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PROJECT MANAGEMENT IN THE DIGITAL ECONOMY

Textbook

Professor Marin Drinov Publishing House
of Bulgarian Academy of Sciences

Sofia 2025

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ISBN: 978-619-245-552-1

The textbook contains conceptual, methodological and methodological provisions for Project management in the digital economy.

The textbook «Project Management in the Digital economy » presents a systematic overview of modern methods, tools, and approaches used in project management. The sections of the textbook cover various aspects of project management, ranging from the application of technologies and methodologies to the use of data and analytics, risk management, and team development.

For graduates and students of economic specialties, scientists.

CONTENT

INTRODUCTION

Project management is an integral part of modern business, where effective planning, coordination, and control play a crucial role in achieving set goals. However, with the new technologies advent and changes in the business environment, project management processes are constantly evolving and require adaptation.

In the modern business world, project management is becoming an increasingly dynamic and complex process. New technologies, constantly changing market demands, and a competitive environment create the necessity for continuously updating approaches to project management.

The evolution of project management involves the development of new methodologies, the application of modern tools and technologies, as well as changes in the work culture within the organization. Key aspects include a flexible management approach, active use of digital tools, and the development of team skills and abilities.

Innovative approaches to project management play a significant role in modern business. They allow organizations to adapt to the rapidly changing business environment, where flexibility and responsiveness to changes are required. Such approaches contribute to improving project management processes, increasing efficiency and effectiveness in project implementation. They also help organizations to be more innovative, which promotes development and competitiveness in the market. Innovative approaches stimulate the search for new solutions, improve team communication, and increase employee engagement in the project management process.

Organizations that can quickly adapt to changes, implement innovations, and effectively manage projects gain competitive advantages in the market. Therefore, it is important not only to keep track of new trends in project management but also to actively apply them in practice to ensure the successful achievement of organizational goals and strategic objectives.

The textbook « Project Management in the Digital economy » presents a systematic overview of modern methods, tools, and approaches used in project management. The sections of the textbook cover various aspects of project management, ranging from the application of technologies and methodologies to the use of data and analytics, risk management, and team development.

The goal of this textbook is to provide a comprehensive overview of modern trends and best practices in project management, as well as to help develop the necessary skills and knowledge for successful project implementation in the modern business world.

The knowledge and competencies acquired as a result of studying the discipline « Project Management in the Digital economy» will help students successfully adapt to modern challenges and business environment requirements. They will enable the effective application of innovative methods and technologies in project management, contributing to increased productivity, improved quality of results, and enhanced competitiveness of the organization. Furthermore, this knowledge will allow for competent risk management, development of an innovative culture within the team, and better understanding and applying principles of cooperation and team development. Ultimately, studying innovations in project management will become a key factor in professional growth and achieving the strategic goals of the organization.

Thus, the continuous development of project management necessitates the development of new competencies and strategies that can adapt the system to the dynamically changing external environment. The primary goal of organizations is to provide their leaders with tools and skills that promote a more flexible and simultaneously structured management process. Project management is no longer an isolated area; today, the project approach is at the forefront of business practice, and it is adapted depending on the specific area of application and it forms new standards and methodologies.

CHAPTER 1.
DIGITAL ECONOMY DEVELOPMENT MODEL

1.1. 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.

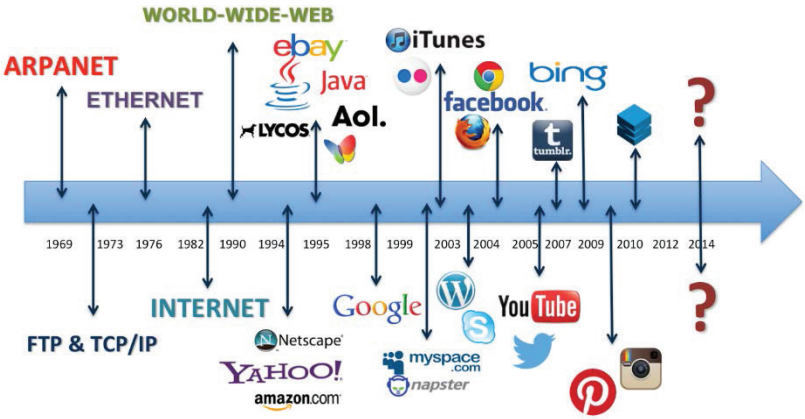

Figure 1.1. Periodization of digitalization, based on Web technologies of different generations

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.1.2.)

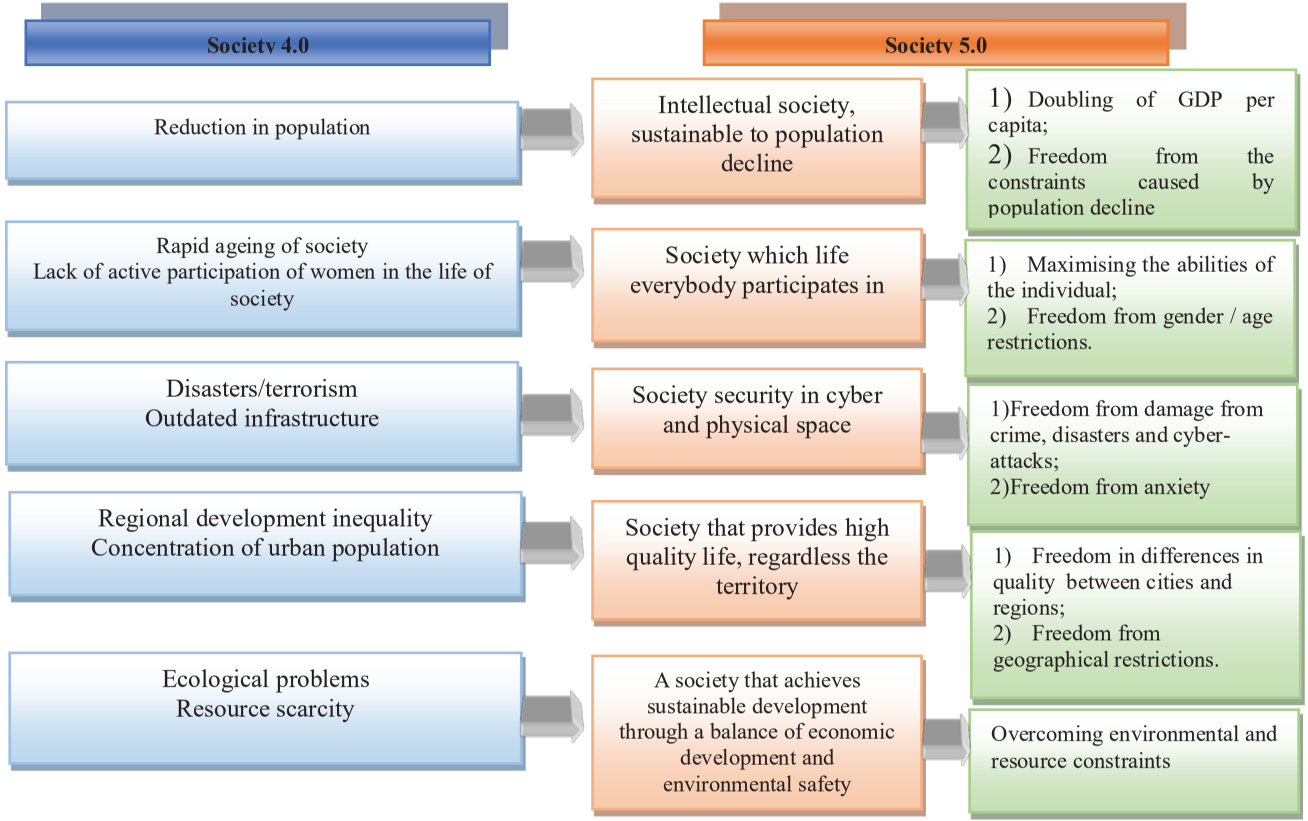

Figure 1.2. Transformation «Society 4.0.» to «Society 5.0.»

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 [150] 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 [124].

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 [134].

Approaches to interpreting the concept of the “digital economy” are presented in Table 1.1.

Table 1.1. - 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.1.3).

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.

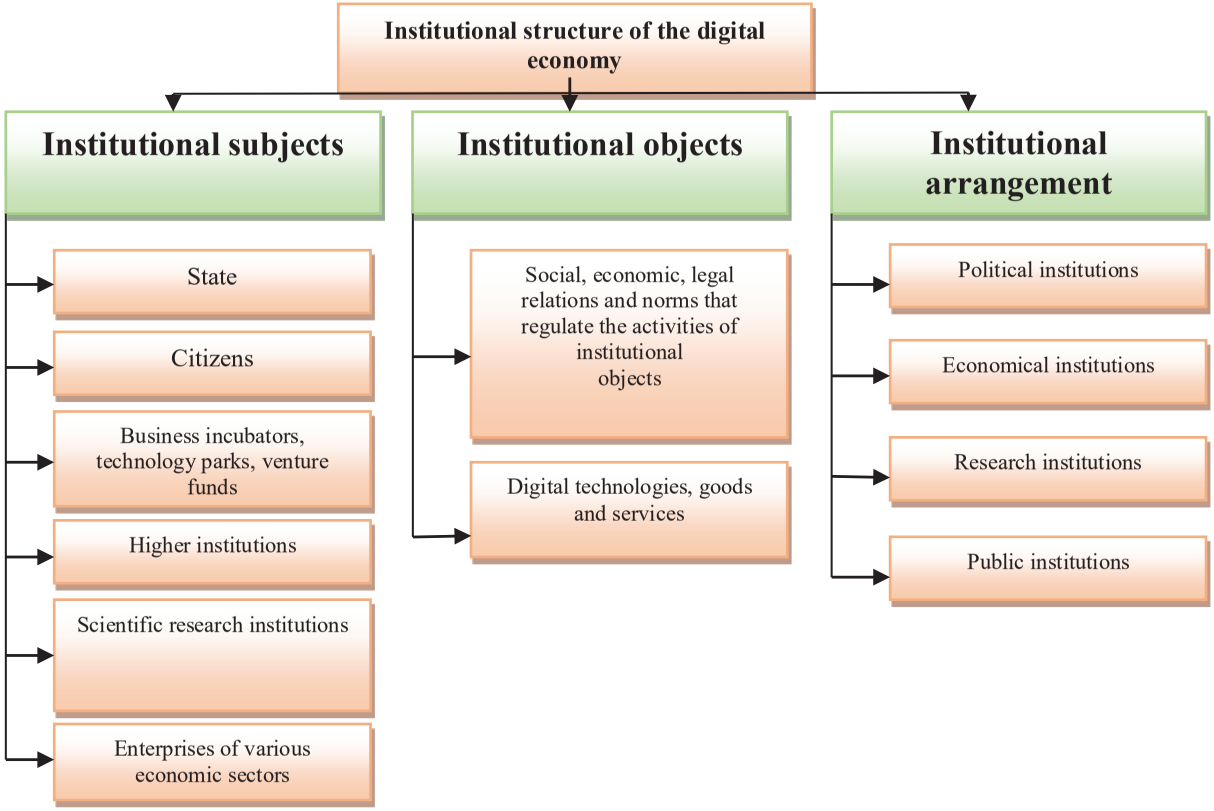

Figure 1.3. Institutional structure of the digital economy

1.2. 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) [132]. 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 [2].

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 [137], 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 [166]. 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 1.2.

Table 1.2.- 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 [131] (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 1.3. - 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 European global empires (1820-1870)	0.94	4.18	4.4
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

1.3. 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.

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.

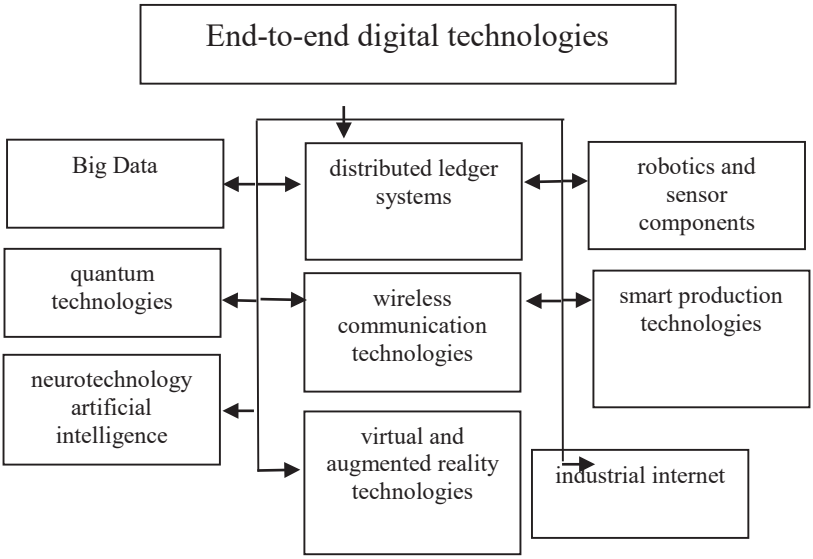

Figure 1.4. «End-to-end» digital technologies

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.

1.4. 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 1.5. - Components of the Amazon digital ecosystem [based on 149]

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.

1.5. Modern Trends in the Digital Economy

The digital economy as the foundation of a new economic paradigm.In the 21st century, the global economy has entered a new phase of development – the digital economy, which is based on the use of information and communication technologies (ICT), digital data, and knowledge as key resources for value creation. It not only transforms individual sectors of the economy but also changes the very logic of economic thinking, management processes, and the behavior of market participants.

The digital economy is an economy in which digital technologies, data, and knowledge are the key factors of production, distribution, exchange, and consumption. It transforms market structures, business models, and the formats of interaction between businesses, the state, and consumers.

According to analytics from international organizations (OECD, EU, World Bank), the digital economy generates more than 15% of global GDP, and in highly developed countries – over 25%.

Key characteristics of the digital economy:

- predominance of intangible assets (data, intellectual property);

- high levels of automation and algorithmization of processes;
- new forms of labor (gig economy, remote work, digital professions);
- platform-based business models;
- dominance of digital ecosystems.

The digital economy is shaping a new economic paradigm, where development is based not on resources in the classical sense, but on digital technologies, information, and innovation. This creates new demands for the knowledge, skills, and tools that modern economists and managers must possess.

In the context of digitalization, those who are able to adapt to rapid changes, work with data, manage flexible teams, and think strategically in a digital environment will gain a competitive advantage.

The KPIs of the digitalization of Ukraine's economy are presented in Table 1.4, and the share of the digital economy in Ukraine's GDP is shown in Figure 1.4 [84].

Table 1.4. - KPIs of digitalization of the Ukrainian economy [84]

Year	Domestic market (ICT consumption), billion dollars	Impact on GDP, percentage growth
2021E	2	0,5
2022E	2,5	1
2023E	3	2
2024E	4,5	3,5
2025E	6	4,5
2026E	8	6
2027E	10	7,5
2028E	12	9
2029E	14	11
2030E	16	14

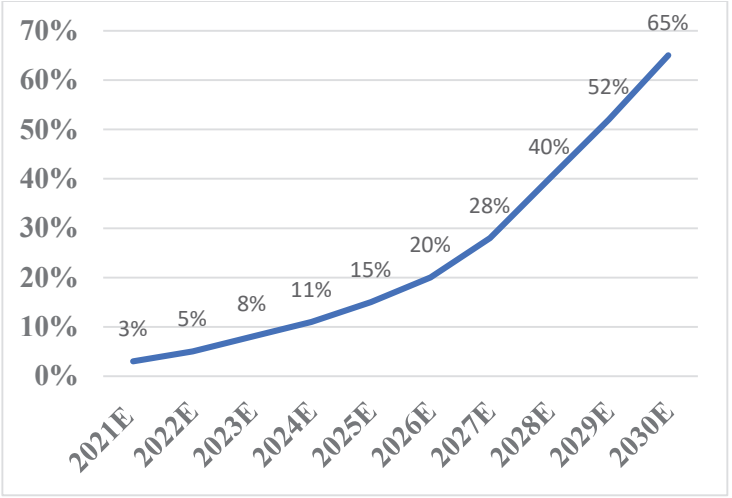

Figure 1.4. Share of the digital economy in Ukraine's GDP [84]

According to forecast data, the share of the digital economy in Ukraine's GDP is growing rapidly – from 3% in 2021 to 65% in 2030. This indicates a deep digital transformation of the country's economy. Such dynamics indicate an increasing role of digital technologies in creating added value. In the future, the digital economy may become the dominant sector of Ukraine's GDP.

The development of digital infrastructure is a key prerequisite for the successful digital transformation of Ukraine's economy. By 2030, a significant increase in indicators in this area is expected, which will contribute to increasing the country's competitiveness in the global digital environment (Table 1.5) [84].

Table 1.5. - KPI development of digital infrastructures until 2030 [84]

Indicators	KPI 2030E
1. Fixed broadband telecommunications infrastructure. Coverage of households and infrastructure facilities	99,9%
2. Mobile telecommunications infrastructure (4G, 5G). Coverage	100%
3. Radio Infrastructure for Internet of Things (IoT) Projects: Sensors, Devices, and Network Coverage	100%
4. Computing Infrastructure (so-called cloud or virtualized infrastructure). Number of local providers with relevant capacities and reliability indicators.	10
5. The share of business processes, transactions, and business interactions that are electronic and online	90%

Let us consider the ***modern trends shaping the digital economy.***

1. Internet of Things (IoT).

The Internet of Things is a concept where physical objects are equipped with sensors, software, and other technologies to collect and exchange data via the internet. Within the digital economy, IoT provides new opportunities for automating business processes, reducing costs, improving efficiency, and creating new business models.

Example: In the transportation sector, IoT can be used to monitor vehicle conditions or organize «smart» cities where all infrastructure elements are connected to a network to optimize energy and resource consumption.

