction of national security.

The main thing, which, in our opinion, is lacking in modern Ukrainian legislation (and which can be gleaned from foreign experience), is a positive (not punitive) orientation. Information security is a new field of activity, it is important to teach, explain, help, not prohibit and punish. Society must realize the importance of this issue, understand the main ways of solving the relevant problems, scientific, educational and production plans must be coordinated. The state can do it optimally. There is no need for large material costs, intellectual investments are required. An example of positive legislation is the British Standard BS 7799:1995, which describes the main provisions of the security policy. More than 60% of large organizations use this standard in their practice, although the law, strictly speaking, does not require it.

Summing up, the following main directions of activity in the organizational and legal aspect can be outlined: development of new laws taking into account the interests of all categories of subjects of information relations; focus on creative rather than punitive laws; integration - into the global legal space, taking into account the modern state of information technologies, as well as interaction between all components of information security.

Organizational and management aspect. The basis of measures of the organizational and management aspect, that is, measures taken by the management of the organization, is the security policy and the peculiarities of personnel management. The appropriate level of information security largely depends on the composition of personnel, their intelligence and professionalism. Chapter 12 of the study guide is devoted to the issue of personnel management, so we will not dwell on this issue in detail.

The security policy is understood as a set of documented management decisions aimed at protecting information and resources associated with it. The security policy determines the strategy of the organization in the field of information security, as well as the degree of attention and the amount of resources that the management considers appropriate to allocate. The BS 7799:1995 standard recommends including the following sections in the document characterizing the organization's security policy: introductory, confirming the concern of senior management with information security issues; organizational, which contains a description of divisions, commissions, groups, etc., responsible for work in the field of information security; classification of the material and information resources available in the organization and the required level of their protection, describing the standard, characteristic security measures applied to personnel (job description from the point of view of information security, organization of training and retraining of personnel, the procedure for responding to violations of the security regime, etc.); a section covering the issue of physical protection; a section describing the approach to managing computers and computer networks; a section describing the rules for delimiting access to production information; a section characterizing the order of system support development; a section describing the measures aimed at ensuring the continuous operation of the organization; the legal section, which confirms the compliance of the security policy with the current legislation.

The security policy is built on the basis of an analysis of risks that are recognized as real for the organization's information system. When the risks are analyzed and the protection strategy is determined, a program is drawn up, the implementation of which should ensure information security. Under this program, resources are allocated, responsible persons are awarded, the procedure for monitoring the implementation of the program is determined, etc. The organizational and management aspect is a white spot in the domestic practice of information security. There are no laws requiring organizations to have a security policy. None of the departments involved in information security offers typical developments in this area. No educational institution trains specialists in drafting security policies. Few managers know what a security policy is, and even fewer organizations have such a policy. At the same time, without such a foundation, other measures of information security are left in the air, they cannot be comprehensive, systematic and effective. For example, protection measures against external hackers and against your own offended employees should be completely different, so first of all it is necessary to determine which threats are capable of causing the greatest damage. Because of this, we note that, according to statistics, the greatest damage is caused by accidental errors of the staff due to carelessness or incompetence, therefore, first of all, it is not the clever technical means that are important, but the training measures, the training of the staff and the regulation of their activities.

Development of a security policy requires taking into account the specifics of specific organizations. It is pointless to transfer the practice of regime state organizations to commercial structures, educational institutions or personal computer systems. In this area, it is appropriate to offer, firstly, the basic principles of security policy development, and secondly, ready-made templates for the most important types of organizations. Analysis of the situation at the administrative level of information security once again shows the importance of creative, not punitive, legislation. You can expect managers to have a security policy (and in the long run, this is correct), but first you need to explain, teach, show why it is needed and how to develop it.

Domestic organizations have accumulated a wealth of experience in drafting and implementing organizational measures, but the problem is that they came from the pre-computer past and therefore require significant revision.

The following groups of organizational measures aimed at ensuring information security can be distinguished: personnel management, physical protection, maintenance of working capacity, response to violations of the security regime, and planning of restoration work.

Personnel management in the context of information security, as already mentioned above, remains an undeveloped and undeveloped issue. First, there must be qualification requirements for information security for each position. Secondly, job descriptions should include sections related to information security. Thirdly, every employee should be taught safety measures in theory and trained in the implementation of these measures in practice (conduct such training twice a year. Informational civil defense is needed. Calmly, without inciting passions, it is necessary to explain to society not only the advantages, but and dangers arising from the use of information technologies. In our opinion, the emphasis should be placed not on the military or criminal side of the case, but on purely civilian aspects related to the maintenance of the normal functioning of hardware and software, that is, to concentrate on issues availability and integrity of data.

The protection of the organizational and managerial aspect of information security covers interconnected and at the same time independent areas of activity of one or another business entity.

At the first stage of the process of protecting this component of information security, the threat of negative actions and possible harm from such actions is assessed. Among the main negative effects on information security, enterprises single out insufficient qualifications of employees of certain structural sub-divisions, their unwillingness or inability to bring maximum benefit to their company. This may be caused by a low level of personnel management, a lack of funds for the payment of certain categories of personnel of the enterprise, or their non-rational spending.

The process of planning and personnel management, aimed at protecting the appropriate level of information security, should include the organization of the system of selection, hiring, training and motivation of the work of the necessary employees, including material and moral incentives, the prestige of the profession, the will to creativity, and the provision of social benefits.

Of course, sections related to information security should become part of school and even more so university computer science courses. Physical protection measures, known since ancient times, need to be refined in connection with the spread of network technologies and the miniaturization of computing equipment. First of all, you should protect yourself from leaking information through technical channels. Maintenance of working capacity is another white spot that was formed relatively recently. In the era of dominance of large computers, it was possible to create an infrastructure capable of providing, in fact, any predetermined level of performance (availability) throughout the life cycle of an information system. This infrastructure included both technical and procedural regulators (training of personnel and users, conducting work in accordance with approved regulations, etc.). With the transition to personal computers and client/server technology, the accessibility infrastructure was largely lost, but the importance of this problem not only did not decrease, but, on the contrary, significantly increased. State and commercial organizations are faced with the task of combining the orderliness and regulation characteristic of the world of large computers with the friendliness and flexibility of modern systems. Responding to information security breaches is again a white spot. Suppose a user or system administrator realizes that a breach has occurred. What should he do? Try to track the intruder? Immediately turn off the device? Call the police? Consult with specialists? Not a single agency involved in information security has offered a regulation of actions in such an extreme situation or its consulting assistance. It is necessary to organize a national information security center, the scope of which would include, in particular, monitoring the current state of this area of knowledge, informing users of all levels about the emergence of new threats and countermeasures, operational assistance to organizations in the event of a violation of their information security – bake.

The planning of restoration work and all issues related to restoration of operational capacity after accidents also require attention. After all, no organization is immune from such violations. Here it is necessary to work out the actions of personnel during and after accidents, to take care in advance of the organization of reserve production sites, to work out the procedure of transferring the main information resources to these sites, as well as the procedure of returning to normal operation mode. We emphasize that such a plan is needed not only by the most important military organizations, but also by ordinary commercial companies, if they do not want to suffer large financial losses.

Organizational and economic aspect. The system of information security of telecommunication networks can be effective if the costs of its creation and management are at least less than the losses due to the destruction, distortion, blocking of information, its unauthorized leakage or from violation of the established order of information routing.

The assessment of information protection costs should always be correlated with the assessment of losses if this information is not protected, and the value of the information, while always taking into account possible risks. Then the provision of information security will be truly qualitative.

Threats to information security that are of a political and legal nature and include:

– internal negative actions;

– external negative actions;

– force majeure circumstances.

Ensuring the company's information security has a very specific economic meaning. And the achievement of this goal should be carried out by economically justified measures. It is advisable to make a decision on the financing of an information security project only if you are sure that you have not just increased the spending part of your budget, but made investments in the development of the company.

That is why the organizational and economic aspect plays an important role in the information security system and is the basis of most methods of evaluating the effectiveness of investments in information security – comparing the costs necessary to ensure information security and the damage that can be caused to the company due to the lack of this system.

Organizational and technical aspect. According to the modern belief, at least the following security mechanisms should be available within the framework of information systems: identification and verification of authenticity (authentication) of users; access management; logging and auditing; cryptography; cross-network screening; ensuring high availability. In addition, the information system as a whole and security mechanisms in particular need to be managed. Both management and security mechanisms must function in a heterogeneous, distributed environment built, as a rule, in a client/server architecture. This means that the mentioned means must rely on generally accepted standards, be resistant to network threats, and take into account the specifics of individual services.

Today, the vast majority of development is focused on Intel/DOS/Windows platforms. At the same time, the most significant information is concentrated on other server platforms. It is not individual personal computers and local networks based on such computers that need protection, but primarily more advanced modern corporate systems.

Consider a typical government organization that has several production sites, each of which may have mission-critical servers that employees based at other sites and mobile users need access to. Supported information services include file and mail services, database management systems (DBMS), Web services, etc. In local networks and for network access, the TCP/IP protocol is the main one.

To build an echeloned defense of such an information system, at least the following software and technical level protection tools are essential: inter-network screens (demarcation of inter-network access); means of supporting private virtual networks (implementation of secure communications between production sites through open communication channels); means of identification/authentication supporting the concept of a single sign-on to the network (the user proves his authenticity once when entering the organization's network, after which access to all available services is granted according to his authority); logging and auditing tools that track activity at all levels - from individual applications to the organization's network as a whole, which quickly detect suspicious activity: a set of tools for the centralized administration of the organization's information system; means of protection that are part of applications, services and hardware and software platforms.

Commercial structures, in contrast to state structures, are somewhat freer in their choice of protective means. However, due to a number of circumstances (necessity of interaction with state structures, expanding interpretation of the concept of "state secret" - the need to obtain a license for the operation of cryptographic means, restrictions on the import of cryptographic means) this freedom is not very large. The approach designed for state structures has been transferred to practically all categories of subjects of information relations.

4. Economic component. The economic component of information security is integral, because protecting the information of any enterprise or company requires money, that is, capital investment. The entire set of technical and organizational means is based precisely on the economic component, so this component cannot be ignored or bypassed altogether.

In our opinion, the economic component consists of the following parts: assessment of costs for information security, assessment of losses from possible obstacles and abuses, assessment of possible risks and their insurance, and assessment of the value of information.

The information security system can be effective if the costs of its creation and management are at least less than the losses due to the destruction, distortion, blocking of information, its unauthorized leakage or from violation of the established order of information routing.