2. Artificial Intelligence (AI) and Machine Learning.

Artificial intelligence and machine learning are significantly transforming the ways businesses make decisions, process data, and interact with consumers. AI enables the creation of intelligent systems that can analyze large volumes of data, automate routine tasks, predict customer behavior, and optimize operational processes.

Example: In banking, AI is used for detecting fraudulent transactions as well as providing personalized financial advice to clients via chatbots.

In e-commerce, AI is applied to create personalized product recommendations based on previous purchases and customer behavior. Machine learning allows for accurate predictions of which products may interest a buyer, increasing conversion rates and average order value. Additionally, AI can automatically handle customer inquiries through chatbots, improving service quality and saving managers' time.

In logistics, AI is used to optimize delivery routes. It analyzes data on traffic, weather conditions, and other factors to select the most efficient routes, reducing transportation costs. This also shortens delivery times and enhances customer satisfaction.

In marketing, AI and machine learning help analyze huge amounts of social media data to determine consumer sentiment and key discussion topics. This enables companies to adjust their marketing strategies based on current customer needs and moods, increasing campaign effectiveness and brand loyalty.

In human resources management, AI assists in automating recruitment processes by analyzing candidate resumes and assessing qualifications and experience. Machine learning systems can predict which candidates are most likely to succeed in a particular position, reducing hiring time and improving HR efficiency.

Artificial intelligence and machine learning provide businesses with the ability to make more accurate forecasts, optimize workflows, improve customer interactions, and make informed decisions. From e-commerce to logistics and marketing, AI helps companies increase their competitiveness and efficiency.

3. Blockchain and Cryptocurrencies.

Blockchain is a distributed ledger technology that ensures transparency, security, and immutability of data. It is applied not only in cryptocurrencies but also in many other areas such as financial services, logistics, healthcare, deregulation, and contract automation.

Example: Blockchain is used to ensure transparency in supply chains or to automate contract execution through smart contracts, where contract terms are automatically verified by the network.

4. Cloud Technologies and Computing.

Cloud services provide flexibility, scalability, and cost-efficiency, allowing businesses to store and process large volumes of data. Cloud computing is used for various purposes, from data storage to big data processing and application deployment. Cloud technologies also promote the development of new business models such as SaaS (Software as a Service), IaaS (Infrastructure as a Service), and PaaS (Platform as a Service).

Example: Companies offering software via the cloud can quickly scale their services based on demand and ensure software availability without costly infrastructure expenses.

5. Big Data and Analytics.

Big Data refers to large volumes of structured and unstructured information that can be analyzed to obtain valuable insights. Big data analytics enables more informed decision-making, market trend forecasting, improved customer interaction strategies, and process optimization.

Example: In e-commerce, companies analyze user behavior to personalize offers, increasing conversion rates. In healthcare, Big Data allows analysis of millions of medical records to identify effective treatments or predict epidemic outbreaks.

6. Digital Transformation of Business Models.

Digital transformation involves transitioning from traditional business models to new ones based on technology. This includes not only automating business processes but also changes in organizational culture, business strategies, and customer relations. Many companies actively use digital platforms to transform their products and services.

Example: Companies that previously operated only offline are now actively developing online platforms for sales and customer service.

7. Digital Governance and e-Government.

Digital governance is becoming a crucial part of state policy as it makes public services more accessible, convenient, and efficient for citizens. e-Government includes electronic services such as submitting applications, paying taxes, registering businesses, and other administrative processes that previously required citizens' physical presence at government offices. This not only improves service access but also increases transparency and reduces opportunities for corruption.

Example: Ukraine has implemented the digital platform "Diia," a vivid example of effective e-Government. Through its mobile app and web portal, citizens can access dozens of online services — from obtaining certificates and extracts to registering businesses and submitting tax reports. Additionally, "Diia" provides access to digital documents (passport, taxpayer ID, driver's license, etc.) legally recognized throughout Ukraine. This significantly simplifies citizens' daily lives and creates new opportunities for business development by reducing administrative burdens. Thanks to such initiatives, digital governance fosters increased citizen trust in the state, reduces bureaucracy, and stimulates the digital transformation of the entire economy.

8. Cybersecurity and Data Protection.

In the digital economy, data security and cybersecurity have become some of the most important aspects for businesses and consumers. The growing number of cyber threats and breaches necessitates the improvement of technologies to protect personal information and confidential data.

Example: The use of two-factor authentication, data encryption, and integration with new technologies to ensure security during transactions.

9. Automation and Process Robotics.

Digital technologies facilitate the implementation of automation across various business sectors. Process robotics involves

the use of robots or software robots (RPA) to perform routine tasks, which helps reduce costs and improve efficiency.

Example: Using robots to automate payment processing or to respond to standard customer inquiries in call centers.

10. Sharing Economy Platforms.

The sharing economy involves using digital platforms to exchange resources or services among users, promoting cost reduction and efficient use of available resources. Digital platforms form the basis of a new economic model where companies and individuals can exchange goods and services without physical barriers. These platforms significantly reduce the costs of launching new businesses and provide access to global markets.

Example: Platforms for car sharing (Uber) or home rentals (Airbnb), and marketplaces like Amazon and eBay.

11. Gig Economy and Remote Work.

The gig economy, based on short-term contracts and freelance work, is becoming increasingly popular thanks to digital platforms that make it easy to find jobs and hire workers online. Remote work, which became the norm during the COVID-19 pandemic, has not only persisted but continues to grow. More companies are adopting flexible employment models, allowing employees to work from home or anywhere else. This increases convenience for workers, supports work-life balance, and reduces costs for employers.

Example: Upwork, a leading international freelance platform, connects millions of professionals worldwide with companies seeking temporary contractors for projects in IT, design, marketing, translation, analytics, and more. Clients post tasks, and freelancers submit proposals, enabling efficient and rapid matching of skilled workers without lengthy hiring processes. Thanks to such platforms, companies can optimize staffing costs without maintaining a permanent workforce, while professionals enjoy the flexibility to choose their schedules, work from anywhere in the world, and build their portfolios without being tied to a single employer. This illustrates how the gig economy and remote work are transforming traditional employment models, making the labor market more dynamic, flexible, and global.

The digital economy offers numerous opportunities for growth and innovation, transforming all aspects of economic activity and opening new possibilities for businesses, governments, and consumers. Businesses aiming to remain competitive must actively invest in new technologies, adapt to a rapidly changing environment, and continuously improve their strategies to achieve sustainable development.

TEST QUESTIONS:

1. *What are the characteristics of the digital economy?*
2. *What is the fundamental difference between economic relations in the digital economy and traditional economy?*
3. *What is the digital economy?*
4. *What is the global nature of the digital economy?*
5. *What changes are taking place in the concept of management in the digital economy?*
6. *What technological solutions underlie business models of the digital economy?*
7. *Describe scientific approaches to the formation of business models in the digital economy.*
8. *What are the fundamental differences between digital business models and traditional ones?*
9. *What is a digital ecosystem?*
10. *What are the main characteristics of Amazon's digital ecosystem?*

CHAPTER 2.
CLOUD COMPUTING TECHNOLOGIES: THE CURRENT TREND OF THE DEVELOPMENT OF THE DIGITAL ECONOMY

2.1. 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 [133].

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. 2.1.

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.

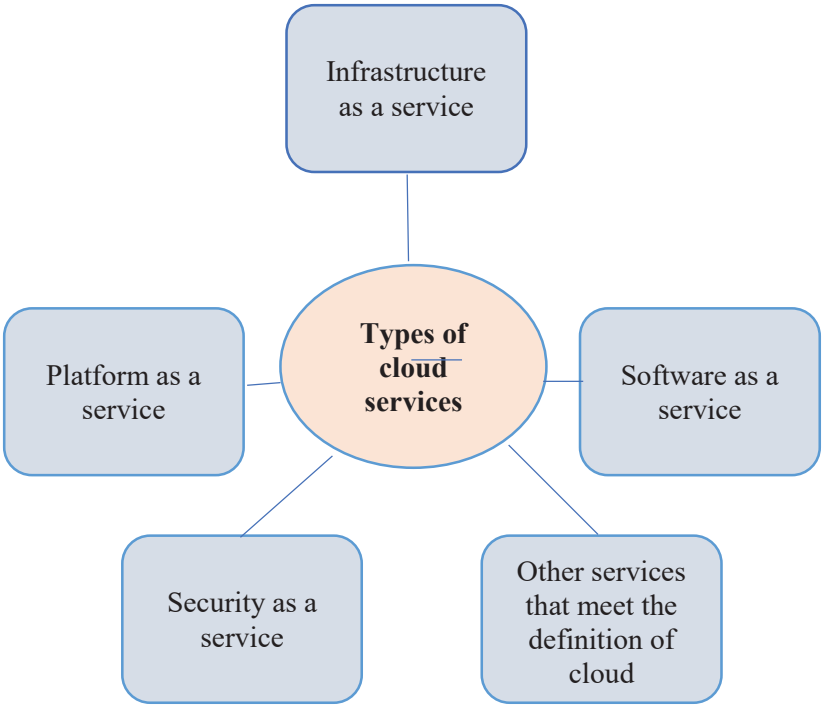

Figure 2.1. Types of cloud services [based on materials 6]

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 [102]. 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 [91].

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 [91].

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 [73].

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% [133]. 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 [84]:

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 [170]:

- 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.

2.2 Main properties of cloud computing technologies

National Institute of Standards and Technologies in its document «The NIST Definition of Cloud Computing» [133] determines a number of the following characteristics of cloud computing technologies (fig. 2.2).

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].

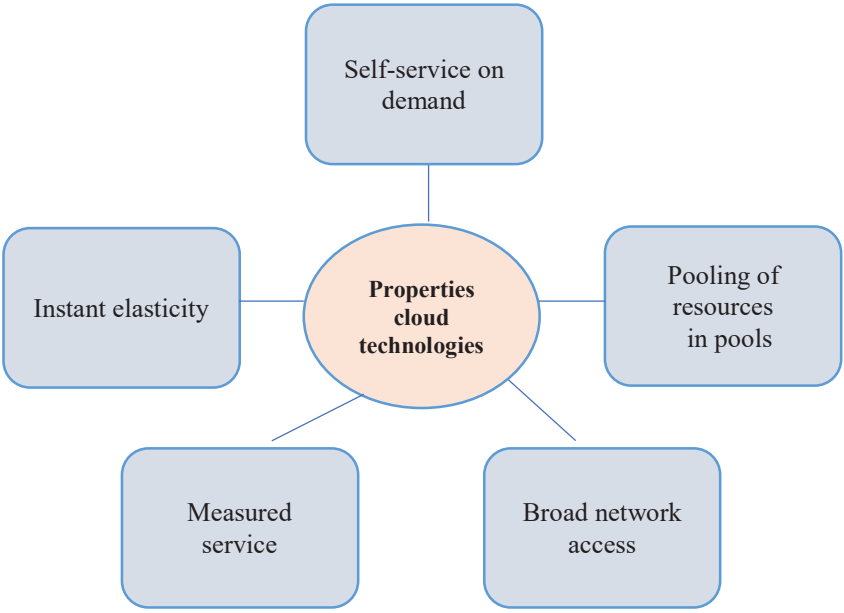

Figure 2.2. The main properties of cloud computing technology [based on materials 133]

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.

2.3 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. 2.3) [91].

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 [91].

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.

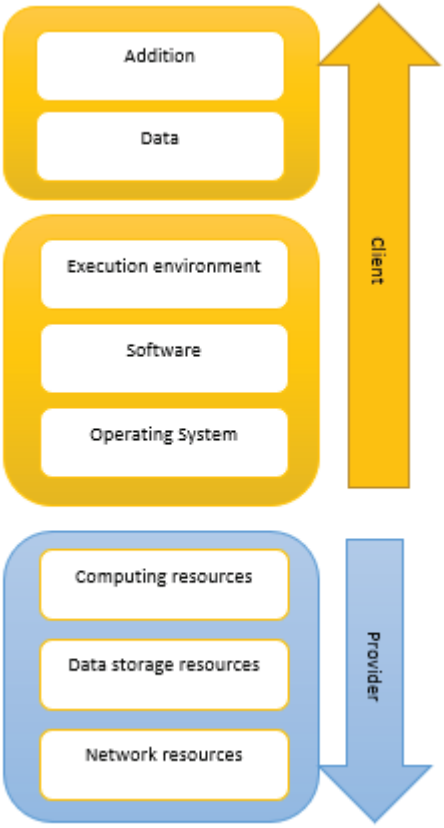

Figure 2.3. Infrastructure as a Service (IaaS) [91]

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. 2.4). 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 [91].

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].

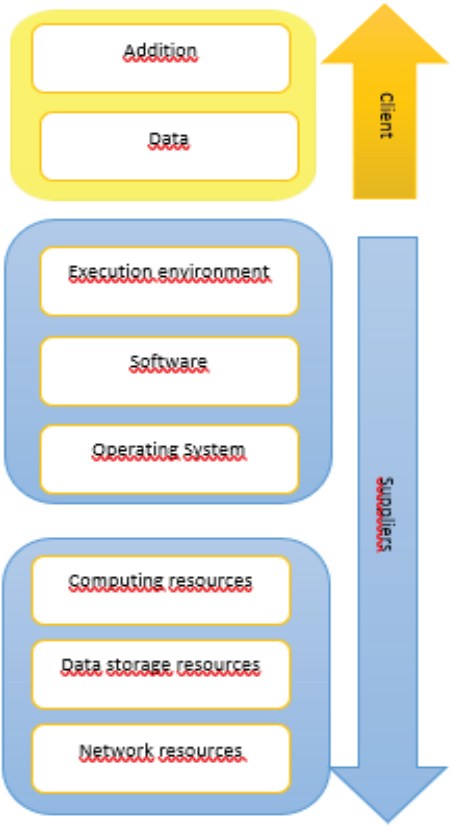

Figure 2.4. Platform as a Service (PaaS) [91]

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. 2.5) [91].

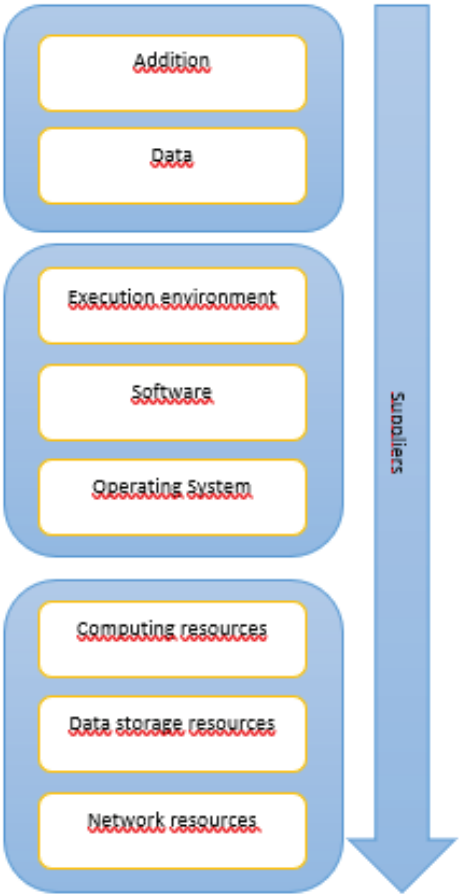

Figure 2.5. Software as a Service (SaaS) [91]

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 [133].

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 [133].

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 [116].

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.

2.4. 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.

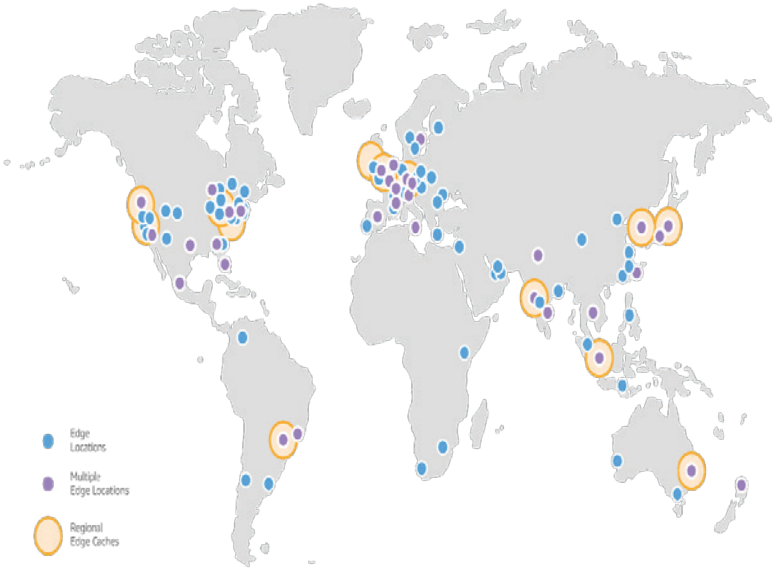

Figure 2.6. AWS Regions Global Infrastructure

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).

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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 3.
INFORMATION AND COMMUNICATION TECHNOLOGIES AS A BASIS FOR PROJECT MANAGEMENT IN THE DIGITAL ECONOMY

3.1. Application of project management software.

Specialized project coordination software helps managers and teams effectively manage client requests and adhere to time, budget, and scope constraints. Implementing such tools in business ensures a significant return on investment, especially if you choose the appropriate software that meets the company's needs.

Software is a collection of programs on a computer or other device. The programs themselves are also called software. In English, software is referred to as "software," so the term "soft" is also used.

Let's consider software solutions for managing the project that meet the needs of various industries and business tasks, ranging from basic project planning tools to corporate platforms that provide high-level planning and project management.

Project management tools help managers, teams, and individual participants effectively perform tasks, coordinate client requirements, and manage time, budget, and scope constraints. Companies that successfully utilize project management gain advantages by completing projects according to plan, within budget, and on time.