It is impossible to create an absolutely reliable security system. Mostly due to the fact that new types of threats are constantly being developed, which the system cannot resist, and also due to the fact that the effectiveness of the protection system depends on the service personnel, and it is human nature to make mistakes. The cost of overcoming the protection must be greater than the cost of breaking it. In any case, the cost of security measures should correspond to the risk and profit in the environment that surrounds this subject.

The management of any company understands that it is impossible to allocate an unlimited amount of finances and human resources to ensure information security. From an economic point of view, investments in security should show a profit or a reduction in possible costs that have occurred. The policy of ensuring information security should determine the priorities of investments in the direction of greatest vulnerability.

There are a number of methods and techniques that are used to assess the feasibility of spending on ensuring the information security of an enterprise. But each company should choose its own method or method of estimating costs for information security, depending on the specifics and activities of the company. But all existing methods share the same principles and rules:

– the method should provide a quantitative assessment of security costs, use indicators for assessing the possibilities of actions and their consequences;

– the method should be transparent from the user's point of view and provide an opportunity to enter personal empirical data;

– the method should be universal, that is, it should be equally used to estimate the costs of purchasing hardware, specialized and universal software, costs of services, costs of moving personnel and training users;

– the chosen method should allow simulating a situation in which there are several countermeasures aimed at preventing the detected threat.

The following methods are used in practice:

– applied information analysis (Applied Information Economics);

– consumer index (Customer Index);

– economic value added (Economic Value Added);

– economic value (Economic Value Sourced);

– asset portfolio management (Portfolio Management);

– assessment of real options (Real Option Valuation);

– method of life cycle of artificial systems (System Life Cycle Analysis);

– system of balanced indicators (Balanced Scorecard);

– total cost of ownership (Total Cost of Ownership);

– functional cost analysis (Activity Based Costing).

In chap. 10 of this training manual developed methodical bases for assessing the economic feasibility of information protection for telecommunication networks and communication enterprises.

5. Social component. It includes the impact of information on social processes and socio-psychological aspects. There is a huge increase in the amount of information, knowledge is differentiated and specialized, the sphere of services is inevitably growing, therefore the process of formation of information civilization is objective and natural. Another thing is that different states, depending on their intellectual, scientific, technological level of development, have different perspectives on this. The highly developed states of the world have already passed the initial stage of forming an information democracy society, others are in the final phase of industrialism, and still others do not even have a more or less developed industrial sector. But one way or another, the world depends more and more on the power of information.

Information in the modern world is already a means and goal of full-fledged life activity and acquires clear features of real power, which is closely woven into all spheres of society's functioning and all other types of power. In this way, humanity is constantly moving towards a new era of its development – an era where information and knowledge are the highest values.

As a social phenomenon, informatization covers current and prospective problems – economic, organizational, social, related to the development of culture and education, activities of all branches of social management and national economy. As the experience of other countries shows, informatization contributes to ensuring national interests, the development of knowledge-intensive industries and high technologies, increasing labor productivity, improving the management of the economy, socio-economic relations, enriching spiritual life and further democratization of society. Therefore, the social component is also indispensable for ensuring information security.

In modern conditions, information penetrates into all spheres of life, that is, the processes of convergence of information and telecommunications and their influence on the formation of new management technologies are inextricable.

From the definition of the components of the IS of the enterprise, it follows that in order to move to the methods and means of protecting confidential information at the enterprise, it is necessary to consider the sources of information threats.

8.7. Sources of threats to enterprise information security

The implementation of information threats at the level of an individual leads to the violation or limitation of citizens' access to public information. This creates a threat to the information security of the individual both from the authorities and from third parties or groups, disrupts the balance of relations between the individual, society and the state.

The consequence of the influence of informational threats on the social community is the complication of social processes, which is manifested in the exacerbation of contradictions between different social strata, the exacerbation of political struggles, the inflaming of religious and ethnic conflicts, the decline of the general culture of the population, the development of spirituality, the growth of crime, the spread anti-humane ideas. The consequences of information crimes in the economic sphere can lead to economic losses due to the depreciation and loss of the marketable part of the information resource - industrial and information technologies.

The main types of threats to the company's information assets [9]:

During the construction of the system for the protection of the company's information assets, it is important to define and systematize the threats acting on them. Creating an effective information protection system at the enterprise is an important and time-consuming process, consisting of the following stages:

– determination of inspection boundaries;

– identification of assets and establishment of dependence between them;

– assessment of assets and establishment of dependence between them;

– threat assessment;

– assessment of vulnerabilities;

– identification of existing and (or) planned means of protection;

– risk assessment;

– the choice of means of protection.

After determining the limits of the inspection, inventory and assessment of assets, it is important to determine the threats that can affect the information system of the enterprise. A potentially possible adverse impact, leading to a decrease in the value of the company's resources, is called a threat.

If the threat is realized, the value of the company's information resource may decrease as a result of a violation of the integrity, confidentiality, and availability of information.

All threats must be identified, and the probability of their occurrence assessed. Owners of information assets should carry out a cost assessment. But in most cases, they are not able to determine the list of all threats that can affect their resources. Therefore, the list of threats to information assets in the organization should be drawn up with the involvement of specialists in the field of information security, as well as managers and their owners. In connection with the constant modification and improvement of threats, such a list should be periodically reviewed and amended [15].

According to the nature of the origin of the source, they can be divided into [12, 15, 22]:

Objective threats arise regardless of direct human activity and are associated with various spontaneous natural phenomena, such as fires, lightning strikes, earthquakes, radioactive radiation, rodent attacks, etc.

Subjective threats, the occurrence of which depends on human activity.

The subjective threat, in turn, can be divided into intentional or accidental based on the motives. Deliberate – related to human actions aimed at obtaining a certain benefit, and accidental includes the specified component and is related to human errors, negligence, design and technological flaws in software and hardware, etc.

Threats can be caused by one or more intentional or accidental events.

The list of possible threats is given [2] in table. 8.1. the threats to information assets listed in the table are an example.

Table 8.1. - List of possible threats

№	Threat	Subjective		Objective
		deliberate	random	
1	**2**	**3**	**4**	**5**
1	Earthquake			+
2	Flood	+	+	+
3	Hurricane			+
4	Lightning			+
5	Industrial influence	+		+
6	Bomb attack	+		+
7	Use of weapons	+		+
8	Fire	+		+
9	Deliberate damage	+		
10	Power failure		+	
11	Water supply failure		+	
12	Malfunction of air conditioning	+	+	
13	Equipment failure		+	
14	Power instability		+	+
15	Extreme values of temperature and humidity	+	+	+
16	Dust			+
17	Electromagnetic radiation	+	+	+
18	Electrostatic charge			+
19	Stealing	+		
20	Unauthorized use of data carriers	+		
21	Deterioration of data carriers			+
22	Operational personnel error	+	+	
23	Service personnel error	+	+	
24	Software failure	+	+	
25	Use of software by unauthorized users	+	+	
26	Using the software in an unauthorized manner	+	+	
27	User ID mismatch	+		
28	Illegal use of the software	+	+	
29	A malicious bookmark	+	+	

30	Illegal import or export of software	+		
31	Operator error	+	+	
32	Escort error	+	+	
33	Access to the network by unauthorized users	+		
34	Use of network facilities in an unauthorized way	+		
35	Technical malfunction of network components		+	
36	Error sending information		+	
37	Damage to communication lines	+	+	
38	Traffic congestion	+	+	
39	Eavesdropping	+		
40	Data leakage during communication	+		
41	Unauthorized analysis of information flows	+		
42	Incorrect message routing		+	
43	Changing the route of messages	+		
44	Failure of communication services	+	+	
45	Disadvantages allowed by the staff in their work		+	
46	User errors	+	+	
47	Misuse of resources	+	+	

It is not possible to make a single comprehensive list of them universal for all enterprises. In each case, an individual approach should be used to identify threats to information assets.

The threat can be measured quantitatively (number of dead, amount of economic losses, etc.) and classified accordingly:

1. According to the degree of probability: improbable, unlikely, probable, quite probable.

2. By degree of development: emergence, expansion, stabilization, liquidation.

3. By development in time: immediate, close (up to 1 year), distant (more than a year).

4. By development in space: territory of the enterprise, adjacent territory, territory of the region, territory of the country, foreign territory.

5. By intensity:

- normal; increased; close to the limit; redundant;
- the one that grows; stable; such that it tends to decrease.

6. By the nature of the occurrence: natural (objective), caused by a spontaneous natural phenomenon independent of man; close to artificial (subjective) caused by human activity, unintentional or intentional.

7. Threats are distinguished by the sphere of occurrence: economic; social media; legal; organizational; informative; ecological; technical, criminal.

The causes of danger, in our opinion, can be classified according to the following characteristics:

- by nature of occurrence: at the macro and micro levels, cultural and ethical, accidental and criminal;
- whose fault the danger arose: management, debtors, business partners, third parties;
- according to the nature of occurrence and source of damages: own actions, actions of third parties, natural disasters, accidents, cataclysms;
- according to the possibility of the enterprise influencing the elimination of threats: eliminated by the enterprise itself, difficult to eliminate, not eliminated;
- by the possibility of prediction and diagnosis: predicted and diagnosed, causes not predicted.

In our opinion, it is most expedient to determine the economic security factors of the enterprise primarily depending on the degree of measurement, which can be divided into two groups.

External factors: change in the form of ownership, change in state priorities regarding industrial policy; change of environment (consumers - suppliers); decrease in production and consumer demand and decrease in the domestic market; credit system, unavailability of development resources; instability of the legislative framework and tax system; growing unemployment, international competition.

Internal factors: ineffective management and marketing; low level of use of all types of resources, in particular fixed assets;

inefficient asset structure; growth of receivables; insufficiently differentiated range of products and its lack of competitiveness.

It is clear that the level of stability of the enterprise depends on the effective activity of the enterprise's services, namely: how much it is possible to prevent threats and eliminate losses from their negative effects on various aspects of the enterprise's functioning. The sources of such negative influences can be: conscious or unconscious actions of people, organizations, including state authorities, international organizations or competing enterprises, as well as a coincidence of objective circumstances - the state of the financial situation in the company's markets, scientific discoveries and technological developments, force majeure, etc. Depending on the subjective conditioning of negative effects on the economic security of the enterprise, the following gradation can be applied:

- objective negative impacts occur without participation and regardless of the will of the enterprise or its employees.

- subjective negative effects arise as a result of ineffective work of the enterprise as a whole or its employees.

We analyzed the components of the company's IS and sources of threats to the company's information security. In order to determine the IS strategy of the enterprise and proceed to the assessment of the economic feasibility of information protection at the enterprise, we will reveal the methods and means of protecting confidential information at the enterprise.

8.8. Methods and means of protecting confidential information in the enterprise

To prevent and eliminate threats to information security, legal, software-technical, and organizational-economic methods are used. Legal methods - provide for the development of a complex of normative legal acts and provisions regulating information relations in society, guiding and normative-methodical documents on ensuring information security.

Software and technical methods are a set of tools:

– prevention of information leakage;

– excluding the possibility of unauthorized access to information;

– prevention of influences that lead to the destruction, destruction, distortion of information, or failures or failures in the functioning of the means of informatization;

– detection of embedded devices;

– exclusion of interception of information by technical means;

– use of cryptographic means of information protection during transmission through communication channels.

Organizational and economic methods provide for the formation and ensuring the functioning of systems for the protection of secret and confidential information, certification of these systems in accordance with information security requirements, licensing of activities in the field of information security, standardization of methods and means of information protection, control over the actions of personnel in protected information systems Motivation, economic stimulation and psychological support of the personnel who ensure information security are important for the prevention of information threats.

The concept of information protection. The protection of information is understood as a set of measures and actions aimed at ensuring its safety, confidentiality and integrity - in the process of collection, transmission, processing and storage.

The essence of information protection is the identification, elimination or neutralization of negative sources, causes and conditions of influence on information. These sources are a threat to information security. The purpose and methods of information protection reflect its essence.

Prevention of possible threats and illegal actions can be ensured by all means, starting from the creation of a climate of deeply aware attitude of employees to the problem of security and information protection to the creation of a deep, echeloned system of protection by physical, hardware, software and cryptographic means. Prevention of threats is also possible by obtaining information about illegal acts that are being prepared, planned thefts, preparatory actions and other elements of criminal acts. In the prevention of threats, an important role is played by the information and analytical activities of the security service based on a deep analysis of the criminogenic situation and the activities of competitors and criminals.

The purpose of detection is to carry out activities related to the collection, accumulation and analytical processing of information on the possible preparation of criminal actions by criminal structures or competitors on the market of production and sale of goods and products.

Identifying threats is the act of identifying specific threats and their sources that cause one or another type of damage. These actions include the detection of embezzlement or fraud, as well as disclosure of confidential information or cases of unauthorized access to sources of trade secrets.

Termination or localization of threats are actions aimed at eliminating an active threat and specific criminal actions.

Elimination of the consequences is aimed at restoring the state that preceded the onset of the threat.

All these methods are aimed at protecting information resources from illegal encroachments and ensuring:

– prevention of disclosure and leakage of confidential information;

– prohibition of unauthorized access to sources of confidential information;

– preserving the integrity, completeness and availability of information;

– compliance with the confidentiality of information;

– copyright protection.

Protected information includes information that constitutes state, commercial, official and other secrets protected by law. Each type of protected information has its own peculiarities in the field of regulation, organization and implementation of this protection.

The most general signs of protection of any type of protected information are:

– information protection is organized and carried out by the owner or master of the information or persons authorized by him (legal or physical);

– by protecting information, the owner protects his rights to own and dispose of information, seeks to protect it from illegal acquisition and use to the detriment of his interests;

– information protection is carried out by carrying out a set of measures to limit access to protected information and create conditions that exclude or significantly complicate unauthorized, illegal access to classified information and its carriers.

Thus, information protection is a set of measures taken by the owner of information to protect their rights to own and dispose of information, create conditions that limit its distribution and exclude or significantly complicate unauthorized, illegal access to classified information and its carriers.

Protected information, which is a state or commercial secret, as well as any other type of information, is necessary for management, research and production and other activities. Currently, before the protection of information, a more significant task is required: to ensure the security of information. This is due to a number of circumstances, and first of all, the fact that computers are increasingly used in the storage and processing of protected information, in which not only information can be leaked, but also its destruction, distortion, forgery, blocking and other interventions in information and information systems.

Thus, information protection is the activity of the information owner or a person authorized by him to:

– ensuring one's rights to possession, disposal and management of protected information;

– prevention of leakage and loss of information;

– preserving the completeness, reliability, integrity of protected information, its arrays and processing programs;

– preserving the confidentiality or secrecy of protected information in accordance with the rules established by legislative and other regulatory acts.

The task of information protection. The means of ensuring the preservation and protection of information in a state organization, enterprise or firm differ in their scope and form. They depend on the production, financial and other capabilities of the enterprise, on the number of secrets it protects and their importance. At the same time, the choice of such measures must be carried out according to the principle of economic expediency, observing the "golden mean" in financial calculations, since excessive closure of information, as well as negligent attitude to its preservation, can cause the loss of a certain share of profit or lead to irreparable losses. The lack of a clear understanding of the conditions that contribute to the leakage of confidential information by the heads of enterprises leads to its unauthorized distribution.

The presence of a significant number of vulnerabilities in any modern enterprise or firm, a wide range of threats, and the rather high technical equipment of attackers requires a reasoned choice of special solutions for information protection. The basis of such decisions can be considered:

1. Application of scientific principles to ensure information security, including: legality, economic feasibility and profitability, independence and responsibility, scientific organization of work, close connection between theory and practice, specialization and professionalism, program-target planning, interaction and coordination , availability combined with the necessary privacy.

2. Acceptance of legal obligations by the company's employees in relation to the preservation of information (information) entrusted to them.

3. Creation of such administrative conditions under which the possibility of theft, embezzlement or misrepresentation of information is excluded.

4. Lawful involvement in criminal, administrative and other types of liability, which guarantee full compensation for loss of information.

5. Carrying out effective control and verification of the effectiveness of planning and implementation of legal forms, information protection methods in accordance with the selected security concept.

6. Organization of contractual relations with state regulatory bodies in the field of information protection.

7. When carrying out a set of protective measures, the main thing is to limit access to those places and to those equipment where confidential information is concentrated (not forgetting, of course, the possibilities and methods of remote obtaining it). In particular, the use of high-quality locks, alarm devices, good sound insulation of walls, doors, ceiling and floor, sound protection of ventilation channels, openings and pipes passing through these rooms, dismantling of excess wiring, as well as the use of special devices (noise generators,

etc.) will seriously complicate or will make attempts to implement special equipment pointless.

For reliable protection of confidential information, it is advisable to apply the following organizational measures:

1. Determination of levels (categories) of confidentiality of protected information.
2. Selection of principles (local, object or mixed) methods and means of protection.
3. Establishing the procedure for processing protected information.
4. Accounting for spatial factors:
   - introduction of controlled (protected) zones;
   - the correct choice of premises and the location of objects among themselves and in relation to the border of the controlled zone;
5. Accounting for temporary factors:
   - limiting the processing time of protected information - bringing the processing time of information with a high level of confidentiality to a narrow circle of persons;
6. Accounting for physical and technical factors:
   - determination of the possibility of visual (or using technical means) observation of the displayed information by third parties, disconnection of the control and measurement equipment from the information object and its de-energization, the maximum separation of information cables between themselves and in relation to conducting structures, their intersection under a straight line corner.

In order to block possible channels of information leakage through technical means of ensuring production and labor activities with the help of special technical means and creating a system of protection of the object, it is necessary to take a number of measures: analyze the specific features of the location of buildings, premises in buildings, the territory communications are built around them; to highlight the premises inside which confidential information circulates and to take into account the technical means used in them.

After determining the components of information security, as well as determining the sources of threats to information security and methods and means of protecting confidential information at the enterprise, an algorithm for creating a system for ensuring the information security of the enterprise should be developed (fig. 8.4):

1. The purpose and tasks of the enterprise are analysed.

2. The state of the enterprise is analysed and the necessary level of information security of the enterprise is determined. On the basis of this information, information security criteria, their deviations from the threshold values are evaluated, and the causes of deviations are analyzed.

3. The concept, policy and programs for ensuring the information security of the enterprise are being developed.

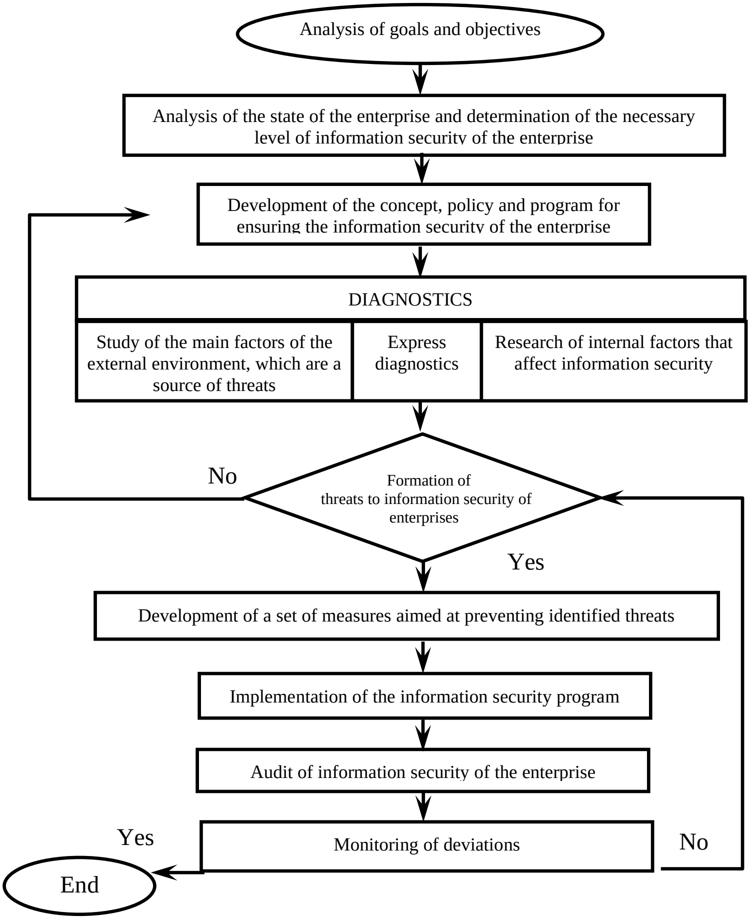

Figure. 8.4 Algorithm for creating a system for ensuring enterprise information security

4. Diagnostics of the enterprise is carried out. The main factors of the external environment, which are a source of threats, and internal factors that affect information security are analysed.