With the advent of affordable and cost-effective project management software solutions, companies are replacing outdated project tracking systems with more modern tools. As technology evolves, desktop applications have become more functional, scalable, and secure, allowing users to access them through the company's internal network. The introduction of cloud computing has brought new opportunities and benefits, leading to the emergence of subscription-based project management products over the Internet for companies of all sizes. This has also expanded the market and attracted more suppliers with diverse project management systems.

Online Project Management Software

Project management services in the form of web applications are available on a monthly subscription basis through SaaS via any web browser connected to the Internet. These online platforms are designed for a wide range of enterprises, regardless of their scale and industry. Users from various locations have the ability to access the tool from different devices, including desktop computers, tablets, and smartphones, to obtain up-to-date information on project status and other data from a centralized database. Modern online project management services offer a wide range of functional capabilities, allowing them to compete with corporate systems. Many of these applications provide various ways to visualize project tasks and progress, collaboration opportunities with colleagues, workflow automation, file sharing, internal team communication, and email integration. The expansion of online project management services' functionalities also allows them to be categorized as collaboration or business process management software. Examples of such online solutions include Zoho Projects, Microsoft Project, and Basecamp.

Local Project Management Software

Project management software, installed locally on a company's server, is located in its data center and managed by internal IT specialists. Frequently, companies purchase a single license for local software and can acquire additional updates. Local project management software is preferred due to concerns about long-term costs. Running software on their own servers provides companies with full control over data storage and security protocols to protect confidential information. Enterprises with a large number of users, starting from 50 and more, can save on monthly subscription costs if they choose one-time licenses for local project management software. They also have the ability to control the timing of software updates to prepare for them and avoid downtimes associated with automatic product updates, which is typical for SaaS systems.

Integrated Software vs. Best-in-Class

Modern project management platforms offer a wide range of tools and features capable of effectively managing various business projects. Specialized project software can successfully handle simple tasks. The best-in-class applications focus on specific functions, such

as task management, scheduling, or time tracking. Integrated end-to-end applications combine several functionalities, such as task management, Gantt chart creation, and time tracking. Enterprises prefer integrated tools as a comprehensive solution providing visibility, collaboration, and reporting support. Startups and small businesses search for simple management software products with a basic set of features.

It is important that the chosen project management tool includes essential features such as task management, team collaboration, document management, and email integration. However, a end-to-end project management solution should have a broader range of functions covering all key aspects of project management, including planning, resource and finance management, and more advanced features. While such a project management package might be more expensive, it provides accurate estimations, dependency control, the ability to handle an unlimited number of projects in one instance, real-time progress tracking, and detailed reporting that justify its cost. Nevertheless, these tools require more meticulous oversight and time for effective project management. Large organizations and teams typically prefer to use integrated management software, especially for handling more complex projects.

However, such tools require closer control and time for effective project management. Large organizations and teams usually prefer to use integrated management software, especially for implementing more complex projects.

Departmental Systems of Project Management

Standard project management systems are not always suitable for various sectors, so specialized project management software has been developed to reduce the need for customization when implementing it in companies. Construction, software development, financial services, healthcare, and legal sectors each have their own specific features and require individualized functions and settings. Specialized software for these industries can include tools for collaboration, expense tracking, portfolio management, contractor control, resource management, and other functions. These solutions can also help effectively manage

creative teams, remote teams, or specialized projects within an extensive portfolio.

Effective project management tools contribute to the successful implementation of projects not only by managers and project teams but also by the entire organization and stakeholders. They help small teams implement digital transformations, thereby increasing the company's agility and resilience. Let's consider some of the most in-demand project management tools, without focusing on a specific order of their presentation.

1. *Wrike*

Wrike is a versatile platform that allows teams to scale seamlessly thanks to global support, industry-leading security, and numerous resources to help teams accomplish complex work.

Features include visual review, which helps the team obtain multi-level client approvals, as well as workflow automation to avoid repetitive tasks. There is access to project portfolio management features, which allow you to know whether your project initiatives are contributing to the company's strategy and goals, as well as cross-reference projects that require other initiatives in the business.

Wrike integrations include more than 400 ready-made built-in integrations, including Asana, Airtable, BambooHR, Chargify, Clearbit, HubSpot, Jenkins, Mailchimp, Replicon, Salesforce and Slack. Additionally, you can create your own automation tools using its API.

Table 3.1. - Advantages and Disadvantages of a Project Management Platform *Wrike*

Advantages:	**Disadvantages:**
– Different ways to view the same data; – Holistic, Comprehensive Task Modeling; – Numerous Options and Customization Capabilities.	– No subtasks in the free plan; – No off-line access; – Quite simple comment system.

2. *monday.com Work OS* is a project management platform that helps create custom workflows for projects. Features include workload and resource allocation, providing information about what the team are doing and how busy they are. Another outstanding achievement is collaborative documentation, which helps everyone co-write documentation and reference other files in the software. Finally, customizable dashboards allow creating views displaying data relevant to the work.

Integration includes ready-made connections to applications such as Slack, Google Drive, DocuSign, Gmail, Google Calendar, Jira, GitHub, Trello, Dropbox, Typeform, and many others. Additionally, there is an option to connect to thousands of additional applications via Zapier.

Table 3.2. - Advantages and Disadvantages of a Project Management Platform *monday.com Work OS*

Advantages:	Disadvantages:
– Great emphasis on collaboration. – Long list of supported integrations; – Easy to set up workflows or boards; – Useful visual/color coding settings.	– User needs time to get used to visual user interface; – Users show interest to additional third part integrations.

3. *Zoho Projects* is a project management application that can handle projects of any size and complexity. The tool includes features that mimic social media sites, such as channels, forums, and discussions, and is available on mobile devices for iOS, Android, and other systems.

With Zoho Projects, you can define dependencies between tasks and assign them to the right people, schedule events in your calendar, and track the percentage of work completed after it has started. It also allows you to automate routine tasks at regular intervals by setting up recurring tasks and personalizing email reminders for tasks.

You can also create or upload project documents, presentations, and spreadsheets, upload files and share them for team collaboration.

Record the hours spent on tasks and compare them with what you initially planned. This can be done manually or using the built-in timer. Entries are automatically logged in the team's schedule, and generating invoices based on this information takes just a few clicks.

Features include task management, task automation, blueprints, time and issue tracking, reports, and forums for detailed discussions with your team.

As part of the Zoho ecosystem, it is possible to connect to several other Zoho services, such as Zoho Books and Zoho's financial suite. The new Zoho Marketplace also supports integration with third-party applications such as Microsoft Office 365, Microsoft Teams, Google Drive, Zapier, Zendesk, and ServiceNow. Integration via Zapier and Zoho Flow is also supported.

Table 3.3. - Advantages and Disadvantages of a Project Management Platform *Zoho Projects*

Advantages:	**Disadvantages:**
– Unlimited amount of projects; – Simple automation of working processes; – Reliable communication features; – Track time for multiple tasks simultaneuosly.	– Not integrated with Quickbooks; – Lack of some reporting features ; – Absence of file type export options.

4. *Teamwork* is a project management tool designed for teams working on client projects. Designed on a central platform, this tool ensures efficient management of projects, clients, freelancers, and internal teams by providing all the necessary capabilities for successful task completion. Teamwork offers ready-made project templates, various task types, team management tools, time tracking, resource control, and process automation. The platform supports collaboration through an integrated chat, document editor, forms, notebooks, and follower system. Additional features include invoicing, custom field settings, dashboards, report generation, and integration with Teamwork and third-party applications.

Table 3.4. - Advantages and Disadvantages of a Project Management Platform *Teamwork*

Advantages:	Disadvantages:
– Task management, priority setting, and automation; – Integrated feature set; – Free plan for a small team of five people.	– Takes time to familiarize; – Users desire faster and more automated default project setups.

5. *Jirat* is a tool developed by Atlassian, originally introduced as a software development tool but is now used for bug tracking, issue management, and project management. It is designed for use in agile software development and provides tools such as Scrum boards, Kanban boards, roadmaps, workflow management tools, reporting features, and a software development application.

Table 3.5. - Advantages and Disadvantages of a Project Management Platform *Jirat*

Advantages:	Disadvantages:
– Autonation saving time; – Multiple work views; – Free plan for small teams.	– Calendar view needs improving; – Users want easier setup of reports and dashboards. – User-friendly and efficient configurations are indeed essential for enhancing productivity.

6. *Basecamp* is a project management platform with built-in team communication features, suitable for various work scenarios, especially remote work. It helps organizations, teams, and individuals to organize tasks, quickly find necessary information, and receive real-time project updates. All participants can collaborate using dedicated tools for project planning, file sharing, and discussing idea. The platform's functionality includes to-do lists, calendar, document and file storage, diagrams, and automated reporting. Users can choose

from various communication options such as message boards, group chat, and direct messages.

Table 3.6. - Advantages and Disadvantages of a Project Management Platform *Basecamp*

Advantages:	Disadvantages:
Seamless communication and collaboration; Customizable notifications; Free plan with basic features.	A common pricing plan is not ideal for small teams; Users would like more drag-and-drop capabilities for the user interface.

7. The project and resource management tool *Kantata* (formerly known as Mavenlink) is ideal for companies specializing in professional services. It effectively helps organizations optimize the utilization of their resources across all projects. Integrated professional services automation (PSA) features allow users to quickly meet staffing needs by finding the right resources with the necessary skills and experience. Kantata provides teams with overall project control and reporting. It includes features for real-time resource management, skill tracking, project portfolio representation, intuitive task management, and time tracking. Additionally, this software offers tools for effective team collaboration, project accounting, and real-time financial data analysis.

Table 3.7. - Advantages and Disadvantages of a Project Management Platform *Kantata*

Advantages:	Disadvantages:
Integrated project accounting and financial tracking; Increased project transparency. Integration with third-party applications.	Need for simpler user interface workflows; Lack of issue management feature.

8. *Workzone* is a project management tool offering multifunctional software that's easy to implement for various real-

world project tasks. It promotes transparency, allowing users to clearly see the current status of projects. All participants can request, share, view, and approve documents online. Workzone provides capabilities for managing tasks, projects, and project portfolios. It features interactive dashboards that allow users to quickly switch from an overview to detailed views. Task lists, Gantt charts, time tracking, group calendars, and templates are included. Other features include status alerts, request forms, workload reports, image annotations, and file versioning.

Table 3.8. - Advantages and Disadvantages of a Project Management Platform *Workzone*

Advantages:	Disadvantages:
Task management and scheduling; Project progress tracking; Responsive support.	Occasional issues with approval flow routing; Users would like more intuitive navigation.

9. *Freedcamp* is a platform that provides a set of project management tools, offering teams a full range of functionalities for successful project execution. It includes various work interfaces such as task lists, Gantt charts, Kanban boards, and calendars. Users can structure their work based on tasks, subtasks, private tasks, and phases.

Table 3.9. - Advantages and Disadvantages of a Project Management Platform *Freedcamp*

Advantages:	Disadvantages:
Intuitive user interface; Email integration; Free plan with basic features.	Mobile capabilities lag behind the web version; Users desire better color schemes.

10. *Asana* is a project management tool from the USA, developed by Facebook co-founder Dustin Moskovitz and former Google and Facebook engineer Justin Rosenstein. Primarily designed to enhance

the productivity of Facebook employees, the software is now used in many companies to streamline organization and teamwork. The workflow is represented by individual cards.

Table 3.10. - Advantages and Disadvantages of a Project Management Platform *Asana*

Advantages:	Disadvantages:
Project organization and task management; Integrated feature set; Free plan for individuals and teams.	Better data export functionality is needed; Users desire more user guides and case studies for maximizing utilization.

When selecting project management software, consider the alignment of the offered features with the team's needs. The necessity of specific features will depend on the team size, project complexity, and areas of application of the software.

3.2 Virtual Communication System

Implementing virtual communication systems in the context of project management is a strategically important step to enhance interaction among participants and increase the efficiency of project initiatives. Virtual communication refers to the process of exchanging information, ideas, and resources among project participants through digital technologies and online platforms. In this context, special emphasis is placed on using modern ICT, such as video conferencing, email, chats, collaborative document editing, and web platforms.

The benefits of implementing virtual communication systems in project management are diverse. Firstly, such systems overcome spatial and temporal limitations, enabling communication among participants irrespective of their location. This is particularly relevant for distributed teams or projects where participants are in different geographic locations. Secondly, virtual communication accelerates decision-making and task execution processes by reducing the time needed to transmit information and organize meetings. Thirdly, it

enhances the availability and accessibility of information for all project participants, thereby increasing the transparency and efficiency of project management.

However, it should be noted that the implementation of virtual communication systems also comes with certain challenges and limitations. These may include technical issues related to network infrastructure and equipment, as well as cultural differences and language barriers that can hinder effective interaction among project participants. Additionally, it is crucial to consider security and data privacy concerns when using virtual communication tools.

Thus, the implementation of virtual communication systems represents a significant step in modern project management, contributing to improved interaction among participants and increased efficiency of project initiatives. However, to achieve optimal results, it is necessary to consider both advantages and limitations of this approach, as well as actively develop participants' competencies in the area of virtual communication and effective use of digital technologies.

Modern business environment is characterized by high dynamism, rapid pace of change, and global competition. In such conditions, effective project management becomes a necessity for organizations aiming to achieve their goals and maintain their competitive positions in the market. However, successful project management is impossible without effective communication among project participants.

In today's information society, the development of virtual communication technologies plays a key role in ensuring effective interaction among project participants, especially in the context of remote work and distributed teams. Implementing modern virtual communication systems can significantly improve information exchange processes, coordination of actions, and decision-making, thereby enhancing productivity and the successful completion of projects.

Virtual communication is any electronic interaction between two or more people without in-person engagement. While many people immediately think of video calls, this is just one form of virtual

communication. Email, messaging apps, corporate communication platforms, and video conferencing are among the most popular ways for business groups to interact without being physically present.

Email is one of the oldest and most widespread forms of virtual communication. It is a simple and effective way to communicate with colleagues, clients, and other contacts, allowing for the quick and easy exchange of information, including documents.

Instant messaging is a longstanding form of virtual communication used in workplaces with platforms such as Slack, Google Chat, and Microsoft Teams. Chat platforms are useful for quick communication, project or team updates, and other situations where email is too cumbersome and other communication methods are too slow.

Video conferencing is an excellent way to interact with colleagues, clients, and other stakeholders, even if you cannot meet personally. Zoom, Skype, and Google Meet are just a few of the popular tools used for video conferencing, offering other features such as screen sharing and session recording.

Let's now consider the comparison of virtual communication tools in Table 3.11.

Table 3.11 - Comparison of Virtual Communication Tools

Tool	Description	Advantages	Disadvantages
Slack	Instant messaging platform; Allows creating separate channels for discussing various topics.	- Flexibility in configuring channels and notifications; - Wide range of integrations.	- Does not provide video calls; - Limited free functionality. expectations.
Google Chat	Part of the Google Workspace package. Provides messaging, audio and video calls, and document sharing.	- Integration with other Google applications; - Free usage for Google Workspace users.	- Fewer features compared to other platforms; - Limited integration with external applications and services.

Microsoft Teams	Communication and collaboration platform. Includes chats, video conferencing, file sharing, and integration with other applications.	- Deep integration with other Office 365 applications; - Powerful collaboration tools.	- Requires Office 365 subscription for full functionality; - Complexity for beginners.
Zoom	Popular platform for video conferencing and webinars. Allows holding online meetings with a large number of participants.	- Ease of use; - Capability for large online meetings.	- Free version has time limitations; - Does not include other communication features besides video.
Skype	Voice and video communication platform, as well as text chat. Allows creating group chats and conducting video conferences.	- Wide usage; - Easy to use; - Free of charge.	- Less advanced features compared to other platforms; - Limited support on mobile devices.
Google Meet	A tool for conducting video conferences within Google Workspace. It allows up to 250 participants.	- Integration with other Google services; - High-quality video and audio	- Requires a Google Workspace subscription for full functionality; - Limited customization options.

Thus, each of the listed platforms has its own features and advantages, which can be useful in different situations.

Virtual communication is also observed on various platforms that encourage asynchronous communication. Message boards, support tickets, notes and comments on documents, as well as knowledge bases, are just a few ways in which employees can virtually contribute, complete tasks, and collaborate.

From fully remote teams to hybrid working groups, many companies are looking for the best ways to organize communication when the location of employees changes. Many companies almost completely transitioned to remote work, video calls, and chat when the pandemic broke out in March 2020. Years later, they are trying to determine what worked best during that era and what they could have improved upon in retrospect.

Even supporters of virtual communication recognize "the challenges faced by leaders who want to build a collaborative culture." Managers need to set clear guidelines for the use of virtual communication, establish expectations regarding availability, and consider the preferences and needs of employees in communication.

Team leaders must understand how virtual communication can enhance communication, collaboration, and employee thinking, as well as be aware of potential drawbacks. Here are some advantages of high level.

Increased flexibility for remote and international employees. In today's world, companies must be able to communicate, collaborate, and operate across different time zones and geographical regions. But the more dispersed a team or client base is, the harder it becomes to coordinate everyone's working hours, not to mention their personal availability.

Virtual communication enhances the flexibility for remote and international team participants by allowing them to utilize asynchronous communication. Teams can work on their tasks during their local working hours, providing their colleagues with updated information before logging off. If they have a question that doesn't require an immediate answer, they can send an email, leave a comment, or schedule a message instead of calling a colleague or approaching their workspace.

Some tasks still need to be done simultaneously in real-time. But for many tasks, virtual communication creates flexibility for team members while maintaining accountability for meeting deadlines and achieving results.

Let's say we have an international consulting company that provides project management services to its clients around the world.

The team consists of specialists from different countries and time zones. Virtual communication allows them to collaborate effectively on projects despite the distance.