5. A list of threats to the company's information security is formulated. If this list is formulated, then we proceed to the development of a set of measures aimed at preventing the identified threats. If this list is difficult to formulate, we return to the analysis of the state of the enterprise and the determination of the necessary level of information security of the enterprise.

6. A set of measures aimed at preventing identified threats or reducing costs in case of their implementation, including measures to localize threats and eliminate their consequences, is being developed.

7. An information security program is being implemented.

8. An audit of the company's information security is conducted.

9. Control of deviations is carried out after the audit.

The proposed algorithm is not tied to specific tasks and problems facing the enterprise, therefore it is universal in nature and can be used at all enterprises in the field of communication.

TEST QUESTIONS:

1. Explain the role and importance of information security in the context of the development of the digital economy?

2. What is global security and how is it related to economic and national security?

3. Name and explain the components of global security?

4. Define the term "information security"?

5. Define the concept of "information security" in a narrow and broad sense?

6. What is information protection?

7. Tasks of information security management?

8. Name the components of information security? Describe each component.

9. What are the channels of information leakage? Describe existing leakage channels.

10. How are information security threats classified?

GLOSSARY

A/B testing (A/B Testing) - a control group of items is compared with a set of test groups in which one or more indicators have been changed in order to find out which changes improve the target indicator.

Automated learning is a concept that describes the process of developing systems that can learn and improve their performance without external intervention.

Sentiment Analysis – a class of content analysis methods in computer linguistics designed for automated detection of emotionally colored vocabulary in texts and emotional assessment of authors (opinions) in relation to the objects mentioned in the text.

Time Series Analysis is a set of mathematical and statistical methods of analysis designed to identify the structure of time series and forecast it.

The business process is a set of interrelated operations and procedures, with the help of which a specific commercial goal of the company's activity is realized within the framework of the organizational structure, while the functions of the structural divisions and their relationship with each other are clearly defined and fixed in advance.

White optimization is a search engine optimization that does not use prohibited and unscrupulous methods of promotion.

Blockchain is algorithms and protocols for decentralized storage and processing of transactions, structured in the form of a sequence of linked blocks without the possibility of their further change**.**

Big data (Big Data) are technologies for collecting, processing and storing structured and unstructured arrays of information, which are characterized by a significant volume and speed of changes (including in real time), which requires special tools and methods of working with them.

Identifying threats is the act of identifying specific threats and their sources that cause one or another type of damage.

Knowledge Representation is the process of modeling knowledge in computer systems so that systems can understand, interpret and use this knowledge.

Virtual reality (VR) is software that immerses users in a three-dimensional, interactive virtual environment, usually using a VR sensor device that transfers real-world action into a virtual world.

Internal optimization - involves the entire set of activities focused on the site itself (keywords, link anchors, human-understandable URLs, meta tags and micro markup, etc.).

The field of artificial intelligence is the field of social relations that arise in the process of applying artificial intelligence technologies with the use of specific methods and means of computer technology.

Genetic Algorithms are an optimization method that simulates the process of natural selection to find the best solutions in optimization problems.

Hybrid clouds - a cloud infrastructure that is a composition of two or more different cloud infrastructures (private, collective or public), which are independent objects interconnected by technologies that allow data or computer programs to be transferred between these objects**.**

Deep learning is a subfield of machine learning that uses neural networks with many layers to solve complex problems.

A public (collective) cloud is a cloud infrastructure that is shared between a defined group of interconnected users of cloud services who have common needs and is controlled by users of cloud services themselves or their representatives.

Augmented Reality (AR) - superimposes virtual elements on a real-world scene, allowing users to exist in the space they are physically in, but benefit from the augmented elements in their experience.

External optimization is a set of measures aimed at obtaining targeted external links to a resource.

Decentralized finance (DeFi) is an analogue of traditional financial services in the cryptocurrency market.

Electronic business is business activity or economic activity of companies through global information networks, with the aim of obtaining profit.

Electronic democracy is the use of electronic technologies in electoral processes, public affairs management and ensuring the openness of government activities.

Electronic commerce is a relationship aimed at making a profit, arising during the execution of transactions related to the acquisition, change or termination of civil rights and obligations, carried out remotely using information and telecommunication systems, as a result of which the participants of such relations have rights and obligations ties of a property nature.

Electronic trade - economic activity in the field of electronic purchase and sale, sale of goods remotely to the buyer by performing electronic transactions using information and communication systems.

Electronic insurance services – insurance services that can be ordered using the Internet.

Public clouds are cloud infrastructure that is potentially available to an indefinite number of cloud service users and is controlled by a cloud service provider.

Information protection is an activity aimed at ensuring the confidentiality, integrity and availability of information in the process of receiving, storing, processing and distributing it using organizational, legal, technical and economic means.

Mixing and integration of data (Data Fusion and Integration) is a set of methods that allow you to integrate and analyze various data from different sources for in-depth analysis more accurately and efficiently than from a single data source.

Simulation modeling (Simulation Modeling) is a research method in which the system being studied is replaced by a model that describes the real system with sufficient accuracy (the constructed model describes the processes as they would occur in reality), from which experiments are carried out, in order to obtain information about this system.

Internet marketing is a complex of the company's marketing activities related to the use of electronic means, the object of which is the information-analytical and expert-research activity of the enterprise (organization, company).

Internet banking is a technology for providing banking services on the basis of orders sent by the client remotely (that is, without his visit to the bank), most often using computer and telephone networks.

Internet commerce is electronic commerce limited to the use of the Internet only.

Information security of the enterprise is the state of protection of the enterprise's information from the destabilizing influence of external and internal threats.

State information security is a component of national security that characterizes the state of protection of national interests in the information sphere from external and internal threats.

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.

Quantum technologies are technologies for creating computer systems based on new principles (quantum effects), which allow to radically change the methods of transmission and processing of large data sets.

Cyber security – providing protection against cyber threats and crime, in particular, with the help of data encryption and the use of modern identification methods.

Classification is the dependence of input data on discrete outputs.

Clustering is the grouping of data based on the properties of the data. Data within a cluster must have the same properties and must differ from data properties in other clusters.

Components of robotics (industrial robots) are production systems with three or more degrees of mobility (freedom), built on the basis of sensors and artificial intelligence, capable of perceiving the environment, controlling their actions and adapting to its changes.

A user of cloud services is a natural or legal entity that uses cloud services to meet its own needs.

Crowdsourcing is a method of collecting, categorizing and enriching data by a wide range of people involved on the basis of a public offer, without entering into labor relations, usually by using network media.Краудфандинг – фінансування, що означає «фінансування натовпом» або «громадське фінансування».

Elimination of threats - restoration of the state that preceded the threat.

Mining (from the English mining - extraction) is the activity of creating new structures (usually new blocks in the blockchain) to ensure the functioning of cryptocurrency platforms. For the creation of another structural unit, a reward is usually provided at the expense of new (issued) units of cryptocurrency and/or commission fees. Usually, mining is reduced to a series of calculations with the selection of parameters to find a hash with given properties. Mining is not the only technology for creating new blocks and ensuring emission. Alternatives are forging (minting) and ICO. Usually only one technology is used, but some cryptocurrencies use combinations of them.

Machine Learning (ML) is a branch of AI that allows systems to learn from data and improve their performance over time without explicit programming.

Network analysis (Network Analysis) is a set of methods used to describe and analyze relationships between discrete nodes in a graph or network.

A metaverse is a virtual space in which people can create their own avatars or characters to interact with other users or digital objects.

Multicloud is the use of several cloud computing technologies and storage services in a single architecture adapted for this, in contrast to the hybrid cloud, where different deployment models are combined.

Association Rule Learning (Association Rule Learning) is a set of methods for analyzing necessary relationships, i.e. "association rules", among variables in large databases.

A cloud service provider is a legal entity or an individual entrepreneur who provides one or more cloud services independently or jointly with other cloud service providers.

"End-to-end" digital technologies are technologies used to search, collect, store, process, transmit and present data in electronic form, the basis of which are software and hardware tools and systems that are needed in all sectors of the economy, create new markets and change business processes and business models.

Neural networks are models that simulate the work of the human brain and are used in many machine learning tasks.

Neurotechnologies are cyber-physical systems that partially or completely replace/supplement the functioning of the nervous system of a biological object based on artificial intelligence.

Reinforcement Learning is a type of machine learning where an agent learns to make decisions in an environment to maximize rewards.

Product marketing is a branch of marketing that focuses on product/product improvement based on user experience, customer retention and return.

Private clouds are cloud infrastructure prepared for use by a single user of cloud services and controlled by him.

Termination or localization of threats are actions aimed at eliminating an active threat and specific criminal actions.

Predictive analytics (Predictive Analytics) is a class of data analysis methods, focusing on predicting the future behavior of objects and subjects in order to make optimal decisions.

Industrial Internet – data transmission networks connecting devices in the production sector, equipped with sensors and able to interact with each other and the external environment without human intervention.

Spatial analysis (Spatial Analysis) is a set of methods that analyze topological, geometric or geographic properties presented in a data set.

Image recognition (Computer Vision) is a field that allows computers to recognize objects, faces, and other images in images or videos.

Smart production technologies are a modern approach to the organization of production of industrial products, focused on intelligent management of the production process, based on the application of digital and information and communication technologies.

Server farms are an association of servers connected by a data transmission network that works as a single entity.

Gray optimization - adding a large number of keywords to the text of the page.

A smart contract is an innovative technology that allows optimizing various processes and methods of interaction between computers and people.

Society 5.0. - a new social paradigm that changes the information society (society 4.0), and implies the total spread of IoT (Internet of Things), the application of Big Data (technologies of working with huge data sets) and AI (artificial intelligence) to it.

Wireless communication technologies are data transmission technologies using a standardized radio interface without using a wired connection to the network.

Virtual and augmented reality technologies are visualization technologies based on adding information or visual effects to the physical world by overlaying graphic and/or audio content to improve user experience and interactive capabilities.

Cloud computing technologies are technologies for providing remote access to cloud infrastructure through electronic communication networks at the user's request.

Artificial intelligence technologies – information technologies using artificial intelligence.

Technological structure - groups of technological aggregates that stand out in the technological structure of the economy, are connected to each other by the same type of technological chains and form wholes that are reproduced.

A tokenized asset is a type of virtual asset that exists in the distributed ledger token accounting system as a record with an identifier of information derived from the original asset.

Tokenized legal relations are legal relations between users of digital assets as subjects of law regarding the object of law, which is the object of accounting carried out using a distributed ledger token.

A thin client is a computer or client program in networks with a client-service or terminal architecture that transfers all or most of the information processing tasks to the server. An example of a thin client can be a computer with a browser that is used to work with web applications.

Thick client - in the "client-server" architecture, it is an application that provides (in contrast to the "thin client") an expanded range of functionality, regardless of the central server. Under this approach, the server acts as a data store, and all the work of processing and providing data goes to the client's computer.

Fiduciary (from Latin fiducia — trust) or fiat (from Latin fiat — decree, instruction), symbolic, paper, credit, unsecured money, money not backed by gold and other precious metals, the nominal value of which is established and guaranteed by the state regardless of the cost of the material used in their manufacture.

The Amazon Web Services (AWS) cloud is a collection of all servers connected to the network, on which its service platform is located, and an operating system that unites several servers into a single entity.

The cloud (cloud infrastructure) is a set of dynamically distributed and configurable cloud resources that can be quickly provided to the user of cloud services and released through global and local data transmission networks.

Cloud services - a service for providing cloud resources using cloud computing technology.

Cloud resources - any technical and software means or other components of an information (automated) system, access to which is provided by cloud computing technologies, in particular, processing time (computing power), space in data stores, computer networks, databases and computer programs.

A digital asset is any object that has value and is represented in a digital or computerized form. It can be a financial asset (a bond), a tangible asset (a work of art), or an intangible asset that is created in a digital environment.

The digital economy is a system of social, cultural, economic and technological relations between the state, the business community and citizens, which functions in the global information space, which generates digital types and forms of production and promotion to the consumer of products and services, which contributes to continuous innovative changes in methods management and technologies in order to improve the efficiency of socio-economic processes.

A digital ecosystem is a network of interconnected digital technologies, platforms and services that interact with each other to create value for businesses and consumers.

Digital management is an organization management system based on the use of digital technologies.

Digital education – introduction of online learning and distance learning formats to improve qualifications and access to education.

Digital platforms are online platforms where buyers and sellers can meet, collaborate and interact, such as marketplaces and social networks.

Black optimization - optimization aimed at increasing the site in search results in ways that are not approved by search engines.

Artificial intelligence (AI) is the property of systems to correctly interpret external data in accordance with a set goal, learn from such data and use the results of learning to achieve the set goals, including the collection and use of new data, through interaction with the environment.

Artificial neural networks (Artificial Neural Networks) are a mathematical model built on the principle of organization and functioning of biological neural networks - networks of nerve cells of a living organism.

AgriTech (agricultural technologies) is the application of technologies in agriculture to optimize production, monitor plants, automate processes and reduce the impact of agricultural activities on the environment.

Ahrefs – offers a suite of search engine optimization tools that make it easy to optimize your website to meet your marketing requirements.

AITech (artificial intelligence technologies) – the use of artificial intelligence in various fields, including machine learning, natural language processing, computer vision, and other advanced algorithms.

Amazone Chime – meetings, video calls and chats.

Amazone Chime Voice Connector SIP– tracking and advanced telephony functions.

Amazon Connect –cloud contact center.

Amazon Honeycode – creating mobile and web applications without programming.

Amazon Pinpoint – multi-channel marketing communications.

Amazone Pinpoint API – flexible mobile SMS and push messages.

Augmented Reality (AR) Tech – using augmented reality to create immersive interactive experiences.

Amazon WorksDocs – secure storage and exchange of corporate documents.

Amplitude – is a product analytics tool that structures data on user behavior, visualizes it for further decision-making.

ASO (App Store Optimization) – it is a set of measures to optimize a mobile application (most often, an application for iOS or Android) in order to improve its visibility and attract a target audience in application stores (for example, App Store from Apple or Google Play from Google).

AWS Coast Explorer – is a cost viewer for analyzing costs and usage of services (user).

AWS Billing Conductor – is an invoicing manager that simplifies the invoicing process with customizable costs and pricing transparency.

AWS Budgets – is a budget that allows the user to set individual spending and usage budgets.

AWS Coast and Usage Report – report on expenses and use of services.

Big Table – a proprietary distributed database system built on the basis of the Google File System.

Bitcoin – the first cryptocurrency, but the possibilities of writing smart contracts in it are very limited.

Blockchain – it is a chain of formed blocks of transactions built according to certain rules.

Business Intelligence (business analytics) - a set of methodologies, processes, architectures and technologies that will transform large volumes of "raw" data into meaningful and useful information suitable for business analysis and to support the adoption of optimal tactical and strategic decisions.

Canva – is a drag-and-drop design platform that allows users to create images using their own images, icons, shapes, and fonts from the Canva catalog.

Cassandra – a freely distributed database management system designed to manipulate large volumes of data in distributed systems.

CivicTech (civic technology) – using technology to improve citizen interaction with government, including electronic voting, open data, online petitions, and other tools for citizen participation.

ClickMeter – a tool capable of tracking, comparing and optimizing all of a brand's marketing links in one place.

Cloud Computing (cloud computing) – a computing paradigm in which highly scalable computing resources, usually configured as distributed systems, are provided in networks as services.

CloudTech (cloud computing technologies) – the use of cloud computing for data storage, calculations, providing access to programs and services via the Internet.

Cybersecurity Tech (cyber security technologies) – development of technologies and tools to protect information from cyber threats, including antivirus programs, network security measures and other cyber security solutions.

Data Warehouse (data warehouse) – a subject-oriented information database, specially developed and intended for the preparation of reports and data analysis for the purpose of supporting decision-making in the organization and is one of the main components of business analysis.

D-commerce (Dynamical commerce) **-** dynamic commerce is dynamic pricing that allows sellers to achieve the highest transparency of operations and conduct electronic transactions on the most favorable terms.

Distributed System (distributed system) – many computers interacting over a network and united to solve a common computational task.

Dynamo – a proprietary distributed data storage system developed at Amazon.

EdTech (educational technologies) – the use of digital tools and platforms to improve education, including online courses, distance learning, interactive learning and other technological innovations in the field of education.

Ethereum – an open online platform where you can write any smart contract, but you need to pay for it with blockchain cryptocurrency.

FinTech (financial technology) **-** expanding the use of technology for financial services, including online banking, mobile payment applications, blockchain for money transfers, cryptocurrencies and other innovative solutions in the financial sphere.

GameFi – are blockchain projects that allow users to earn through gameplay.

Global Ledger – a solution that eliminates risks when working with cryptocurrencies.

Google Analytics – the primary tool for identifying and tracking user navigation on a website that has been around since the dawn of digital marketing.

Google File System – a proprietary distributed file system. The Hadoop system was built on its basis.

Google Keyword Planner – a tool that allows you to improve the effectiveness of keywords and adjust search engine optimization.

GovTech (governance technologies) – the use of technologies to optimize government services, ensure interaction between the government and citizens, improve election systems, create electronic platforms for providing services, etc.

GreenTech (green technologies) – technologies aimed at protecting the environment and reducing human impact on nature, including renewable energy sources, waste disposal, water conservation technologies and other energy and resource conservation solutions.

Hadoop – a project of the Apache Software Foundation, a free set of utilities, libraries and frameworks for the development and execution of distributed applications running on clusters of hundreds and thousands of nodes.

Hbase – a freely distributed distributed non-relational database based on Google's Big Table.

HealthTech (medical technologies) – the use of information technologies and data to improve medical services, including telemedicine, medical applications, collection and analysis of health data.

Hotjar – a popular analytics tool that provides insight into how consumers interact with a website and apps.

Hootsuite – one of the first social media management systems, it allows you to create, schedule and publish content to multiple social media channels.

InsurTech (insurance technology) – the use of technology to facilitate insurance processes, including online policies, use of data to assess risks and improve customer service.

IoT (Internet of Things technologies) - a network of physical objects that are equipped with sensors, software and other technological means that allow these objects to collect and exchange data.

Just Walk Out technology – technologies of retail trade without cash registers.

LegalTech (legal technologies – use of innovative technologies to improve and optimize legal services and processes in the field of law.

Lumen5 – is a video creation platform designed for brands and businesses to create compelling video content for social posts, stories, and ads.

MailChimp – is a social advertising and e-marketing tool designed to organize and automate digital marketing campaigns.

Mapreduce – a distributed computing model introduced by Google that is used for parallel computing on very large data sets, up to several petabytes, in computer clusters.

MarTech (marketing technologies) – the use of technologies to optimize marketing strategies and campaigns, including analytics, marketing automation, CRM systems and other marketing tools.

Mashup – a web application that combines data from multiple sources into one integrated one, for example, combining map data from Google Maps with real estate data from Craigslist results in a unique new web service that is not offered by any data source from the start.

M-commerce (Mobile commerce) – commerce using mobile services.

Media Buying – the direction of marketing, which involves the purchase of advertising space or time on various media platforms on the Internet for the subsequent placement of advertising materials.

MeetEdgar – a social media management tool that integrates with LinkedIn, Twitter, Facebook and Instagram.

Moosend – is another email marketing tool that lets you create, monitor and manage all your email campaigns in one place.

NXT – an open online platform with a limited number of smart contracts written according to blockchain templates.

Optimizely – combines visual creation and audience targeting tools to quickly test different audience segments.

PPC (Pay per click) – is a form of online advertising that involves paying for each click on an advertising banner or link.

PropTech (real estate technology) – the use of technology to optimize real estate management, including platforms for search, booking, market analytics and efficient building management.

Push-marketing is a direction of marketing in which companies actively study and influence their target audience through the active distribution of advertising messages aimed at supporting their products or services.

Reserved Instance Reporting – reserved instances report.

RetailTech (retail technologies) – the use of technologies to improve processes in retail trade, including online sales, self-service checkouts, customer behavior analytics and other solutions.

Saving Plans – savings plans that save up to 72% on computing resources with flexible pricing.

Securitize – platform for tokenization of securities.

SEMrush – is a comprehensive marketing toolkit that helps increase business visibility online through SEO optimization, content marketing, market research, advertising, social media management and search engine reputation management.

Sensor Tower – a platform for analytics, optimization and promotion of mobile applications for AppStore and Google Play, as well as monitoring the effectiveness of advertising campaigns.

SEO (Search Engine Optimization) – is the process by which a website is rebuilt or improved in order to improve its position on search engine results pages.

SimilarWeb – a service for analyzing various websites, applications, platforms for advertising.

SMM (Social Media Marketing) – this is a set of works aimed at promoting a specific product or service in social networks, the main task of which is to popularize the brand and attract attention to the company.

Sprout Social – is a comprehensive social media management platform with tools for publishing, engagement, analytics and more.