Since the participants are in different time zones, they use asynchronous virtual communication to exchange ideas, discuss plans, and present the results of their work.

For instance, one of the team members can prepare an analytical report on the current state of the client's technological infrastructure during their working hours and then pass it on to their colleagues for analysis and strategy development at another time. This allows the team to continue working on the project continuously, taking into account the individual schedules of each participant.

Thus, virtual communication ensures flexibility for international team members, allowing them to collaborate effectively and achieve project goals despite differences in time zones and work schedules.

Expanding connections and diversity.

The Internet, cloud computing, and virtual communication tools are just a few examples of technologies that enable businesses to hire a wider range of employees. When team members are not limited by a specific geographic location, it is also possible to increase the diversity of the employees pool.

Companies that are more diverse in terms of race, gender, culture, thinking, and other characteristics are likely to gain a wide range of ideas and perspectives. When leaders support diversity, including cognitive diversity, within their teams, their employees naturally think outside the box and drive innovation.

Virtual communication also helps companies communicate more with customers. Through email, online chat, social media, and other means, they can instantly interact with customers to resolve issues, receive feedback, and offer various products and services.

Instead of information being kept within teams or business units, employees can seek assistance and advice from any specialist in the organization, regardless of the physical distance between them.

Virtual communication also helps track progress and stay organized. Tools like shared calendars, checklists, and project management systems can keep everyone informed. These tools can

streamline task completion, automatically track progress, and send reminders to help people meet deadlines.

For instance, let's say we have a global company specializing in financial management software development. By utilizing virtual communication technologies such as cloud computing and online chat, the company can hire employees from different countries and cultures, which allows for a more diverse employees pool.

Diversity in employees' racial, gender, cultural, and cognitive characteristics drives innovation and enriches ideas. For example, developers from different cultures can bring various perspectives to product development and service delivery, leading to more diverse and customized solutions for clients.

Moreover, virtual communication allows the company to easily interact with clients worldwide. Through various communication channels such as email, online chat, and social media, the company can quickly respond to customer inquiries, provide support, and gather feedback to improve products and services.

Virtual communication also helps employees stay organized and track work progress. Shared calendars and project management systems allow all team members to stay informed and meet task deadlines.

Thus, the use of virtual communication helps companies expand their network, improve customer interactions, and stay organized, leading to increased productivity and higher performance outcomes.

As leaders help their teams communicate better in various environments, let's consider some hidden catches they might encounter in overcoming communication challenges.

1. Unclear expression of ideas or instructions can lead to misunderstandings and wrong task execution. Leaders must pay special attention to the clarity of their communication, using clear and specific expressions to prevent misunderstandings.

2. Leaders often focus on delivering information without giving enough attention to the opinions and suggestions of their colleagues. This can lead to dissatisfaction and limited benefits from communication. It's important to actively listen and consider the opinions of all team members.

3. A lack of empathy from the leader can result in dissatisfaction and conflicts within the team. Leaders should be able to put themselves in others' shoes and understand their feelings and needs to effectively address arising issues.

4. In teams with diverse cultural and cognitive characteristics, disagreements and conflicts may arise due to different perspectives. Leaders must be able to value diverse opinions and encourage constructive dialogue to find optimal solutions.

5. In modern team structures, technology plays a key role in ensuring effective communication. The lack of use or improper use of communication tools can lead to a decrease in team productivity and work quality.

Considering these hidden catches, leaders can develop communication strategies and methods that help them effectively overcome communication challenges and build a close-knit and productive team.

Lack of personal interaction.

Video calls can be a powerful tool for bringing employees together, especially for projects and other collaborative tasks. However, during a video call, people may not necessarily pick up the same cues as they would in face-to-face communication, which can lead to misunderstandings. For example, face-to-face conversations generate signals related to body language, eye contact, and voice intonation. However, a video call might not generate these signals in the same way, especially if you only see a person's head. As a result, people may misinterpret their colleagues' words, expressions, and intentions.

Other forms of virtual communication, such as email and text messages, lack facial expressions. For example, if a manager and an employee are communicating via chat, they are likely to miss subtle cues. Worse still, they might imagine non-existent signals, such as misinterpreting a message as sarcastic. This can lead to misunderstandings, confusion, and a loss of trust within the virtual team.

Delayed responses.

Asynchronous work is a powerful tool for companies, especially multinational organizations. However, when teams lack clarity in communication norms, you might encounter delayed responses (or no responses at all) to critical questions.

For instance, a team from Kazakhstan regularly work with a team from Europe on external communications issues. Much of this work is done asynchronously, with people working on documents, leaving notes, or asking questions via email or chat. But imagine that the Kazakhstan team have a deadline-sensitive question but no protocol to escalate the concern with their European colleagues. The urgent message from the Kazakhstan team might remain in the inbox or chat window until the next morning, leading to a missed deadline.

Challenges in creating team cohesion.

Virtual meetings for the entire team are a great way to bring people together, especially in larger groups. However, they do not necessarily provide the same connection that an in-person meeting could, and some people might feel uncomfortable speaking up during these sessions.

Table 3.12: Advantages and Challenges of Virtual Communication.

Advantages	Disadvantages
Increased flexibility	Disadvantages of face-to-face communication
Expanding connections and diversity	Delayed responses
Easier collaboration	Challenges in building team cohesion

Note – composed by the author

Without personal interaction, some team members may find it challenging to build relationships, understand their colleagues' cognitive preferences, and collaborate effectively. This can lead to a decrease in trust levels, which can further slow down productivity and innovation.

Let's say we have a team of software developers working on a VR project. The team consists of developers, designers, and testers

who need to closely interact for the successful implementation of the project.

In teleworking, where teams are distributed across different geographic locations, building cohesion becomes challenging. The lack of personal interaction can result in ineffective communication and a decrease in mutual understanding.

To solve this problem, the team could organize virtual work sessions in the format of a 'collective hackathon.' During these sessions, participants can work on solving specific tasks and challenges using methods of collective creativity and collaboration.

For example, the team might designate an entire day or weekend for conducting a virtual hackathon, during which participants will collaborate on specific project tasks. They can use specialized tools for virtual collaboration and idea exchange, as well as conduct online presentations and demonstrations of their results.

Such virtual work sessions will help strengthen interaction among team members, increase the level of cohesion and work efficiency, despite the remote locations of the participants

3.3. Digital Platforms for Organizing Project Activities

In today's world, where digital transformation permeates all areas of business, effective organization of project activities is impossible without the use of specialized digital tools. Digital platforms for project management have become an integral part of a manager's daily routine, enabling coordination of team interactions, task tracking, communication storage, and real-time progress analysis.

Among the wide array of available tools, the most widespread platforms include Trello, Slack, Jira, ClickUp, Notion, and others. These platforms differ in functionality, interface, and approaches to project visualization; however, they all aim to simplify task management and enhance team efficiency.

This subsection explores the key features and advantages of using popular digital platforms in the context of project management, with a focus on the needs of the manager as a coordinator, organizer, and communicator in a team environment.

Connection to digital business transformation. The digital transformation of the global economy in general, and the Ukrainian economy in particular, is already a primary source of sustainable and long-term economic growth. Recognizing the significance of this direction for the national economy, state executive authorities – notably the Ministry of Digital Transformation of Ukraine – are promoting Ukraine's overall digitalization. At the state level, a number of strategies have been adopted to accelerate this process, including the Digital Transformation Strategy for the Social Sphere [69], the Electronic Communications Development Strategy [76], the Recovery, Sustainable Development and Digital Transformation Strategy for Small and Medium Enterprises until 2027 [70], and the Digital Development Strategy for Ukraine's Innovation Activities until 2030 [75].

Digital maturity of enterprises is a key indicator of their readiness to adapt to the rapid changes in the market environment and technological progress. It reflects an organization's ability not only to implement innovative technologies but also to integrate them into internal business processes, corporate culture, and development strategy. In the modern economy, digital maturity is becoming a vital factor in competitiveness, as companies with a high level of digital maturity are more capable of responding effectively to market challenges, implementing new solutions faster, and adapting to change more readily.

Digital maturity is not only an indicator of a company's technological readiness but also a strategic resource that defines its long-term success.

In the context of enhancing digital maturity, the implementation of modern digital tools for organizing internal processes – particularly project activities – is gaining increasing relevance. Online project management platforms such as Trello, Slack, Jira, ClickUp, and others serve as essential components of an enterprise's digital ecosystem. These platforms not only automate management processes but also shape a new culture of team interaction, transparent planning, and fast decision-making. Their application meets the demands of the time, supports the implementation of national digital development

strategies, and becomes a necessary condition for effective enterprise operation in the digital economy.

For the next-generation manager, proficiency in digital platforms is not just a competitive advantage – it is a core competency, essential for managing projects of any complexity in the context of the digital economy.

Classification of Digital Platforms for Project Management

In modern management, various digital tools are widely used to organize project activities, helping to increase productivity, simplify communication, and ensure control over processes. These tools can be classified according to their functional purpose, allowing teams or organizations to select the most suitable solutions based on their specific needs.

1. Task Management Tools

These platforms are designed for the effective planning, allocation, and monitoring of tasks within a project. They allow users to create task lists, set priorities, assign responsible team members, and track deadlines. A user-friendly interface and support for Agile methodologies (Kanban, Scrum) make these tools especially popular among project managers.

Trello is an intuitive platform based on the Kanban methodology. It enables users to organize workflows through visual boards, lists, and cards that can be easily dragged and dropped across different stages of task execution. This helps the team monitor task progress in real time and maintain order within the project. Trello supports the addition of descriptions, checklists, deadlines, comments, and files to each card. It also allows for process automation with Butler and integration with other services such as Google Drive, Slack, and more [40].

Key features:

- Creation of boards, lists, and cards that can be moved between lists (e.g., «Planned», «In Progress», «Completed»).
- Ability to add descriptions, checklists, due dates, labels, comments, and files to each card.
- Team collaboration: assigning responsible members, discussing tasks in the comments.

- Automation with Butler: creating rules, triggers, and buttons to speed up workflows.
- Integrations with Google Drive, Slack, Jira, GitHub, and other services.

Visualizing project management with Trello is shown in Figure 3.1.

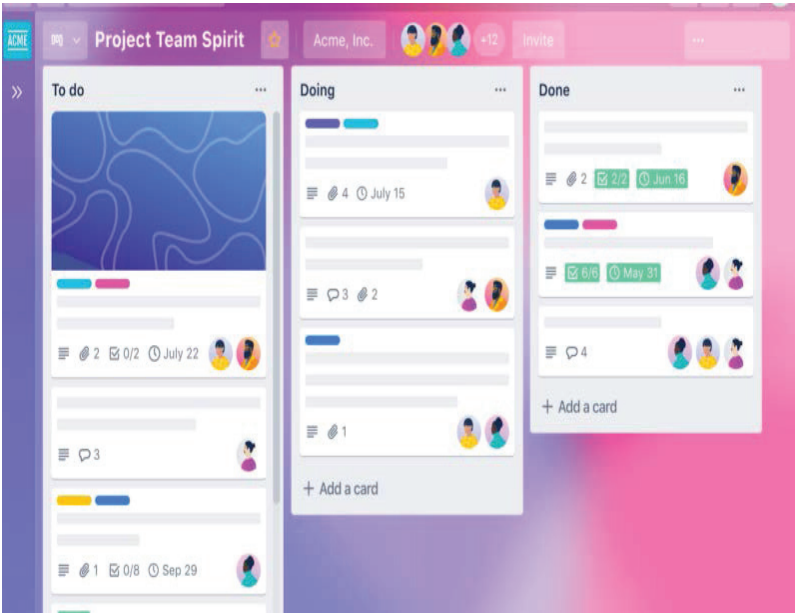

Figure 3.1. Visualizing project management with Trello

ClickUp is a universal tool that combines a wide range of features for task management, documentation, time tracking, and team collaboration. It allows users to create tasks, subtasks, lists, calendars, and also track working time and productivity. ClickUp supports workspace customization and multi-level project organization. Additionally, the platform integrates with hundreds of other services (Google Drive, Slack, Zoom, GitHub, etc.), making it a powerful tool for comprehensive work management [41].

Key features:

- Creation of tasks, subtasks, checklists, goals, and documents within a single platform.
- Flexible customization of workspaces, statuses, task types, and views (list, board, calendar, Gantt chart, timeline, etc.).
- Time tracking, workload evaluation, sprint planning, and support for Agile methodologies.
- Team collaboration tools: comments, mentions, discussions, chats, and real-time document editing.
- Workflow automation using a built-in automation builder.
- Advanced analytics and dashboard system for evaluating efficiency and productivity.
- Integrations with Google Workspace, Slack, Zoom, GitHub, Microsoft Teams, OneDrive, and many other services.

ClickUp Project Management Dashboard visualization is shown in Figure 3.2.

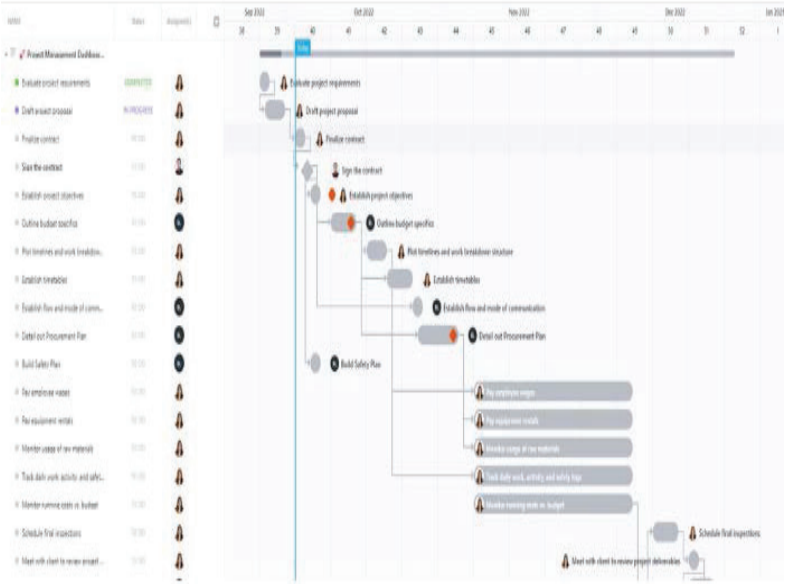

Figure 3.2. ClickUp Project Management Dashboard

Microsoft Planner is a simple and user-friendly tool for organizing tasks and teamwork, integrated within the Microsoft 365

ecosystem. Planner allows users to create plans, task boards, categorize work into «buckets», assign responsibilities, and visually track progress. Thanks to its integration with Microsoft Teams, Outlook, and SharePoint, it is ideal for collaborative work within companies already using Microsoft services [42].

Key features:

- Creation of tasks and plans with the ability to group items into buckets and set priorities.
- Adding labels, deadlines, attachments, and checklists to each task.
- Assigning responsible team members and tracking task status in real time.
- Visualizing progress using a Kanban board or workload chart.
- Integration with Microsoft Teams to enable task discussions within chats and channels.
- Synchronization with Outlook and calendars for deadline planning.
- File and document storage through OneDrive and SharePoint, attached directly to tasks.
- Automatic notifications about task updates and approaching due dates.

Microsoft Planner is an ideal choice for teams already working within the Microsoft 365 environment and seeking a simple way to organize their work without complex setup or additional training.

Project Management with Microsoft Planner visualization is shown in Figure 3.3.

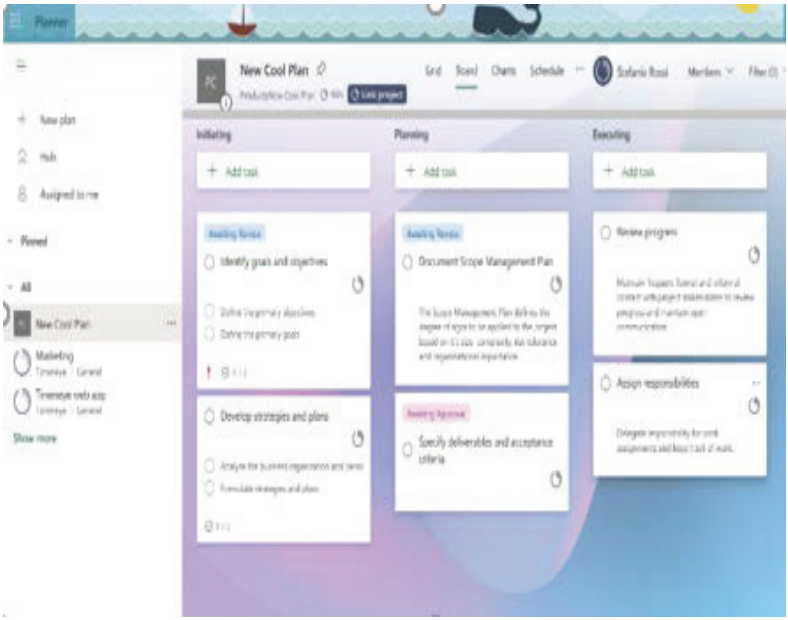

Figure 3.3. Project Management with Microsoft Planner

Taskade is a minimalist yet functional tool for task management and team collaboration. The platform supports various view modes – list, Kanban board, and mind map – allowing flexible organization of workflows to suit different needs. Taskade is ideal for small teams and personal use, offering quick access to notes, tasks, and collaborative work in a single workspace [43].

Key features:

- View modes: task list, Kanban board, and mind map for visualizing processes and ideas.
- Creation of tasks, subtasks, checklists, and notes within a single workspace.
- Real-time collaboration: comments, mentions, discussions, and co-editing of documents.
- Flexible structure organization with nested lists and seamless switching between view modes.
- Mobile and desktop apps for working across various devices.

- Notifications and reminders to track deadlines.
- Integrations with calendars, Slack, Google Drive, and other popular services to enhance productivity.

Taskade is a simple yet powerful tool for those who value minimalism and flexibility in workflow organization – especially for remote teams or personal planning.

Table 3.13 presents a comparative analysis of the key features of digital task management tools, helping to better understand their capabilities and choose the optimal solution based on specific needs.

Table 3.13. Comparative characteristics of key features of digital task management tools

Feature / Platform	Trello	ClickUp	Microsoft Planner	Taskade
UI/UX	Intuitive, simple, visual Kanban	Multifunctional, customizable interface	Simple, integrated into Microsoft 365	Minimalist, with list, board, and mind map views
Main view modes	Kanban (boards, cards)	List, board, calendar, Gantt, timeline	Kanban board, workload chart	List, Kanban board, mind map
Task creation	Tasks, checklists, comments	Tasks, subtasks, checklists, goals	Tasks, checklists, labels, deadlines	Tasks, subtasks, checklists, notes
Assignee assignment	Yes	Yes	Yes	Yes
Deadline tracking	Yes	Yes	Yes	Yes
Team collaboration	Comments, mentions, discussions	Chats, comments, real-time document collaboration	Integration with Teams for chats and discussions	Discussions, mentions, real-time collaboration

Automation	Butler (rules, triggers)	Automation builder	Limited (via Power Automate)	Limited
Analytics and reports	Basic	Powerful, dashboards, reports	Limited	Minimal
Integrations	Google Drive, Slack, Jira, GitHub	Google Workspace, Slack, Zoom, GitHub, Teams	Microsoft Teams, Outlook, OneDrive, SharePoint	Slack, Google Drive, calendars, and others
Mobility	Mobile apps (iOS, Android)	Mobile apps (iOS, Android)	Microsoft 365 mobile apps	Mobile apps (iOS, Android)
Customization flexibility	Medium	High, many customization options	Low to medium (standard MS style)	Medium, several view modes
Agile support (Kanban, Scrum)	Kanban, limited Scrum	Kanban, Scrum, Agile, Gantt	Kanban	Kanban (via boards)
Intended use	Teams of any size	Teams of any size, complex projects	Microsoft 365 teams, organizations	Small teams, personal use

As a result of the comparative analysis of the main task management tools –Trello, ClickUp, Microsoft Planner, and Taskade – several key conclusions can be drawn. Trello is a convenient and intuitive solution for teams that prefer simplicity and visual process representation in a Kanban format. ClickUp stands out for its versatility and multifunctionality, offering extensive customization options, analytics, and the ability to manage complex projects, making it suitable for large teams and complex tasks. Microsoft Planner is ideal for organizations operating within the Microsoft 365 ecosystem, providing ease of use and deep integration with office tools, which is important for corporate environments. Taskade, in turn, is the optimal

choice for small teams or individual users who value a minimalist interface and the ability to organize tasks in various ways–list, Kanban board, or mind map. The choice of a specific tool depends on team size, project complexity, integration needs, and personal preferences regarding platform usability and functionality.

Thus, each of the reviewed digital tools has its advantages and can become an effective instrument for organizing work depending on the specific conditions and tasks.

2. Communication Platforms. These services provide organized team interaction in real time. They support messaging, group chats, video conferencing, and integration with other work tools. Thanks to them, misunderstandings are reduced, decision-making speed increases, and the quality of team collaboration improves.

Slack is a popular messaging platform that allows creating topic-based channels, organizing private or public conversations, and using various integrations with other services (Google Drive, Trello, Zoom, etc.). Slack supports instant messaging, file sharing, message history search, reminders, and audio/video calls. Its flexible settings and developed app ecosystem make Slack one of the leading tools for corporate communication [44].

Main features:

- Themed channels and direct messages.
- Search through messages and files.
- Video and audio calls.
- Integrations with over 2000 services.
- Notifications and priority settings.

Microsoft Teams is an integrated tool for chats, video calls, collaborative document editing, and online meetings within the Microsoft 365 ecosystem. The platform is tightly connected to Microsoft 365, enabling easy real-time work with Word, Excel, and PowerPoint files, scheduling meetings via Outlook, and coordinating team work in a single environment. Teams is suitable for both small businesses and large corporations requiring a high level of security and scalability [45].

Main features:

- Chats and channels for discussions.
- Video conferences and webinars.
- Collaborative editing of Microsoft 365 documents.
- Integration with Outlook, SharePoint, OneDrive.
- Support for task planning and workgroups.

Discord is a platform originally created for gamers but now actively used by various teams for fast communication. It offers voice channels, text chats, video calls, and the ability to create servers with a branched channel structure. Discord stands out for its ease of use, bot support for automation, and numerous settings for managing access rights [46].

Main features:

- Voice and text channels within servers.
- Video calls and streams.
- Integration with bots to extend functionality.
- Ability to create private and public servers.
- Support for file and media sharing.

Zoom is a popular video conferencing platform widely used for online meetings, webinars, training sessions, and remote work. Zoom provides high-quality video and audio, screen sharing, meeting recording, and calendar integration (Google Calendar, Outlook). The platform is known for its ease of use and scalability, allowing many participants to join simultaneously [47].

Main features:

- Video and audio conferences supporting up to 1000 participants.
- Screen sharing and collaboration.
- Meeting recording and automatic transcription.
- Breakout rooms for group discussions.
- Integrations with calendars and other services.

Google Chat is a team communication platform integrated into Google Workspace that enables discussions, group chats, and file sharing. It is closely connected with Google Docs, Sheets, Slides, and Calendar, facilitating real-time collaboration. Google Chat supports bots and integrations that automate workflows. Users can easily switch to video calls via Google Meet – both services are integrated [48].

Main features:

- Themed chats and group conversations.
- Collaborative work with Google Workspace files.
- Search through messages and files.
- Integration with Google Calendar, Meet, Drive.
- Support for bots to automate tasks.

Mattermost is an open-source platform for corporate communication focused on security and data privacy. This tool is often chosen by organizations that want to host servers on their own infrastructure and control access to information. Mattermost offers chats, audio and video calls, integrations with popular services, and extensible functionality via API [49].

Main features:

- Text and voice channels.
- Video calls and file sharing.
- Support for on-premises deployment.
- Flexible security and access rights settings.
- Integrations with Jira, GitHub, Jenkins, and others.

Flock is an alternative to Slack that offers convenient team communication, support for video calls, messaging, and integrations with various services. Flock is aimed at small and medium-sized businesses and provides a simple interface, tools for task planning, and collaborative work [50].

Key features:

- Thematic channels and private chats.
- Video and audio calls.
- Task planning and reminders.
- Integrations with Google Drive, Trello, Zoom, and others.
- Search through messages and files.

Cisco Webex Teams is an enterprise platform for team collaboration that combines chats, video conferences, collaborative file editing, and project management. The platform is known for its high level of security, compliance with corporate standards, and flexible tools tailored to large companies and organizations with complex structures [51].

Key features:

- Chats, group, and private messages.
- HD-quality video conferences and webinars.
- Collaborative work on documents.
- Integrations with Outlook, Microsoft 365, Salesforce.
- Advanced security and access control features.

Table 3.14 presents an analysis of digital communication platforms (Slack, Microsoft Teams, Discord, Zoom, Google Chat, Mattermost, Flock, Cisco Webex Teams) based on key criteria.

Table 3.14 – Comparative characteristics of digital communication platforms

Criteria	Slack	Microsoft Teams	Discord	Zoom	Google Chat	Mattermost	Flock	Cisco Webex Teams
Communication Type	Chats, channels, audio & video calls	Chats, channels, video conferencing	Text and voice channels, video calls	Video and audio conferences	Chats, group conversations, video calls	Chats, audio & video calls	Chats, video & audio calls	Chats, video conferences
Integrations	2000+ services (Google Drive, Trello, Zoom)	Deep integration with Microsoft 365 (Outlook, SharePoint)	Bot support, gaming service integrations	Calendars (Google, Outlook), others	Deep integration with Google Workspace (Docs, Calendar)	Jira, GitHub, Jenkins, API for extending functionality	Google Drive, Trello, Zoom	Outlook, Microsoft 365, Salesforce

Target Audience	Corporate users, teams of any size	Businesses of all sizes, especially Microsoft environments	Gamers, creative and small teams	Online meetings, webinars, education	Corporate users within Google Workspace	Organizations valuing security and private servers	Small and medium-sized businesses	Large corporations and organizations
Security	Data encryption, two-factor authentication	High security level, Azure AD integration	Standard security measures, permissions control	Encryption, access control	Standard Google security level	Privacy-focused, self-hosted deployment	Standard business-level security	Advanced security features, compliance standards
Scalability	Supports small to large teams	From small businesses to large corporations	Supports large servers	Up to 1000 participants per conference	From small teams to enterprise users	Self-hosted, flexible scaling	Supports small and medium teams	Supports large corporate structures
Special Features	Message search, reminders, flexib	Document collaboration, planning,	Automation bots, streaming	Meeting recording, virtual	Bots, deep integration with Google	Self-hosted servers, flexible	Task planning, rem	Project management, advanced

	le integrations	webinars		rooms	services	security settings	inders	access control
Pricing	Free basic version, paid plans	Included in Microsoft 365 (paid subscription)	Free with paid add-ons	Free with limitations, paid plans	Part of Google Workspace (paid subscription)			

The conducted comparative analysis of digital communication platforms demonstrates a wide range of tools tailored to different audiences and business needs. Slack and Microsoft Teams stand out for their rich integrations and are suitable for teams of any size, with Teams offering deeper integration within the Microsoft 365 environment. Discord remains popular among gamers and creative communities thanks to its voice channels and bot support. Zoom specializes in video conferencing, providing high-quality communication and scalability of up to 1,000 participants. Google Chat is effective for corporate users within the Google Workspace ecosystem, offering seamless integration with other Google services. Mattermost is an optimal solution for organizations seeking data control and security due to its self-hosting capabilities. Flock targets small and medium-sized businesses, offering a simple interface and task management tools. Finally, Cisco Webex Teams is a powerful enterprise platform with advanced security features, making it ideal for large organizations with high demands for protection and integration.

3. Comprehensive Solutions. These platforms combine task management, communication, documentation, and analytics features within a single environment. They are especially useful for large and

complex projects, where having a centralized space for storing information and coordinating activities is essential.

Notion is a flexible digital workspace that integrates knowledge base management, note-taking, task tracking, and collaboration features into one platform. It is designed for both personal use and team collaboration across projects of any complexity. Notion allows users to structure information in the form of pages, databases, tables, and boards, making it an ideal tool for organizing knowledge, planning, and documentation. The platform is notable for its high level of customization and integration capabilities with other services [52].

Key functionalities include:

- Creation of structured pages, databases, Kanban boards, and lists.
- Built-in templates for project management, CRM, task tracking, and more.
- Real-time collaborative editing and commenting.
- Visual elements: nested blocks, timelines, charts, tables.
- Integrations with Google Drive, Slack, GitHub, Trello, Zapier, and others.
- Mobile and desktop versions with synchronization.
- A powerful system of tags, filters, and relations between pages.

Some visual examples of project management templates in Notion are shown in Figures 3.4…3.6.

Figure 3.4. Notion: Project Management Template

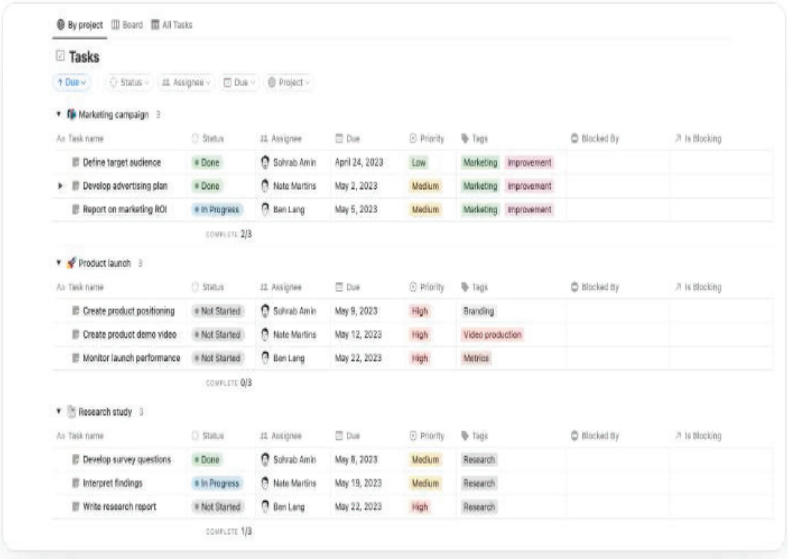

Figure 3.5. Notion: Project Management Tasks

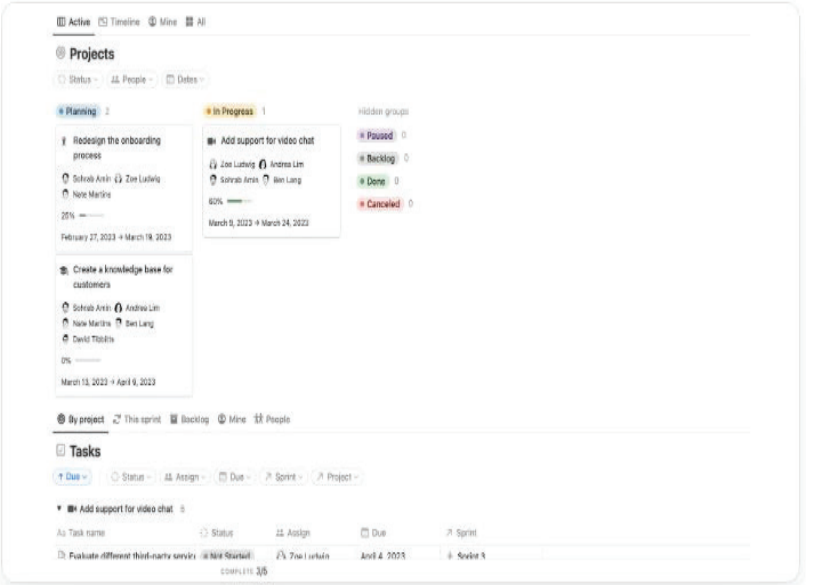

Figure 3.6. Notion: Agile Project Management

Jira is a professional project management system developed by Atlassian, primarily designed for software development teams. It supports Agile methodologies such as Scrum and Kanban, enabling detailed sprint planning, bug tracking, task management, epics, and user stories. Jira is suitable for both small startups and large-scale enterprises with multi-level projects. The product integrates with other Atlassian tools and CI/CD systems, making it a core component of DevOps infrastructure [53].

Key functionalities include:

- Creation and tracking of tasks with a flexible hierarchy (Epic → Story → Task).
- Sprint planning and workload distribution among team members.
- Backlog management, version control, and changelogs.
- Kanban and Scrum boards for workflow visualization.

- Integrations with GitHub, Bitbucket, Confluence, Slack, Figma.
- Performance reports: velocity charts, burndown/burnup charts.
- High-level security features, access control, and activity logging.

A visualization of the project workflow in Jira is shown in Figure 7.

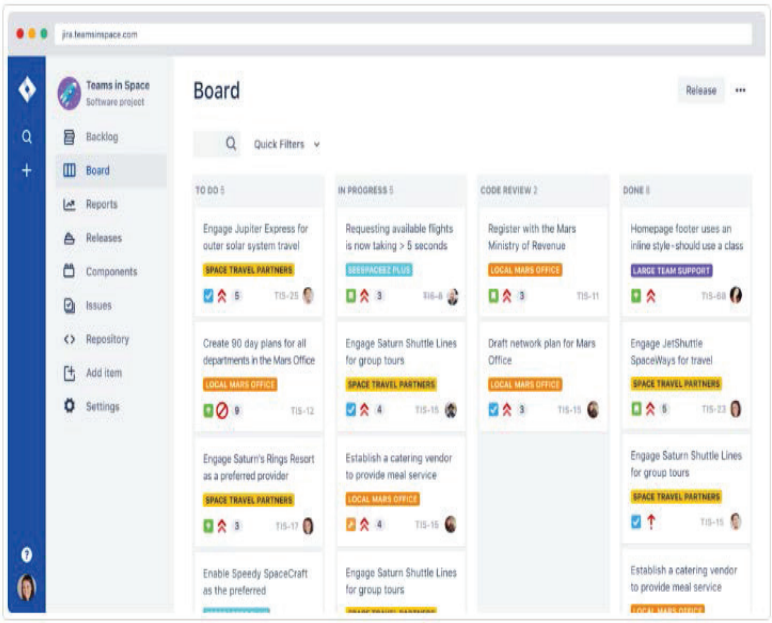

Figure 3.7. Visualizing the project workflow in Jira

Table 3.15 provides a comparative overview of these platforms based on key parameters, allowing for an evaluation of their advantages, disadvantages, and appropriateness depending on the specifics of project activity.

Table 3.15 - Comparative analysis of comprehensive solutions Notion and Jira

Criterion	Notion	Jira
Type of Tool	Universal platform for note-taking, knowledge bases, and task management	Project management system tailored for IT teams
Target Audience	Broad user base: freelancers, educators, startups, businesses	Primarily technical teams, developers, and companies using Agile/Scrum
Core Functionality	Notes, tasks, databases, calendars, pages, wikis, documents	Issues, backlogs, sprints, boards, Agile boards, reporting
Customization Flexibility	High: users can create any page structures and databases	Medium: customization of Agile processes, roles, and workflows within defined structure
Agile Methodology Support	Limited, not a specialized Agile tool	Full support for Scrum, Kanban, SAFe
Team Collaboration	Access sharing, comments, real-time collaboration on pages	Team collaboration on tasks, shared sprint planning, in-task discussions
Integrations	Slack, Google Drive, Trello, GitHub, Figma, etc.	Bitbucket, Confluence, Slack, GitHub, Microsoft Teams, Jenkins, etc.
Analytics & Reporting	Limited: basic tables, custom structures	Advanced: burndown charts, velocity charts, progress tracking, custom reports
Platform/Availability	Web, Windows, macOS, Android, iOS	Web, Windows, macOS, Android, iOS

Learning Curve	Low — intuitive interface	High — requires training, especially for non-technical users
Pricing Model	Freemium (free version + paid features for teams and enterprises)	Paid (limited free version; pricing depends on user count and feature set)

Notion is ideal for flexible knowledge management, creating wiki documentation, and organizing teamwork without complex technical requirements. Jira, in contrast, is indispensable for development teams working within Agile/Scrum methodologies, requiring precise tracking and advanced reporting.