Stream Processing – a technology designed to process large streams of data in real time.

T-commerce (Televigion commerce) – commerce using interactive digital television.

TravelTech (travel technology) - the use of technology to optimize travel, including online booking, price comparison, navigation applications, innovation in tourism and hospitality.

Typeform – cloud service for creating forms, tests and surveys.

U-commerce (Universal commerce) – it is the ability to perform commercial actions with an electronic device at any time.

Unbounce – is a landing page and website optimization platform that allows businesses to create, publish, and test landing pages, popups, and panels without the need for IT or web development resources.

V-commerce (Voice commerce) – voice commerce. These are automated transactions on the Internet, which are carried out through voice portals using a computer or phone thanks to voice commands. Voice portals, such as brokerage systems, can control home devices over the Internet.

Visme – is an easy-to-use tool that allows you to create a variety of designs for marketing use, including presentations, infographics, web banners, animations, printed materials.

Virtual Reality (VR) **–** using virtual reality to create immersive interactive experiences.

Weld Money – cryptocurrency card service.

LITERATURE

1. Верховна Рада України. (2022, 8 липня). Про затвердження завдань Національної програми інформатизації на 2022-2024 роки (2360-IX). https://zakon.rada.gov.ua/laws/show/2360-20 (дата звернення: 20.10.2023).

2. ДСТУ ISO/IEC TR 13335-1:2003 Інформаційні технології. Настанови з керу-вання безпекою інформаційних технологій (ІТ). Частина 1. Концепції й моделі безпеки ІТ (ISO/IEC TR 13335-1:1996, IDT) URL: https://online.budstandart.com/ua/catalog/doc-page.html?id_doc=71834 (дата звернення: 1.06.2023).

3. Закон України «Про віртуальні активи» від 17.02.2022 № 2074-IX URL: https://zakon.rada.gov.ua/laws/show/2074-20#Text (дата звернення 3.11.2023)

4. Закону України «Про електронну комерцію» від 03.09.2015 р. № 675-VIII URL: https://ips.ligazakon.net/document/T150675?an=1&ed=2022_01_01(дата звернення: 10.09.2023).

5. Закон України „Про захист інформації в інформаційно-комунікаційних систе-мах” від № 1089-IX від 16.12.2020. URL:ttps://zakon.rada.gov.ua/laws/show/80/94 (дата звернення: 22.11.2023).

6. Закон України «Про хмарні послуги». Офіційний портал Верховної Ради: веб-сайт. URL: https://zakon.rada.gov.ua/laws/show/2075-20#Text (дата звернення: 27.11.2023).

7. Андрощук Г.О. Штучний інтелект: економіка, інтелектуальна власність, загрози // Теорія і практика інтелектуальної власності № 2 (2021). С.56-74.

8. Бабаченко Л.В., Москаленко В.А., Марченко А. О. Сучасні тенденції застосування інструментів digital-marketing в діяльності підприємства. Вісник аграрної науки Причорномор’я. 2019. № 4. С. 20–29. URL: https://doi.org/10.31521/2313-092x/2019-4(104)-3 (дата звернення: 07.03.2023).

9. Безштанько В.М. Основні види загроз інформаційним активам організації. Би-знес и безопасность. №5. 2006. С. 80.

10. Бурячок В.Л., Толюпа С.В., Семко В.В. Інформаційний та кіберпростори: про-блеми безпеки, методи та засоби боротьби: посібник. – К.: ДУТ-КНУ, 2016. 178 с.

11. Вовчук О., Шпилик С. SMM-просування у соціальних мережах. Маркетингові технології підприємств в сучасному науково-технічному середовищі 2017: мат. VIII Регіон. наук.-практ. інт.-конф. 20 грудня 2017 р. Тернопіль: ТНТУ. 2017. С. 137-138.

12. Виговська О., Бєлоусова Н. Інформаційна складова національної безпеки України: кол. монографія / Ін-т міжнар. відносин, Київ. нац. ун-т ім. Тараса Шевченка, Київ. ун-т ім. Бориса Грінченка. Київ: Київ. ун-т ім. Б. Грінченка, 2017. 166 с.

13. Виноградова О. В., Недопако Н. М. Digital маркетинг: еволюція розвитку в Україні. Економічний вісник Національного технічного університету України «Київський політехнічний інститут». 2021. № 18. С. 103-108. URL: https://doi.org/10.20535/2307-5651.18.2021.240678 (дата звернення: 07.03.2023).

14. Головенчик, Г. Г. Цифровая экономика [Электронный ресурс]: учеб.-метод. комплекс / Г. Г. Головенчик. – Минск: БГУ, 2020. – 1 электрон. опт. диск (CD-ROM). ISBN 978-985-566-847-4.

15. Гребенюк А.М., Рибальченко Л.В. Основи управління інформаційною безпе-кою: навч. посібник. Дніпро. 2020. 144 с.

16. Гриценко С.І. Цифровий маркетинг – нова парадигма розвитку освітніх кластерів в умовах глобалізації. Вісник економічної науки України. 2016. № 1. С. 29-31.

17. Дрокіна Н.І. SEO-оптимізація сайту підприємства як інструмент інтернет-маркетингу. Науковий вісник Ужгородського національного університету. Серія: Міжнародні економічні відносини та світове господарство. 2018. №. 19(1). С. 127-132. URL: http://nbuv.gov.ua/UJRN/Nvuumevcg_2018_19(1)__30 (дата звернення: 10.03.2023).

18. Ексабайтова економіка: підручник. За науковою ред. Татомир І.Л., Шульжика Ю.О. Трускавець: ПОСВІТ, 2022. 292 с

19. Інститут проблем штучного інтелекту МОН України і НАН України. (2021). Національна стратегія розвитку штучного інтелекту в Україні 2021-2030: проєкт. URL: https://bit.ly/3rconkm (дата звернення: 5.01.2024).
20. Кабінет Міністрів України. (2020, 20 грудня). Про схвалення Концепції розвитку штучного інтелекту в Україні (1556-р). https://bit.ly/3XBWNJg (дата звернення: 8.01.2024).
21. Карпіщенко О.О., Логінова Ю.Е. Економічні проблеми сталого розвитку: матеріали доповідей Міжнародної науково-практичної конференції, присвяченої 20-річчю наукової діяльності ф-ту економіки та менеджменту СумДУ, 3-5 квітня 2012 р. Суми: СумДУ, 2012. С. 177-178.
22. Кононович В.Г., Стайкуца С.В., Тардаскіна Т.М., Шинкарчук Т.М. Забезпечення інформаційної безпеки цифрових програмно керованих АТС Інформаційна безпека телефонного зв'язку: навч. посібник / За ред. чл.-кор. МАЗ В.Г. Кононовича. – Одеса: ОНАЗ ім. О.С. Попова, 2010. С. 168.
23. Кононюк А.Е. Фундаментальная теория облачных технологий. В 18-и книгах. Кн.1. К.: Освіта України. 2018. 620 с.
24. Кормич Б.А. Інформаційна безпека: організаційно-правові основи: навч. посіб-ник. К.: Кондор, 2004. 384 с.
25. Кочетов Э.Г. Украина и ее регионы на пути к инновационному обществу. Глобалистика, геоэкономика, мировой порядок и новая модель безопасного развития / Э.Г. Кочетов, В.И. Дубницкий; [под общ. ред. И.П. Булеева, В.И. Дубницкого]. – Донецк: Юго-Восток, Лтд, 2011 – Т.1. 573 с.
26. Логінова Н.І., Дробожур Р.Р. Правовий захист інформації: навчальний посіб-ник. Одеса: Фенікс, 2015. 264 с., іл.
27. Маркетингові комунікації: підручник / Н. В. Попова, А. В. Катаєв, Л. В. Базалієва, О. І. Кононов, Т.А. Муха; під загальною редакцією Н.В. Попової. Харків: «Факт», 2020. 315 с.
28. Месарович М., Мако Д., Такахара И., Теория иерархических многоуровневых систем. М: Мир, 1973. 344 с.
29. Месарович М. Человечество у поворотного пункта / М. Месарович, Е. Пестель // Доклади римського клубу. 1974. № 75. 73 с.

30. Минулого року ринок e-commerce досяг $4 мільярдів URL: https://dia.dp.gov.ua/minulogo-roku-rinok-e-commerce-dosyag-4-milyardiv/ (дата звернення: 15.10.2023).

31. Музиченко А.О., Скорба О.А., Шевчук А.А. Штучний інтелект як засіб оптимізації бізнес-процесів в електронній комерції. Академічні візії. 2003. Вип. 25. С. 1-13.

32. Мэддисон Энгас. Контуры мировой экономики в 1-2030 гг. Очерки по макроэкономической истории // Перевод с английского Ю. Каптуревского; под редакцией О. Филаточевой. – М.: Издательство Института Гайдара, 2012. 584 с.

33. Національна стратегія розвитку штучного інтелекту в Україні 2021-2030 / Міністерство освіти і науки України Національна академія наук України. URL: https://www.naiau.kiev.ua/images/news/img/2021/06/strategiya-110621.pdf. (дата звернення: 12.10.2023).

34. Нельсон М. Эволюционная теория экономических изменений / М. Нельсон, Р. Ричард, С. Дж. Уинтер. – М.: Финстатинформ, 2000. 286 с.

35. Об'єми рекламно-комунікаційного ринку України 2021 і прогноз розвитку ринку в 2022 році від ВРК. VRK. URL: https://vrk.org.ua/news-events/2021/ad-volume-2021.html (дата звернення: 10.04.2023).

36. Об'єми рекламно-комунікаційного ринку України 2022. VRK. URL: https://vrk.org.ua/images/AdVolume2022.pdf (дата звернення: 10.04.2023).

37. Окландер М.А., Романенко О.О. Специфічні відмінності цифрового маркетингу від інтернет-маркетингу. Економічний вісник Національного технічного університету України «Київський політехнічний інститут». 2015. № 12. С. 362-371.

38. Он-лайн курс «Основи AI». URL:https://google-ads.brandlive.com/AI-basics-by-Google/uk/session/16a40b26-4c0f-11ee-9f0c-e37978a9c23b (дата звернення: 10.09.2023).

39. Основи цифрової економіки. Навчальний посібник / За ред. Крисоватий А. І., Гулей А. І., Язлюк Б. О., Ліп'яніна-Гончаренко Х. В., Максимович В. І., Бутов А. М. Тернопіль: ЗУНУ, 2021. 274 с.