Table 3.16 presents a comparative analysis of the digital platforms Notion and Jira in the context of project organization.

Table 3.16 – Comparative Analysis of Digital Platforms Notion and Jira in the Context of Project Organization

Criterion	Notion	Jira
Purpose	A flexible workspace for creating knowledge bases, managing tasks, notes, and documentation	A professional project management platform focused on IT processes and Agile methodology
Project Types	Educational, creative, administrative, startups, informal IT projects	IT projects, DevOps, large-scale technical projects using Scrum, Kanban, SAFe
Task Management	Kanban boards, lists, tables, databases	Advanced task management (issue types), stages, workflows, backlogs, estimations, priorities
Project Planning	Calendar, timelines, basic templates, deadline tracking	Sprints, releases, roadmaps, flexible planning with timeframes and metrics

Monitoring and Control	Limited analytics: user-defined tables with filters	Advanced analytics: burndown charts, velocity, time tracking, performance reports
Team Management	User roles, comments, @mentions, collaborative page templates	Assignee management, team hierarchy, workload control, task execution overview
Customization Flexibility	Very high (pages, templates, databases adaptable to any workflow)	High (workflow, field, project type, and automation customization within a defined logic)
Integrations	Slack, Trello, GitHub, Google Calendar, Figma, Zoom, Zapier	Bitbucket, GitHub, Confluence, Microsoft Teams, Jenkins, Google Workspace, Slack
Automation Capabilities	Limited, via third-party services (e.g., Zapier, Make)	Built-in automation rules (IF → THEN), triggers, actions, and conditions
User Interface	Intuitive, minimalist interface suitable for non-technical users	More complex interface requiring adaptation, oriented toward technical specialists
Scalability	Suitable for small to medium-sized teams	Suitable for medium to large teams managing a high volume of tasks and contributors
Pricing	Free version + paid team plans	Paid model (limited free version for up to 10 users)

The comparative analysis of the digital platforms Notion and Jira highlights their different specializations and application areas. Notion is a more versatile and flexible tool, well-suited for organizing project activities in educational, creative, and administrative environments, as well as for startups. Jira, on the other hand, is tailored for technical teams and large-scale IT projects that require structured task management under Agile methodologies. Notion stands out with

its user-friendly interface and high level of customization, though it has limited analytics and automation capabilities. Conversely, Jira offers deep integration with DevOps tools, an advanced reporting system, and excellent scalability. The choice between these platforms depends on the project type, team size, and technical complexity of the processes involved.

4. Cloud Services for Storage and Collaboration. These tools provide secure cloud file storage and shared access for team collaboration. They support real-time document editing, backups, and integration with other digital tools, making them a vital component of a company's digital infrastructure.

Google Workspace is a suite of cloud-based office tools by Google that enables efficient real-time collaboration. The suite includes the following services [54]:

Google Drive – centralized cloud storage for storing and sharing files;

Google Docs, Sheets, Slides – tools for creating documents, spreadsheets, and presentations;

Google Meet, Calendar, Gmail – tools for video conferencing, scheduling, and email communication.

Google Workspace allows multiple users to simultaneously edit files, leave comments, track version history, and manage access rights at various levels. The platform is suitable for both educational institutions and corporate use.

Core features:

- Real-time collaborative editing of documents;
- Automatic saving and version history;
- Access control: view, comment, edit;
- Integration with Gmail, Google Calendar, Meet, Forms;
- Support for add-ons and Google Apps Script;
- High availability and scalability for teams of any size.

Dropbox is a popular cloud platform for storing, backing up, and syncing files across devices. It focuses on ease of use, enabling fast file sharing and integration with numerous third-party services [55].

Core features:

- File synchronization between the cloud and local directories;
- Shared access to individual files or folders;
- Automatic backup of important data;
- File commenting, activity log, and version control;
- Integrations with Microsoft Office, Slack, Zoom, Trello, etc.;
- Dropbox Paper – a tool for collaborative notes and planning.

OneDrive is Microsoft's cloud storage platform, tightly integrated with the Windows operating system and Microsoft 365 suite (Word, Excel, PowerPoint, Teams). OneDrive makes it easy to store documents, photos, and other files, access them from any device, and share them with others [56].

Core features:

- Automatic synchronization with Windows and mobile devices;
- Integration with Word, Excel, PowerPoint, and Teams;
- Collaborative editing with Microsoft 365;
- Version control, change log, file recovery;
- Enhanced security features (encryption, 2FA, data loss protection);
- Backup capabilities for PC files including Documents, Desktop, and Pictures.

Box is a secure cloud platform for content management and collaboration, primarily aimed at the enterprise sector. Founded in the USA, it complies with GDPR, HIPAA, and other international security standards [57].

Core features:

- File storage and sharing with controlled access;
- Robust version management and commenting system;
- Integration with Microsoft 365, Google Workspace, Salesforce, Zoom, etc.;
- Built-in tools for business process automation (Box Relay);
- Box Notes – for collaborative work on documents;
- Advanced security features: encryption, access rights management, user activity audit.

iCloud Drive is Apple's cloud storage solution integrated into the macOS, iOS, and iPadOS ecosystem. It is suitable for both personal and team use within Apple Business Manager [58].

Core features:

- Automatic file saving and synchronization across Apple devices;
- Shared access to files and folders;
- Backup of photos, contacts, documents, and settings;
- Integration with Apple apps (Pages, Numbers, Keynote);
- Strong data protection mechanisms: end-to-end encryption, two-factor authentication.

OnlyOffice is an open-source suite of office web applications tailored for corporate clients, educational institutions, and government organizations. It is developed by Ascensio System SIA, a company registered in Latvia [59].

Core features:

- Document, spreadsheet, and presentation editing (compatible with Microsoft Office);
- Real-time collaboration with comments and version history;
- Integration with Nextcloud, Seafile, Alfresco, Moodle, and other systems;
- On-premises deployment on a local server;
- Built-in CRM, email, calendar, and project management tools.

Nextcloud is an open-source cloud platform for file storage and collaboration, which can be deployed on a private server. It is developed by the German company Nextcloud GmbH [60].

Core features:

- Full data control through self-hosting;
- Collaborative document editing (in combination with OnlyOffice or Collabora);
- Built-in calendar, email, video meetings (Nextcloud Talk), tasks, and groups;
- Integration with LDAP, Active Directory, and SSO;
- Advanced security features: end-to-end encryption, access control, audit trails.

Table 3.17 provides a comparative analysis of popular digital services based on key criteria: functional features, collaboration support, integration capabilities, security level, on-premises deployment availability, and target implementation scenarios. This helps to better understand the appropriateness of using each service in specific business or educational contexts.

Table 3.17– Comparative analysis of popular digital services

Service	Description	Collaboration	Integrations	Security	On-premises Deployment	Implementation
Google Workspace	A suite of Google cloud tools (Docs, Sheets, Slides, Drive, Gmail, etc.)	Real-time document editing	Google Meet, Slack, CRM, Zoom	High, includes 2FA, encryption	–	Business, education, teams of any size
Dropbox	File storage and sharing service with basic commenting features	File sharing, comments	Slack, Zoom, Microsoft Office	Data encryption, access control	–	Individual users, small businesses
OneDrive	Microsoft cloud storage	Online editing in Word, Excel	Microsoft 365, Teams,	Encryption, Azure AD,	–	Microsoft users, corporate clients

	with integration into Windows and Office 365		SharePoint	security policies		
Box	Cloud platform for businesses with advanced control and integrations	Comments, collaboration	Microsoft 365, Google Workspace	High, certifications (HIPAA, GDPR)	–	Enterprises, corporations
iCloud Drive	Apple's cloud storage for syncing files across devices	Basic file interaction	iWork, macOS, iOS	Apple ID, encryption	–	Apple users
OnlyOffice	Open-source document editing platform, supports both cloud and	Full-featured document editing	Nextcloud, ownCloud, Moodle	SSL, role-based access, local infrastructure	+	Universities, SMBs, government bodies

	server use					
Nextcloud	Open-source platform for creating a private cloud with extensive features	Editing, chats, video calls	OnlyOffice, Collabora, calendars	End-to-end encryption, local control	+	Organizations needing full data sovereignty

The comparative analysis shows that all examined services provide file storage and collaboration capabilities, but they target different user needs. Google Workspace stands out as the most versatile solution for teams of any size due to its ease of collaboration, wide integrations, and high security level. Dropbox and OneDrive are convenient for file storage and basic interaction but have limited capabilities for comprehensive document workflows. Box and OnlyOffice are tailored for the corporate segment, offering enhanced control, strong protection, and integration with popular office solutions. Nextcloud emerges as a strong alternative for organizations requiring complete local data control and private cloud functionality.

Overall, the choice of platform depends on the scale of operations, required security level, integration needs, and infrastructure autonomy requirements.

TEST QUESTIONS:

1. What project management methodologies exist and how does project management software support them?
2. What are the main steps in the project lifecycle, and how does software help manage it?
3. How can choosing project management software affect team efficiency and project outcomes?

4. What types of reporting does project management software provide, and how do they help monitor project progress?

5. What is the role of project management software in managing project risks and resources?

6. What are the advantages and disadvantages of virtual communication compared to traditional communication methods in the work environment?

7. What are the main elements of a virtual communication system, and how does it ensure effective interaction among project participants?

8. How does virtual communication help reduce time and distance in the process of collaborative work on projects?

9. How does virtual communication affect the quality of team communication and problem-solving capabilities?

10. What factors should be considered when choosing a virtual communication system to optimally support team project work?

CHAPTER 4.
PROJECT MANAGEMENT METHODOLOGY IN THE DIGITAL ECONOMY

4.1 Basic Project Management Methodologies

Project management methodology can be considered from several perspectives [32], which are commonly referred to as concepts. Each concept might use its own terminology, define its own strategy of actions, and be aimed at achieving different success criteria.

For instance, if a project is external and oriented (criterion) towards successfully fulfilling a contract in its entirety (scope, time, quality), traditional project management methodologies, including PMI (PMBoK), are used. If a project is customer-oriented and involves long-term interaction rather than a single project/contract, agile methodologies like Scrum, Kanban, and others are used. If a project is implemented within a single organization and focused on financial success and development, balanced project management methodologies such as PRINCE2 are used. The choice of project success criteria is extraordinarily important, as applying different criteria to the evaluation of the same project can yield directly opposite results (successful/unsuccessful), which both the customer and contractor need to be responsible for.

As is known, in every project, two types of activities can be identified, which are implemented through two groups of processes: product-oriented processes, i.e., processes whose implementation leads to the final product (service), and processes for managing product-oriented processes [31]. The first type of activity (process group) is characterized by its uniqueness, as each project is a distinctive endeavor and scarcely lends itself to standardization, although standard procedures may be used to form unique processes. The second type of activity (process group) is amenable to standardization, and the documents that formalize it are named according to the level of detail in the description: “methodology/method/procedure/regulation of project management.”

Project management methodologies are also distinguished by their level of generality, sometimes referred to as “project management models (methods)” [106]. Some models are applicable to all types of projects and are called “basic models.” Others are only applicable to specific organizations or certain types of activities, as they take into account their specifics, for example, for the road construction sector or software development; these are called “models (methods, regulations) for specific organizations.”

Understanding and applying project management methodologies plays a crucial role in achieving success in modern business. The choice of the most suitable methodology, its competent adaptation, and consistent application will allow organizations to manage projects effectively, achieve set goals, and remain competitive in the market.

Effective project management is crucial for success in the modern business world. For a project to be successfully implemented, it is important to have a clear understanding of the project's goals, timelines, and budget.

Project management methodologies provide a structured framework for planning, executing, and monitoring a project from start to finish. Different project management methodologies offer unique approaches to solving complex tasks in various work environments, allowing teams to adapt and respond to changing circumstances.

From the traditional Waterfall to more flexible project management methodologies, understanding the strengths and limitations of each is crucial for selecting the right framework that meets the specific needs and goals of an organization.

Project management methodology is a systematic approach that defines project planning, execution, and control. It provides a structured way to manage complex projects, ensuring that tasks are organized, resources are allocated efficiently, and goals are achieved within set constraints.

Project management methodologies help project managers and teams navigate the different phases of a project, from initiation to closure, providing guidelines, best practices, and tools.

They offer a set of principles, processes, and methods that can be adapted to the specific needs and requirements of different projects. By understanding and effectively using project management methodologies, organizations can improve project execution, enhance team collaboration, and increase the chances of project success.

The choice of the most effective management methodology is the main thing for the successful completion of an IT project. The chosen methodology decides how communications, management and control will be organized within the IT project and the IT team. But choosing the most effective methodology for a specific project, with the existence of a large number of different approaches to development, is not a trivial task. Each management methodology is focused on different aspects and features of projects, so you can use several methodologies at once or combine them, taking into account the uniqueness of the IT project, its goals, tasks, requirements and organizational structure.

Management of IT teams is based on various methodologies and approaches that help to ensure effective team work, reduce risks and achieve set goals (Table 4.1.).

Table 4.1 - Management methodologies in the field of IT

Traditional (cascade) model	**Flexible (iterative) model**	**Process-oriented model**
Waterfall	Agile: -Scrum -KanBan	Lean DevOps

The traditional (cascade) Waterfall model is a classic cascade methodology for starting a project, which is divided into parts. These are fixed stages that are always present in any project. Waterfall proceeds strictly gradually: first, analytics is collected, requirements are described, then development, testing and launch of the project with subsequent support [105].

Waterfall is a common methodology for most IT projects used by outsourcing (service) IT companies. Waterfall - the «waterfall» model, cascading or cascading product development. It, like the flow

of water, directs teams to solve tasks consistently and strictly according to the original plan.

Waterfall is a methodology where everything is thought out and fixed from the beginning, and this has its advantages. There are projects for which it is suitable - those in which all requirements are known in advance and cannot change during work and where there is no risk of making a mistake (Fig. 4.1.).

Advantages and disadvantages of Waterfall are presented in Table 4.2.

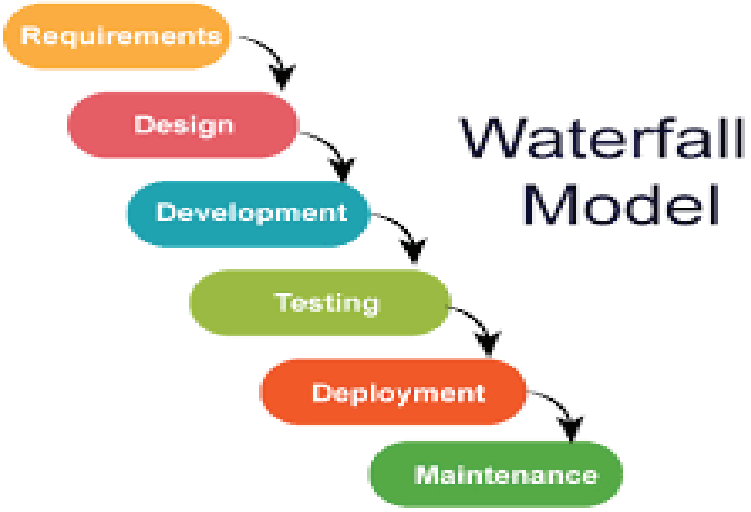

Fig. 4.1. Structure of the Waterfall methodology [3]

Table 4.2 - Advantages and disadvantages of Waterfall

Advantages	Disadvantages
ease of understanding and use. Waterfall is a simple and easy-to-understand approach to project management, as it involves sequential execution of phases: analysis, design, development, testing and implementation	inflexibility Waterfall does not allow for the ability to adapt to changes in project requirements or conditions, which can lead to problems when new needs or problems are identified during implementation

clear structure and manageability. Each phase of the project is carried out sequentially, which allows for a clear structure and control over the development process	high risk of delays. In Waterfall, each phase depends on the previous one, so delays in one phase can lead to delays in the entire project
attention to documentation. Waterfall involves the careful creation of documentation at each stage of the project, which can be useful for preserving the knowledge and history of the project	lack of early feedback. Waterfall involves testing the product only at the final stage, which can lead to the discovery of problems and failures only in the later phase of development, when correction can already be expensive and difficult
suitable for stable requirements. Waterfall is most effective in cases where product requirements are stable and do not change significantly	not suitable for complex projects. In complex projects with a lot of uncertainty, Waterfall can be less effective because it does not allow for iterative improvement and experimentation

This is rarely the case in the digital economy, so teams add agile practices to the cascade model: for example, testing the product for compliance after each stage of work, rather than at the very end.

Flexible (iterative) Agile methodologies, according to the publication of the article «BrainRain» [125], are flexible and repeatable. Agile is a set of methods for software development that makes work on the project consistent, flexible and adaptive to changes. Agile methodology is based on open communication, collaboration, adaptation and trusting relationships between team members. Usually, the project manager or product owner is responsible for prioritizing the assigned functions. How the work will be done is decided by the team. She independently chooses which parts of the work to perform and how to divide responsibilities between participants. Agile is not reduced to a series of meetings and specific development techniques. Agile is a group of methodologies, in each of which there is a desire to relentlessly use feedback loops and continuous improvement (Fig. 4.2.).

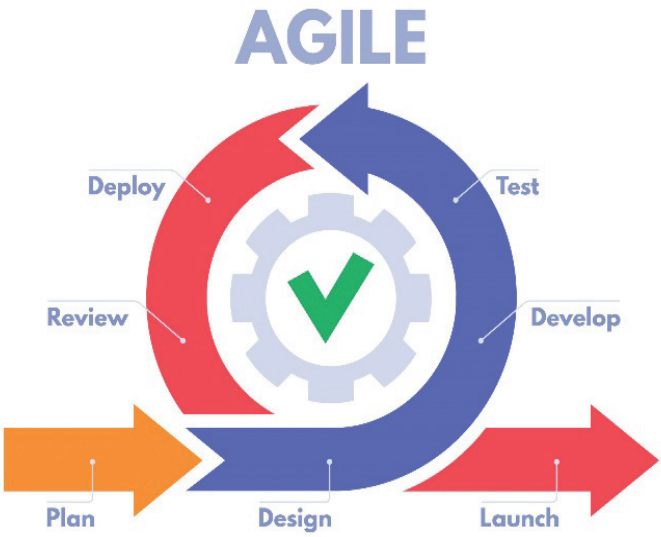

Fig. 4.2. Structure of the Agile methodology [31]

Agile principles clearly reflected in the Agile Software Development Manifesto [97]:

- People and collaboration are more important than processes and tools;
- A working product is more important than comprehensive documentation;
- Cooperation with the customer is more important than discussing the terms of the contract;
- Readiness for changes is more important than following the plan.

That is, although the values on the right are important, we value more what is on the left [97].

The advantages and disadvantages of Agile are presented in Table 4.3.

Table 4.3. - Advantages and Disadvantages of Agile

Advantages	Disadvantages
flexibility and adaptability. You can quickly react to changes in project requirements or conditions and make appropriate changes to testing. This allows you to keep the relevance and relevance of the product throughout the entire development process	the need to involve the customer. If the customer is not ready to contribute and take the time to interact with the team, this can negatively affect the project
reducing the time between iterations. It allows you to get work results quickly, and also reduces the risk of problems	some Agile methods and tools can be difficult to master. Training and adaptation of the team to new methods and processes is required
continuous improvement. Agile enables the team to continuously improve, analyze errors and provide feedback from users	not all projects are suitable. Agile is not always the best choice for all types of projects. For example, it may be less effective for projects with fixed scopes and deadlines
early detection of problems and errors. Agile testing is carried out throughout the development process, which makes it possible to identify problems at early stages and quickly correct them	not always predictability. Changes in requirements and priorities may affect planning and test results
	the need for automation. Agile testing often requires test automation to support a fast pace of development. This may require additional resources and time
	team requirements. Successful implementation of Agile requires a high level of cooperation, communication and self-organization from the team. Not all teams can immediately adapt to this style of work

Agile principles include: Scrum, Kanban, XP, DSDM, FDD (functionality-driven technology), Lean and others. Agile methods are

optimally suited for small teams of developers - self-organized or democratically managed.

Scrum is one of the most popular agile software development methodologies from the Agile family. Easy and accessible to use, but difficult to learn, if you believe the official description [100].

Scrum is a short «sprint» approach to project management. Sprint is the main feature of Scrum. This is the name of each small subtask that makes up the project. All sprints should be the same in duration, most often the length of one is 2 weeks, less often a month. And how much depends on the specifics of your project. Usually, the more complex and unusual the task, the shorter the sprint to quickly understand how much time is actually needed to achieve the larger goal, and not waste development time on something that may not be needed.

In general, sprints are about specific tasks. Was there a feature missing? Added Did something not work? They fixed it. Thanks to it, it is convenient to organize work and it is even more convenient to monitor the progress of the project in general.

Scrum artifacts are important information used by the scrum team to describe the product and the work that needs to be done to create it. There are three artifacts in Scrum: the Product Backlog, the Sprint Backlog, and the Increment with your readiness criteria.

These are the three constants that the scrum team should reflect on during sprints and over time.

1. Product Backlog (product backlog) is the main list of tasks that need to be completed. It is run by the product owner or manager. This is an ever-changing list of features, requirements, improvements, and fixes from which the sprint backlog tasks are drawn. It's essentially a team task list, or as Wikipedia calls it, a «project wish log». The product owner regularly reviews the product backlog, changes priorities in it and maintains its relevance as new information or changes in the market appear, due to which certain tasks lose their meaning or new ways of solving problems arise.

2. Sprint backlog is a list of work tasks for a specific sprint, which is formed at a meeting regarding its planning. It can also change if the team encounters difficulties and needs to do something other

than what was planned. But his goal, the sprint goal, remains unchanged.

3. An increment (or sprint goal) is a ready-to-use final product based on the results of the sprint. The word «Increment» is not so widely found in everyday life. It is often defined as a team-agreed product readiness criteria, a checkpoint, a sprint goal, or even a complete release or delivered epic. It all depends on what readiness criteria your team is guided by and how the sprint goals are chosen.

For example, some IT teams prefer to release something to their customers at the end of each sprint. For them, the word «ready» means «delivered». However, this may not be practical for other teams. Imagine you are working on a server product that can only be shipped to customers once every three months. You can still break your work into two-week sprints, but the product will be «ready» for you when you've completed part of a larger version that you plan to deliver in its entirety. However, let's not forget that the more time it takes to release software, the less likely it is to succeed. Scrum methodology is presented in Fig. 4.3. [31].

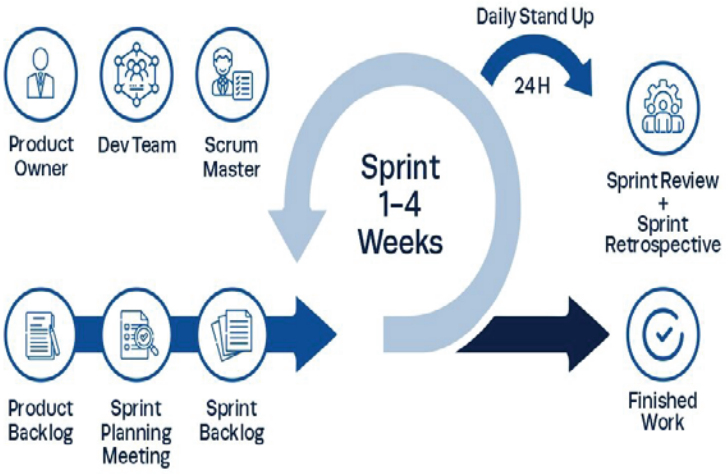

Fig. 4.3. Structure of the Scrum methodology [148]

Scrum is an iterative, adaptive framework for small teams (up to 12 people) to manage their work through a set of values, principles and practices.

The Scrum Team is shown in Fig. 5. The Scrum Team consists of:

One Scrum Master - creates an appropriate working Scrum environment and is responsible for teaching the Scrum rules to the entire team.

One Product Owner is responsible for achieving the maximum quality of the product that is the result of the team's work.

Developers are all team members who work on tasks during each sprint.

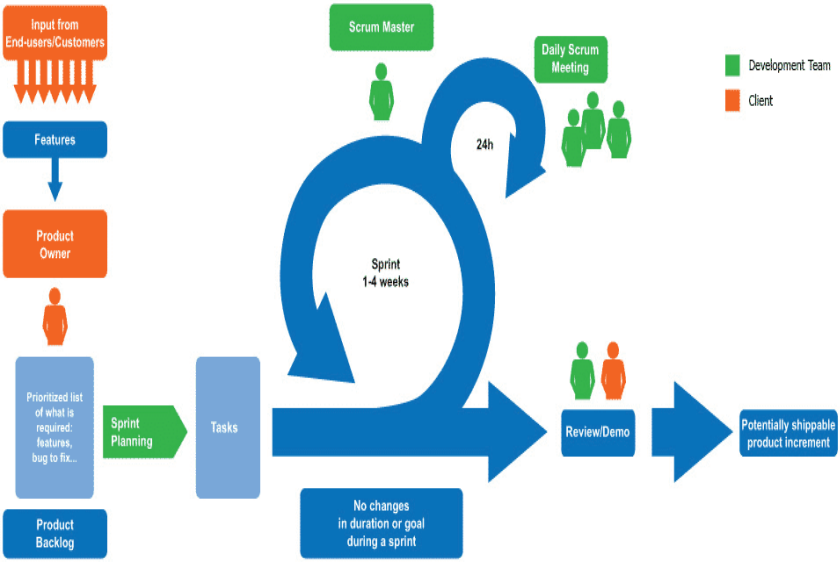

Fig. 4.4. Algorithm of IT product development processes in Scrum [148]

Principles of the Scrum management system:

- Transparency – a transparent process of developing and setting tasks, clear to every participant;
- Inspection – constant checking of processes in the retro-session;
- Adaptation – flexible adjustment to the results in the retro-session and feedback.

The advantages and disadvantages of Scrum are presented in Table 4.4.

Table 4.4 - Advantages and Disadvantages of Scrum

Advantages	Disadvantages
transparency and openness: Scrum provides clarity about the tasks, responsibilities and progress of work in the team, allowing all participants to understand the current state of the project	team requirements: Effective use of Scrum requires high qualification and experience of the team, as well as the ability to work in conditions of high self-organization
incremental development: Scrum promotes incremental product development through short iterations (sprints), which allows for quick product functional parts for testing and feedback	instability of requirements: If product requirements change frequently or are unstable, this can lead to deficiencies in the performance of tasks and increase the risk of project failure
risk reduction: Through short development cycles and regular feedback from the customer, Scrum enables quick identification and correction of problems, thereby reducing project risks	the need for frequent communication: Scrum involves regular meetings and active communication within the team, which can require significant effort and time
customer involvement: Scrum involves the active involvement of the customer in the development process through regular reports and demonstrations of results at each iteration	not suitable for all projects: Scrum may be less effective for some types of projects, especially those with tight time constraints or requirements
self-organization of the team: Scrum promotes the development of self-organized and responsible teams that determine for themselves how best to perform their tasks	

*Kanban i*s a method of designing, managing and improving flow systems for mental work. This method enables organizations to start with an existing workflow and implement evolutionary changes in it. This can be done by visualizing the flow and limiting the amount of work in progress (WIP). Simply put, Kanban will help you stop starting work and start finishing it.

The Kanban method gets its name from the use of Kanban - visual signaling mechanisms to control work-in-progress for intangible work products.

Kanban is an iterative framework that focuses on visualizing the entire project on boards to increase process transparency and collaboration between team members.

The Kanban board consists of 3 indicators, within which all tasks are located (Fig. 4.5.):

-current tasks being performed;

- tasks to be completed in the future;

- completed tasks.

Fig. 4.5. Structure of the Scrum methodology [31]

Kanban can be used in any mental work environment. It is especially effective in situations where work comes in unexpectedly or when you want to release when ready without waiting for other work tasks to be completed.

By choosing Kanban, the team commits to adhere to the following values:

1. Transparency – Open sharing of information using clear, understandable communication improves the flow of business value.

2. Balance – different aspects, perspectives and capabilities must be balanced for effectiveness.

3. Collaboration – Kanban is designed to improve how people work together.

4. Customer Orientation – Kanban systems aim to optimize the flow of value for stakeholders who are external to the system, but can be either internal or external to the organization in which the system exists.

5. Flow – work is a continuous or episodic flow of value.

6. Leadership - the ability to inspire others to action through example, words and thought is required at all levels to realize continuous improvement and deliver value.

7. Understanding – individual and organizational self-awareness is necessary for moving forward and improving.

8. Agreement - all participants in the system commit to improvement and agree to jointly move towards the goals, respecting and taking into account differences in views and approaches.

9. Respect – team members commit to value, understand and show respect for people.

Principles of Kanban:

- Principles of change management:

Kanban is built to overcome people's tendency to resist change. Start with what you're doing right now - understand current processes as they actually work. Respect existing roles, responsibilities and positions. Look for improvement through evolutionary change. Encourage acts of stewardship at every level.

- Principles of service provision:

These principles recognize that organizations are a set of interrelated services and focus on the work, not the people who do it. Understand and focus on the needs and expectations of your customers. Manage work; let people organize themselves around you. Develop policies to improve customer and business outcomes.

The advantages and disadvantages of Kanban are presented in Table 4.5.

Table 4.5 - Advantages and disadvantages of Kanban

Advantages	Disadvantages
simplicity and ease of implementation. Kanban is a simple and easy-to-use method that can be easily implemented even without significant changes in the team's work processes	possibility of overload. Without proper workload limit management, team overload can occur, resulting in delays and not completing tasks on time
workflow visualization. Kanban is achieved using a board with cards or columns that represent different stages of work. This allows you to better control the work of the team and identify problems faster	no fixed terms. The Kanban methodology does not have fixed deadlines for project completion or iterations, which can lead to uncertainty about the timing of work
flexibility and adaptability. Kanban can easily adapt to changes in team requirements, priorities, and needs without much effort	the possibility of increasing the cycle time. If the workload limit or other aspects are not properly managed, an increase in the cycle time of the work on the task can occur
work load (WIP) limit. Using a workload limit helps avoid team overload and ensures a more rational distribution of work	not suitable for all types of projects. While Kanban can be effective for many projects, it is not suitable for all types of projects, particularly projects with large changes in requirements or deadlines
control and problem solving. Kanban facilitates regular review of work and identification of problems, allowing for quick response and resolution	

Process-oriented Lean is a methodology and a philosophical principle. Its main idea is to maximize value for the consumer while minimizing costs. Simply put, more value = less resources [165].

Lean strives to implement the idealistic principle of zero waste (nothing is wasted). For this, it is necessary to minimize resources that are spent uneconomically, on unnecessary, too expensive or insufficiently profitable and unpromising directions.

Lean thinking, or frugal thinking, no longer focuses on the optimization of the management vertical - individual technologies, assets and vertical departments. Instead, we learn to optimize the flow of products and services across all value streams that flow horizontally through technology, assets and customer-facing departments. Structure of the Lean methodology presents on Fig. 7.

By eliminating waste in all value streams, rather than at their individual points, we get processes that require less human effort, less space, less capital and less time to produce at much lower costs and with fewer defects than traditional businesses - systems. Managing information becomes easier and more accurate. Companies can respond to the changing wishes of customers by offering a wide range of services, high quality, low cost and very fast order fulfillment time.

A popular prejudice is that Lean is only suitable for manufacturing. But this is fiction. Lean can be applied to any business and any process. Lean is not a tactical program, nor is it a cost reduction program. Lean is a way of thinking and acting of the entire organization.

Companies in all industries and services, including healthcare and government, are using lean manufacturing as a way of thinking and acting. However, many prefer not to use the word «lean production», but to label the system with its own name. Thus, they emphasize that lean manufacturing is not a short-term cost-cutting program, but a way of doing business for the company. The word «lean transformation» is often used to describe a company moving from an old way of thinking to a lean way of thinking. After all, it requires a long-term perspective and perseverance.

The advantages and disadvantages of Lean are presented in Table 4.6.

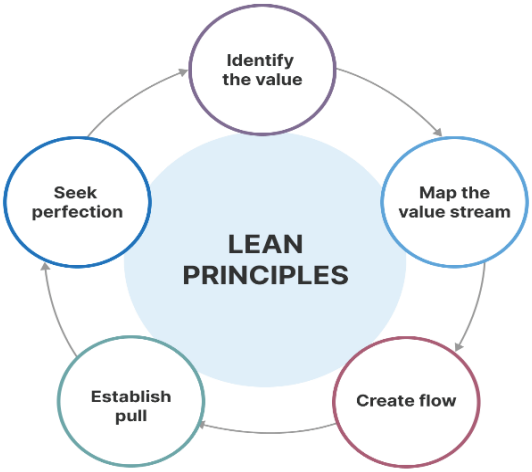

Fig. 4.6. Structure of the Lean methodology [168]

Table 4.6 - Advantages and disadvantages of Lean

Advantages	Disadvantages
cost minimization. One of the main advantages of Lean is increasing efficiency and minimizing costs, which is achieved by eliminating redundant operations and optimizing processes	the need for cultural change. Implementing Lean can require significant changes in corporate culture and work approaches, which may be difficult to achieve in some organizations
improvement of product quality. Lean is aimed at continuous improvement of processes, which allows to improve the quality of the product and ensures satisfaction of customer needs	the need for time. Implementing Lean can take time and requires an organization to focus on continuous improvement and change

work flow management. Lean focuses on managing the flow of work and determining the best ways to accomplish tasks, which allows for reduced cycle times and improved productivity	complexity of implementation. Implementing Lean can be a complex process, especially in larger organizations or in manufacturing industries with complex production processes and structures
inventory reduction. Lean helps to avoid excessive accumulation of stocks and materials, which allows you to reduce costs and optimize production processes	the need for a focus on quality. Lean involves a constant focus on process quality and efficiency, which can require significant effort and resources to maintain

DevOps is a set of methods, tools, and a culture philosophy that allow you to automate and integrate the processes of software development teams and IT teams. DevOps focuses on empowering teams, their interaction and collaboration, and automating technology.

A DevOps team includes developers and IT professionals who work together throughout the product lifecycle to improve the speed and quality of software deployment. This is a new way of working and an important culture change that has significant implications for teams and the organization as a whole.

In the DevOps model, development and operations teams are no longer disconnected. Sometimes these two teams merge into one, and its members work throughout the entire application life cycle - from development and testing to deployment and operation - and possess multifaceted professional skills.

DevOps teams use tools to automate and accelerate processes, thereby increasing reliability. The DevOps toolset enables teams to solve key DevOps challenges: implement continuous integration, continuous delivery, automation, and collaboration. Structure of the DevOps methodology presents on Fig. 4.7.

DevOps values are sometimes used beyond development teams. When the DevOps approach is applied by security teams, security becomes an active and integral part of the development process. This approach is called DevSecOps. Structure of the Lean methodology of DevOps.