40. Парадигмальні виклики сучасного розвитку: колективна монографія / за загальною редакцією Дуки А. П. Чернігів: ГО «Науково-освітній інноваційний центр суспільних трансформацій», 2022. 242 с.

41. Парубець О.М., Сугоняко Д. О., Середюк І. О. Дослідження сучасного стану та перспектив розвитку штучного інтелекту у фінансовому секторі України. Фінансові дослідження. 2019. № 1. С. 1-9.

42. Пахомов Ю.Н. Національні економіки в глобальному конкурентному середовищі. К., 1998. С. 120-122.

43. Піжук О.І. Штучний інтелект як один із ключових драйверів цифрової трансформації економіки. Економіка, управління та адміністрування. 2019. № 3(89). С. 41-46.

44. Плескач В.Л. Електронна комерція: підручник / В.Л. Плескач., Т.Г. Затонацька. Київ: Знання, 2007. 535 с.

45. Романенко Л.Ф. Цифровий маркетинг: сутність та тенденції розвитку. Scientific Notes of Lviv University of Business and Law, 2019, P. 80-84. URL: https://nzlubp.org.ua/index.php/journal/article/view/201 (дата звернення: 07.03.2023).

46. Рубан В.В. Сучасні інструменти цифрового маркетингу. Науковий вісник Херсонського державного університету. Серія «Економічні науки». 2018. № 30. С. 143-146.

47. Серверні ферми. Відкрита Інтернет – енциклопедія: веб-сайт. URL: https://uk.wikipedia.org/wiki/%D0%A1%D0%B5%D1%80%D0%B2%D0%B5%D1%80%D0%BD%D0%B0_%D1%84%D0%B5%D1%80%D0%BC%D0%B0 (дата звернення: 27.11.2023).

48. Сохецька А.В. Цифрові маркетингові інструменти для розвитку бізнесу: ретроспективний аналіз, сучасні тенденції, напрями розвитку. Причорноморські економічні студії. Одеса, 2020. №. 50. С.7-12.

49. Стратегія розвитку штучного інтелекту в Україні: монографія [За заг. ред. А.І.Шевченка]. Київ: ІПШІ, 2023. 305 с.

50. Тардаскіна Т.М., Кононович В.Г. Менеджмент інформаційної безпеки в галузі зв'язку: навч. посіб. Одеса: ОНАЗ ім. О.С. Попова, 2010. 268 с.

51. Тардаскіна Т.М., Стрельчук Є.М., Терешко Ю.В. Електронна комерція: Навчальний посібник. Одеса: ОНАЗ ім. О.С. Попова, 2011. 120 с.

52. Тінберген Я. Пересмотр международного порядка. Доклади римського клубу. 1976. № 76. С.15-26

53. Трансформація соціально-трудової сфери в умовах цифровізації економіки: монографія / О.Ф. Новікова, О.І. Амоша, Ю.С. Залознова, О.О. Хандій, Н.А. Азьмук, Я.В. Остафійчук, Л.Л. Шамілева, О.В. Панькова, І.М. Новак, А.Д. Шастун, О.Ю. Касперович, О.В. Іщенко, Я.Є. Красуліна, Л.П. Амелічева, В.В. Компанієць; НАН України, Ін-т економіки пром-сті. Київ, 2022. 385 с.

54. Україна 2030Е – країна з розвинутою цифровою економікою. URL: https://strategy.uifuture.org/kraina-z-rozvinutoyu-cifrovoyu-ekonomikoyu.html#6-2-5 (дата звернення: 05.09.2023).

55. Філіппова Л.Л. Електронна комерція: за і проти. Вісник НТУ «ХПІ». 2013. №44.– С. 58-65.

56. Цифровая экономика: коллективная монография / И. А. Павлинов, Л. К. Скодорова, Е. И. Павлинова [и др.] Рыбница: ПГУ, 2019 (Тип. "Теслайн"). – 260 p.: fig., tab.Bibliogr. la sfârşitul cap. – 30 ex.

57. Цифрова адженда України URL:https://ucci.org.ua/uploads/files/58e78ee3c3922.pdf (дата звернення: 02.09.2023).

58. Цифровий маркетинг – модель маркетингу XXI сторіччя: монографія / Окландер М.А., Окландер Т.О., Яшкіна О.І. [та ін.]; за ред. д.е.н., проф. Окландера М.А. Одеса: Астропринт, 2017. 292 с.

59. Цифрова економіка: підручник / Т. І. Олешко, Н. В. Касьянова, С. Ф. Смерічевський та ін. К.: НАУ, 2022. 200 с.

60. Цифрова економіка: тренди, ризики та соціальні детермінанти. URL:

https://razumkov.org.ua/uploads/article/2020_digitalization.pdf (дата звернення: 05.10.2023).

61. Червякова Т.І. Інформаційна безпека технології хмарних обчислень. Вісник Національного транспортного університету. 2020. Вип. 1. С. 427-436.

62. Чукурна О.П. Концепція маркетингового ціноутворення в глобальній економіці: монографія. Одеса: Астропринт, 2016. 336с.

63. Штучний інтелект для України – ризик чи можливість // Everest-AI Review. – 2018. URL: https://www.everest.ua/wp-content/uploads/2019/01/Everest-AI-Review-%E2%84%965.pdf. (дата звернення: 17.11.2023).

64. Шулікін Д. Штучний інтелект проти "винахідників". / Освіта України. Київ, 2014. № 31. С.9.

65. Яцюк Д.В. Цифровий маркетинг: майбутнє маркетингових комунікацій в брендингу. Інвестиції: практика та досвід. 2015. № 7. URL: http://www.investplan.com.ua/pdf/7_2015/16.pdf (дата звернення 06.03.2023)

66. Alchemix. URL: https://alchemix.fi

67. Amit R ., Zott C . (2001) Value Creation in e-Business // Strategic Management Journal. Vol. 22. P. 493-520.

68. Bakeryswap. URL: https://www.bakeryswap.org (дата звернення: 5.10.2023).

69. Bell D. The Third Technological Revolution and Its Possible Socio-Economic Consequences. Dissent. 1989. Vol. 36, Issue 2. P. 167.

70. Blaisdell R. A Brief History of Cloud Computing. Risk Cloud: веб-сайт. URL: https://rickscloud.com/a-brief-history-of-cloud-computing-2/ (дата звернення: 11.11.2023).

71. Castells M. The Rise of the Network Society. Information Age, vol. 1; 2nd Edition with a New Preface edition. Wiley-Blackwell, 2009.

72. Chesbrough H. W., Rosenbloom R. S. (2002) The Role of the Business Model in Capturing Value from Innovation: Evidence

from Xerox Corporation's Technology Spin-off Companies // Industrial and Corporate Change. Vol. 11. P. 529–555.

73. Cisco (2016). Where to Begin Your Journey to Digital Value in the Private Sector Economic Analysis. URL: https://www.cisco.com/c/dam/en/us/ solutions/collateral/service-provider/value-at-stake.pdf (дата звернення: 28.10.2023).

74. Coppola D. Statistics and facts about global e-commerce. 2021. URL: https://www.statista.com/topics/871/online-shopping/#dossier-chapter1 (дата звернення: 10.10.2023).

75. Crowdsourcing: Why the Power of the Crowd is Driving the Future of Business [Book Review] 2009 Jeff Howe. New York, NY: Crown Business

76. ENS. URL: https://ens.domains (дата звернення: 9.10.2023).

77. Foundation. URL: https://foundation.app/ (дата звернення: 4.10.2023).

78. Gartner (2018b). Top 10 Strategic Technology Trends for 2019. URL: https:// www.gartner.com/smarterwithgartner/gartner-top-10-strategic-technologytrendsfor-2019/ (дата звернення: 2.01.2024).

79. Global Education Futures Report (2018). URL: https://drive.google.com/file/d/0B9ZvF6mQ5FMbSTFKVmhodU5rNTNiTXpUZ2QwZktiR0pzSmJR/view (дата звернення: 24.12.2023).

80. GMX. URL: https://gmx.io/#/ (дата звернення: 11.10.2023).

81. Google Anthos Takes On Amazon Web Services And Microsoft Azure With Multi-Cloud Strategy: Analysis. Forbes: веб-сайт. URL: https://www.forbes.com/sites/jeanbaptiste/2019/04/15/google-anthos-takes-on-amazon-web-service-and-microsoft-azure-with-multi-cloud-strategy-analysis/?sh=3ca3c64c626f (дата звернення: 17.11.2023).

82. Deloitte (2019). What is Digital Economy? URL: https://www2.deloitte.com/mt/en/pages/technology/articles/mt-what-is-digital-economy.html (дата звернення: 4.02.2024).
83. Digital Advertising – Worldwide. Statista. URL: https://www.statista.com/outlook/dmo/digital-advertising/worldwide#ad-spending (дата звернення: 28.03.2023).
84. Digital marketing tools for every team and budget in 2023. Social Media Marketing & Management Dashboard. URL: https://blog.hootsuite.com/digital-marketing-tools/#Analytics_tools (дата звернення: 17.03.2023).
85. European Commission (2018*a*) Digital Economy. URL: https://ec.europa.eu/jrc/en/research-topic/digital-economy. (дата звернення: 4.09.2023)
86.Iskiev M. The HubSpot Blog's 2023 Marketing Strategy & Trends Report: Data from 1,200+ Global Marketers. HubSpot Blog | Marketing, Sales, Agency, and Customer Success Content. URL: https://blog.hubspot.com/marketing/hubspot-blog-marketing-industry-trends-report (дата звернення: 25.04.2023).
87. June 2015. URL: https://www.mckinsey.com/~/media/mckinsey/business%20 functions (дата звернення: 10.02.2023).
88. Lane, N. Advancing the digital economy into the 21st century. Information Systems Frontiers. 1999. Vol. 1. No. 3. P. 317-320.
89.Lido. URL: https://lido.fi/ (дата звернення: 10.10.2023).
90. Mahadevan B. (2000) Business Models for Internet-Based e-Commerce // California Management Review. Vol. 42. URL: http://www.iimb.ernet.in/~mahadev/bmodel.pdf. (дата звернення: 15.10.2023).
91. Mahlup F. Production and spread of knowledge in the USA. M: Progress, 1966. 462 p. c. 38.
92. Malone T. W., Weill P., Lai R. K. et al. (2006) Do Some Business Models Perform Better than Others? // MIT Sloan. WorkingPaper 4615-06.
93. Masuda Y. The information Society as Postindustrial Society. – Washington: World Future Society, 1983. 178 p.

94. McKinsey (2017a). A Future That Works: Automation, Employment and Productivity. URL:https://www.mckinsey.com/~/media/McKinsey/Featured%20

95. Magic Eden. URL: https://magiceden.io/ (дата звернення: 11.10.2023).

96. Meadows D.L. Alternatives to growth-I: a search for sustainable futures. N.Y.: Ballinger Pub Co, 1977. 405 p.

97. Mell P., Grance T. NIST. Cloud Computing Reference Architecture. Recommendations of the National Institute of Standards and Technology. USA: U.S. Department of Commerce, 2011. 7 c.

98. Mesenbourg T. L. Measuring the Digital Economy // U.S. Bureau of the Census. URL: https://www.census.gov/content/dam/Census/library/working-papers/2001/ econ/digitalecon.pdf (дата звернення: 1.02.2024)

99. Morris M., Schindehutte M., Allen J. (2005) The Entrepreneur's Business-Model: Toward a Unified Perspective // Journal ofBusiness Research. Vol. 58. P. 726-735.

100. Needle F. AR vs. VR: which is more effective for marketing [+consumer data]. HubSpot Blog | Marketing, Sales, Agency, and Customer Success Content. URL: https://blog.hubspot.com/marketing/ar-vs-vr (дата звернення: 25.04.2023).

101. Opensea. URL: https://opensea.io/ (дата звернення: 3.10.2023).

102. Oracle Content Management. URL: https://docs.oracle.com/en/cloud/paas/content-cloud/index.html (дата звернення: 10.10.2023).

103. Osterwalder A., Pigneur Y., Tucci C. (2005) Clarifying Business Models: Origins, Present, and Future of the Concept //Communications of the Association for Information Systems. Vol. 15. P. 1–25.

104. Partnering with Intel to accelerate cloud-native 5G. Cloud Google: веб-сайт. URL: https://cloud.google.com/blog/topics/partners/speeding-up-cloud-native-5g-networks-with-intel-and-google-cloud (дата звернення: 20.11.2023).

105. Rarible. URL: https://rarible.com/ (дата звернення: 3.10.2023).
106. Rocket Pool. URL: https://rocketpool.net (дата звернення: 9.10.2023).
107. Shafer S., Smith H. J., Linder J. (2005) The Power of Business-Models // Business Horizons. Vol. 48. P. 199-207
108. Slywotsky A. J. (1996) Value Migration. Boston, MA.: Harvard Business Review Press
109. Stanford: Fintech Maintains Position as Third Biggest AI Investment Focus Area – Fintech Schweiz Digital Finance News – FintechNewsCH. Fintech Schweiz Digital Finance News – FintechNewsCH. URL: https://fintechnews.ch/aifintech/stanford-fintech-maintains-position-as-third-biggest-ai-investment-focus-rea/59671/ (дата звернення: 18.05.2023).
110. Stewart D.W., Zhao Q. (2000) Internet Marketing, Business Models, and Public Policy // Journal of Public Policy & Marketing.Vol. 19. P. 287-296.
111. Superrare. URL: https://superrare.com/ (дата звернення: 3.10.2023).
112. Talin Benjamin, MoreThanDigital
113. Tapscott D., Ticoll D., Lowy A. (2000) Digital Capital — Harnessing the Power of Business Webs. Boston: Harvard Business School Press.
114. Taylor T. 20 Artificial intelligence statistics that marketers need to know in 2023. HubSpot Blog | Marketing, Sales, Agency, and Customer Success Content. URL: https://blog.hubspot.com/marketing/artificial-intelligence-stats (дата звернення: 24.04.2023).
115. The economic potential of generative AI: The next productivity frontier (June 14, 2023) Report. URL: https://www.mckinsey.com/capabilities/mckinsey-digital/our-insights/the-economic-potential-of-generative-ai-the-next-productivity-frontier#introduction (дата звернення: 24.12.2023).
116. The effects on consumers of augmented and virtual reality. Psychology Today. URL: https://www.psychologytoday.com/us/blog/mind-brain-and-

value/202204/the-effects-on-consumers-of-augmented-and-virtual-reality (дата звернення: 26.04.2023).

117. The history and evolution of digital marketing: Simplilearn.com. URL: https://www.simplilearn.com/history-and-evolution-of-digital-marketing-article (дата звернення: 02.03.2023).

118. The State of AI in the Online Marketing Industry: 2023 Report. URL: https://www.authorityhacker.com/ai-survey (дата звернення: 20.12.2023).

119. The state of AI in 2023: Generative AI's breakout year (August 1, 2023) URL: https://www.mckinsey.com/capabilities/quantumblack/our-insights/the-state-of-ai-in-2023-generative-ais-breakout-year (дата звернення: 5.01.2024).

120. The most useful digital marketing tools (2023 guide). CareerFoundry. URL: https://careerfoundry.com/en/blog/digital-marketing/digital-marketing-tools/#email-marketing (дата звернення: 17.03.2023).

121. The 10 most important social media statistics for 2023 - GWI. GWI. URL: https://blog.gwi.com/marketing/social-media-stats/ (дата звернення: 22.04.2023).

122. These 2023 digital marketing trends will help your business succeed. Blog Wrike. URL: https://www.wrike.com/blog/digital-marketing-trends-2023/ (дата звернення: 25.04.2023)

123. Top 20 digital marketing tools for 2023. Great Learning Blog: Free Resources what Matters to shape your Career. URL: https://www.mygreatlearning.com/blog/digital-marketing-tools/#16-unbounce (дата звернення: 20.03.2023).

124. Uniswap. URL: https://uniswap.org/) (дата звернення: 9.10.2023).

125. Veleva S. S., Tsvetanova A. I. Characteristics of the digital marketing advantages and disadvantages. IOP Conference Series: Materials Science and Engineering. 2020. Т. 940. С. 012065. URL: https://doi.org/10.1088/1757-899x/940/1/012065 (дата звернення: 09.03.2023).

126. Video marketing statistics - New Data For 2023. Wyzowl. URL: https://www.wyzowl.com/video-marketing-statistics/ (дата звернення: 24.04.2023).

127. Wallerstein I. The Modern World-System / I. Wallerstein // Capitalist Agriculture and the Origins of the European World-Economy in the Sixteenth Century. New York, 1974. P. 18-80.

128. Yearn. URL: https://yearn.fi/ (дата звернення: 5.10.2023).

129. YEC. Council Post: Video marketing trends that you cannot ignore In 2023. Forbes. URL: https://www.forbes.com/sites/theyec/2023/03/24/video-marketing-trends-that-you-cannot-ignore-in-2023/?sh=2fb84d545aac (дата звернення: 23.04.2023).

130. 5 головних трендів хмарних обчислень у 2021 році. NT: веб-сайт. URL: https://nt.ua/blog/2021-cloud-computing-trends (дата звернення: 11.11.2023).

Appendix A
Evolution of marketing concepts depending on the innovation component of the techno-economic structure [62]

Table B.1

Periodization of marketing concepts depending on the innovation component of the techno-economic structure

Years of domination of the concept	Marketing concept	Main content	Marketing tools	The main goal of the concept	Innovative component	Factor of production underlying price formation	Economic technological structure
1	2	3	4	5	6	7	8
1860-1920	Produc-tive	Production of goods and services based on the availabi	Cost reduction due to cost optimization	Improving production, increasing sales and maximizing profits	Light industry technologies, water and steam energy technologies, mechanization of all industries	Labour, land (rent), capital The price is formed on the basis of costs	The second (1840-1890) and third (1890-1940) technological structure

		lity of resourc es			based on steam engine. Key factor: steam engine		
1920-1930	Commo-dity	Produci ng of high quality goods	Commodity policy	Improvement of consumer properties of goods	Use of electric power, development of heavy engineering, chemical industry. Emergence and spread of radio communicatio n, telegraph, automobiles. Key factor: electric motor	Labor, land (rent), capital The price is formed on the basis of costs. However, the concentratio n of banking and monetary capital increases the influence of capital as a	The third (1890-1940) technologica l structure

						factor of production1.	
1930-1950	Marketing	Develop-ment of the marke-ting system and sales promo-tion, forma-tion of sales channels.	Marketing policy	Intensification of sales of goods and services through the formation of promotion and sales incentive systems.	Development of energy using oil, petroleum products and gas, as well as communication tools of new synthetic materials. Key factor: internal combustion engine	Labour, land (rent), capital The price is formed on the basis of costs.	The fourth (1940-1990) technological structure
1960-1980	Traditio-nal marketing	Producing goods accor-ding to customers demands	Marketing mix, consumer research	Meeting the needs of target markets.	Development of technologies in the field of military weapons, electronics,	Labour, land (rent), capital The price is formed on the basis of costs price	The fourth (1940-1990) technological structure

					synthetic materials, organic chemistry.	line) and demand (as an upper price line).	
1980-1995	Social and ethical marketing	Produ-cing goods consi-dering custo-mer needs, as well as moral and ethical require ments of society	Marketing mix, consumer research of social and ecological problems of producing and consuming goods and services.	Meeting the needs of target markets considering social and ecological requirements.	Advances in microelectronics, informatics, biotechnology, genetic engineering, development of new types of energy, outer space, and satellite communications. Key factor: gas technology	Labour, land, (rent), capital and informationn. Price is formed on the basis of the value of the product to the consumer.	The fifth (1990-2020) technological structure

1	2	3	4	5	6	7	8
Since 1995 till present times	Relation-ship marketing (partner-ship marketing)	Producing goods and servicing that satisfy partners and customers.	Coordination, integration and networking techniques, marketing mix.	Meeting the needs of consumers and business and government partners in their interactions with them.	Development of biotechnology, medicine, nanotechnology, information and IT technology, optoelectronics, aerospace industry Key factor: non-conventional energy sources	Labour, land, (rent), capital and informa-tionn. Price is formed on the basis of the value of the product to the consumer.	The sixth (since 1995 till present times) technological structure
Since 2005 till present times	Cognitive marketing	Production and promotion of consumption technologies and consumption standards,	Methods of creating demand and value for the consumer.	Creating standards and technologies for the consumption of goods and services that form the	Development of neurotechnolog y, genetic engineering, artificial intelligence, unmanned vehicles,	Labour, land, (rent), capital and informa-tionn. Price is formed on	The seventh structure (since 2005 till present times)

		not just goods and services		consumer's lifestyle.	implantable technologies. Key factor: unconventional energy sources	the basis of the value, created by the enterprise (transnational corpora-tions).	