The continuous nature of DevOps leads practitioners to use an infinite loop to show the relationship between the phases of the DevOps life cycle. Despite the external consistency of the cycle, it symbolizes the need for constant collaboration and iterative improvement throughout the life cycle.

The DevOps lifecycle consists of eight stages, with the left side of the never-ending cycle representing the processes, capabilities, and tools needed for development, and the right side for operations. At each stage, teams collaborate and interact to maintain consistency, speed, and quality [123].

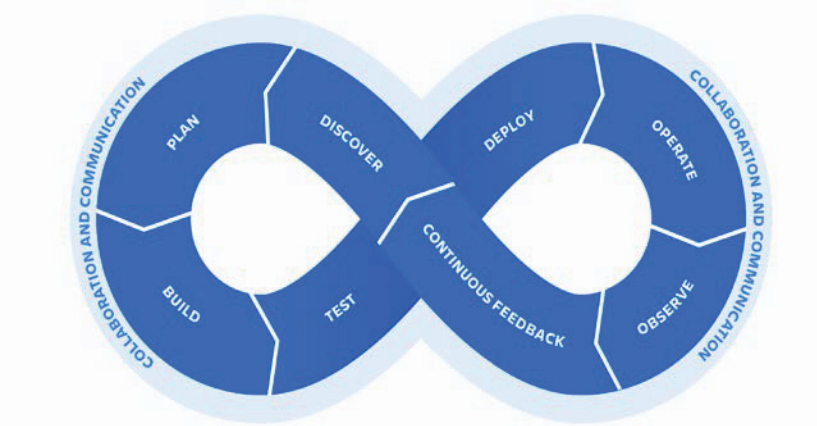

Fig. 4.7. Structure of the Lean methodology [119]

1. Explore (Discover). Software development is a team sport. In preparation for the upcoming sprint, teams should hold a workshop to explore ideas, organize them, and prioritize them. Ideas must be in line with strategic goals and meet customer needs. Agile methodology helps to direct the work of DevOps teams.

2. Plan (Plan). To improve speed and quality, DevOps teams must adopt Agile methodologies. Agile is an iterative approach to project management and software development that helps teams break down work into smaller parts and deliver results in separate portions.

3. Assembly (Build). Git is a free and open source version control system. It has excellent support for branching, merging, and rewriting the history of the repository. Thanks to this, many innovative and effective workflows and tools appeared, designed to improve the development process.

4. Test (Test). Continuous integration (CI) enables multiple developers to commit code to a single shared repository. When changes are merged, automatic testing is performed to verify the correctness of the code before integration. Code merging and testing often help development teams ensure the quality and predictability of the code being deployed.

5. Deployment (Deploy). Continuous deployment (CD) enables teams to release new features to the production environment frequently and in an automated manner. Additionally, teams can use feature flags during deployment to deliver new code to users gradually and methodically, rather than all at once. This approach increases the speed, productivity and stability of software development teams.

6. Operation (Operate). Manage the end-to-end delivery of IT services to clients. It refers to the techniques associated with the design, implementation, configuration, deployment, and maintenance of the entire IT infrastructure that supports the organization's services.

7. Observation (Observe). Quickly identify and resolve issues that impact product uptime, speed, and performance. Automatically notify the team of changes, dangerous activities and failures so that services can continue to be provided.

8. Continuous feedback. DevOps teams must evaluate each release and create reports to improve future releases. With continuous feedback, teams can improve their processes and take customer feedback into account to improve the quality of subsequent releases.

The advantages and disadvantages of DevOps are presented in Table 4.7.

Table 4.7 - Advantages and disadvantages of DevOps

Advantages	Disadvantages
faster software delivery. DevOps allows you to automate development, testing, and deployment processes, which	complexity of implementation and training. DevOps can require significant effort to implement, as well as time to train teams and

ensures faster release of new features and fixes	change the culture of the organization
improving collaboration between teams. DevOps helps create a shared culture and unite development, testing and operations teams to achieve common goals	the need for investment in tools and infrastructure. Implementing DevOps may require investment in new automation tools, hardware, and infrastructure
risk reduction. By automating and standardizing processes, DevOps allows you to reduce the risk of errors and failures in the development and implementation process	security requirements. Through automation and integration, DevOps can introduce certain security risks, especially if appropriate security standards and practices are not followed
increasing stability and reliability. DevOps promotes the automation of testing, version control, and monitoring, which improves software quality and stability	the need to change the culture of the organization. Implementing DevOps may require a change in organizational culture and the way business communicates, which may be difficult for some companies

The main approaches to the formation of traditional methodology (Waterfall), iterative flexible methodology (Agile, Scrum, KanBan) and process-oriented models (Lean, DevOps) were investigated. It was determined the advantages and disadvantages of each methodology and their compliance with the goals of project management and the peculiarities of the formation of IT teams. It was made a comparative analysis by functionality, scope of application (domain), advantages and disadvantages of IT team management methodology in project management in the digital economy.

4.2 Application of Design Thinking Principles in Project Development

Design thinking is a methodology based on design principles that is used to solve complex problems and create innovative solutions. It

involves applying core design principles such as empathy, problem definition, idea generation, prototyping, and testing to develop creative and effective human-centered solutions. Design thinking emphasizes the needs and expectations of users, stimulates collective thinking, and encourages an iterative development process.

The application of design thinking principles can significantly enhance creativity and engagement in the project development process. Let's explore a few ways to achieve this:

1. Understanding user needs is a key step in the process of developing any product or service. This involves conducting research, interviews, and observations to deeply understand the product's use context, as well as the true needs and problems of the target audience. Let's consider each of these methods in details and provide examples of their application:

- *Research*: This may include market analysis, competitor analysis, trend analysis, and user data analysis. For example, if you are developing a fitness mobile application, you could conduct market research on health and fitness mobile applications, study their features, user reviews, and popular trends.

- *Interviews*: Conducting interviews with potential users can help you better understand their needs, problems, and expectations for the product. For instance, you can interview regular gym-goers to find out what features and functionalities they would like to see in a health mobile application.

- *Observations*: Observing user behavior in their natural environment can also be beneficial. For example, you could join a fitness class at a gym and observe how users interact with the equipment, which exercises they prefer, and how they track their progress.

Understanding user needs will help create a product that perfectly meets their expectations and addresses their real problems. This will allow you to develop more effective and appealing solutions that will be successfully accepted in the market.

2. Creating Personas and Empathy: Creating personas is a method that helps visualize and describe typical representatives of your target audience. Each persona represents an archetype user with

specific characteristics, needs, goals, and motivations. This helps the team better understand who they are developing the product for and comprehend their needs and motivations.

Here are a few steps for creating personas and developing empathy towards users:

- *Data Collection:* Start by gathering data about your target audience, such as demographic information, behavioral patterns, problems, and desires. This information can be obtained from research, interviews, surveys, or user data analysis.

- *Creating Personas*: Based on the collected data, create several personas representing different types of users of your product. For each persona, describe their name, age, profession, goals, needs, problems, and motivations. This will help the team better understand who they are developing the product for and what solutions are needed.

- *Using Personas in the Development Process*: Incorporate the created personas into the product development process. Imagine how each of them would use your product, what tasks they would solve, and what problems they might encounter. This will help the team make decisions based on real user needs.

Let's assume the team is developing a mobile application for travelers. They create several personas:

- Anna, 30 years old, works in an office, loves outdoor activities and weekend travel. Her goal is to find an application that helps her quickly find interesting places to visit in a new city and plan routes.

- Maxim, 25 years old, student, loves budget travel and fun parties. His goal is to find an app that helps him find the cheapest deals on tickets and accommodation, as well as fun places to spend time in a new city.

Developing empathy for these personas will help the team better understand their needs and create a more appealing and user-friendly application for both users.

3. Interactive Methods and Prototyping: Using interactive methods such as brainstorming, role-playing games, and prototyping plays an important role in engaging the team in the process of generating ideas and solving problems. These methods allow the team

to freely express their thoughts, contribute, and interact with each other, fostering the search for creative and innovative solutions. Prototypes, in turn, help quickly visualize ideas and test them in practice, helping to refine the product concept and prevent possible errors.

Let's consider some examples of using interactive methods and prototyping:

- *Brainstorming:* Organize a brainstorming session where team members can freely express their ideas regarding different aspects of the product or solving a specific problem. It's important to create an atmosphere of openness and support so that every team member feels comfortable sharing their thoughts.

- *Role-playing Games*: Conduct a role-playing game where team members can take on the role of the end-user of the product or client. This will help them better understand users' needs and expectations and view the problem from different perspectives.

- *Prototyping:* Create prototypes of the product or its individual elements to visualize ideas and test them in practice. This can be a paper prototype, a wireframe, or a prototype using specialized software tools. For example, if you're developing an online shopping application, create a prototype interface with the main functional elements (buttons, input fields, product lists) and test it with users to gather feedback.

Using these methods will help the team generate ideas, solve problems, and develop a product that truly meets users' needs.

4. Iterative Approach and Feedback: An iterative approach and feedback collection play an important role in product development, allowing the team to quickly test and improve their ideas in the early stages of development. Instead of developing the product fully and releasing it to the market, the iterative approach involves creating prototypes or Minimum Viable Products (MVPs), which are then tested with real users. The feedback collected is used to adjust and improve the product before its full release to the market.

Here are more detailed steps and examples of using the iterative approach and feedback:

- *Creating Prototypes or MVPs*: Start by creating prototypes or MVPs that demonstrate the main functions or concept of your product. For example, if you are developing a task management application, create a prototype with basic functions such as adding tasks, editing them, and marking tasks as completed.

- *User Testing*: Conduct testing of prototypes or MVPs with real users. Gather feedback about their impressions, user experience, as well as any bugs or shortcomings they noticed. For example, you can ask users to complete certain tasks using your application and observe how they interact with the interface and what issues arise.

- *Iteration Analysis*: After conducting testing, analyze the collected feedback. Determine what works well and what needs improvement or changes. Use this information to adjust the prototype or MVP before the next iteration of development. For example, if users pointed out interface inconveniences, you can review and make changes to improve the user experience.

- *Iteration Repetition:* Repeat the process of creating, testing, and analyzing iterations, making improvements at each development stage. This will gradually refine your product and meet user needs more effectively. Applying an iterative approach and collecting feedback helps create a product that better addresses user needs, reduces the risk of errors, and speeds up the development process.

5. Collaboration and Multidisciplinary Teams: Collaboration and the work of multidisciplinary teams play a crucial role in successful product development. Creating teams that represent various areas of expertise, such as design, development, marketing, analytics, and others, ensures a diverse perspective on the problem and provides the best ideas for solving it.

Here's a more detailed description and examples:

- *Diversity of Perspectives*: In multidisciplinary teams, each participant has their unique area of expertise and experience. For example, a designer may approach a task from the perspective of user experience and product appearance, a developer from a technical standpoint, and a marketer from the market needs perspective. This allows for viewing the problem from different angles and finding the best solutions.

- *Synergy and Creative Interaction*: The diversity of perspectives and experience in the team promotes better ideation and idea generation. For instance, a designer can inspire a developer with new ideas, and a developer can suggest technical solutions to improve the user experience. This kind of creative interaction fosters innovative solutions.

- *Enhancing Product Quality*: The diversity of expertise in the team allows for creating products that take into account various aspects—from user experience to technical capabilities. For example, thanks to the involvement of a marketer in the team, the product can be better adapted to the needs of the target audience and successfully launched in the market.

Example: Suppose a team is developing an online shopping application. Such a team might include the following experts:

- *Designer*, who is responsible for the user interface and visual design of the app.

- *Developer,* who is handling the technical implementation of the functionality and performance optimization.

- *Marketer*, who is analyzing the market, competitors, and target audience needs, as well as developing marketing strategies to promote the app.

- *Analyst,* who is tracking user behavior data and helping optimize the user experience.

The diversity of expertise in such a team will help create an application that combines an attractive design, high performance, and effective marketing strategies.

Applying design thinking principles will help the team create more innovative and appealing products that solve real user problems.

TEST QUESTIONS:

1. What are the main characteristics that define project management methodologies, and how do they differ from each other?

2. What are the main stages included in the project life cycle, and how do project management methodologies take them into account?

3. What are the advantages and disadvantages of classical project management methodologies such as Waterfall and PRINCE2?

4. What is the main difference between agile project management methodologies like Agile and Scrum and classical approaches?

5. How can the choice of project management methodology affect the final outcome and success of the project?

6. What is design thinking and what are the main principles behind it?

7. How can applying design thinking principles in the project development process help in identifying user needs?

8. What tools and methods are used when applying design thinking in the project development process?

9. How does design thinking contribute to innovation and creativity in the product or service development process?

10. What challenges might arise when implementing design thinking principles in an existing project development process, and how can they be overcome?

CHAPTER 5
ANALYTICS METHODS IN PROJECT MANAGEMENT

5.1 Data Analytics for Forecasting and Risk Management

Applying data analytics for more accurate forecasting and risk management is one of the key areas of innovative practices in project management. Modern information technologies and big data analysis methods significantly enhance the accuracy of predictive models and the effectiveness of identifying, assessing, and managing potential project risks.

Data analytics in the context of risk management relies on the principles of data collection, processing, and analysis to identify patterns, trends, and anomalies that may indicate potential risks or opportunities for the project. The use of statistical methods, machine learning, and artificial intelligence allows for processing large volumes of data, including historical project data, financial information, market trends, and social and economic indicators.

Applying Data Analytics for Risk Forecasting

Risk forecasting using data analytics includes the following steps:

1. Data Collection: Organizing the collection of relevant data from various sources, including the organization's internal databases, open data, data from partners, and customers.

Let's consider the example of the retail company "MegaMarket," which uses various data collection methods to optimize its business. "MegaMarket" is a supermarket chain striving to improve its product range and service based on customer preferences and needs data.

- Surveys and Questionnaires: The company "MegaMarket" conducts surveys among its customers to get feedback on service quality, product assortment, and pricing levels. For example, they may use in-store surveys or electronic surveys through the company's application.

- Web Traffic Analysis: The company analyzes data on their website visits and online user behavior. They track which products are

viewed most frequently, how long users stay on the site, and which pages lead to purchases.

- Social Media Monitoring: "MegaMarket" monitors mentions of their brand on social media to assess public opinion and respond to negative comments or customer requests. They can use special tools for social media monitoring.

- Open Data Analysis: The company studies open data on demographic and economic indicators in the regions where their stores are located. This helps them understand their target audience and demand for certain products and services.

- Monitoring and Reporting Systems: "MegaMarket" uses customer relationship management (CRM) systems to collect and analyze data about their customers, their purchases, and preferences. They can use this data to personalize marketing campaigns and offers for their customers.

As a result of using these data collection methods, "MegaMarket" can better understand their customers, adapt their product range and service to meet their needs and preferences, ultimately helping them increase sales and improve their business.

1. Data Preprocessing: Cleaning data from errors and anomalies, standardizing and normalizing for analysis preparation. Let's consider an example of the company "E-Shop," which conducts data preprocessing in its operations. "E-Shop" is an online store specializing in electronics and household appliances. To optimize its activities and improve sales efficiency, "E-Shop" carries out data preprocessing.

- Data Cleaning from errors and anomalies: "E-Shop" regularly checks sales and inventory data for errors and anomalies. For example, they may detect duplicate orders, incorrect prices, or incomplete customer data. They can use automated tools or special anomaly detection algorithms for this purpose.

- Data Standardization: For ease of analysis and data comparison, "E-Shop" standardizes various attributes. For example, they can unify product names, use consistent units of measurement for prices and quantities, and standardize customer addresses.

- Data Normalization: The company may also apply data normalization to bring them to a common scale. For example, they can normalize product prices so that all prices fall within a certain range, simplifying price comparison between different products.

As a result of data preprocessing, "E-Shop" ensures data cleanliness, integrity, and consistency, allowing them to more effectively analyze their operations, identify sales trends, optimize inventory, and improve customer service.

1. Data Analysis: Applying statistical methods and machine learning algorithms to identify patterns, correlations, and predictive trends.

An example of data analysis application can be in the retail sector. Suppose we have a chain of stores, and we want to optimize the product assortment in each store to maximize sales and profits. We can use data analysis to examine historical sales data, customer behavior data, demographic data, etc.

Afterward, we can apply statistical methods and machine learning algorithms to identify patterns and correlations between various factors such as season, day of the week, weather, store location, product assortment, and so on. Based on this data, we can develop forecasts about which products will be most popular at certain times and in specific stores.

For example, data analysis may show that during hot weather in coastal regions, the demand for ice cream significantly increases. This will allow us to optimize the assortment in these stores by increasing ice cream stock during hot weather and reducing it on cooler days. Thus, we can improve customer satisfaction, increase sales, and optimize inventory.

1. Results Interpretation: Analyzing the obtained results to identify potential risks and develop strategies for managing them.

An example of results interpretation can be in the context of marketing research for a new product. Suppose a company is launching a new product on the market and conducts an analysis of the marketing campaign results. Interpretation of the results may include assessing the effectiveness of different advertising channels and their impact on consumer behavior. For instance, after analyzing the data,

the company may find that social media advertising attracted more potential customers than traditional advertising campaigns. Based on this conclusion, the company can develop a strategy to increase the budget for social media advertising and reduce costs for other channels to optimize their marketing efforts and manage risks associated with ineffective advertising strategies.

Data-Driven Risk Management

Data analytics not only allows for identifying and predicting risks but also developing effective strategies for managing them. This includes:

1. Q*uantitative Risk Assessment:* Determining the probability of risk occurrence and potential damage, which allows for prioritizing risks and focusing efforts on the most significant ones.

2. Development of Risk Minimization Strategies: Based on analytical data, specific actions and measures can be developed to reduce the likelihood of risks occurring or to minimize their consequences.

First, it is necessary to thoroughly analyze possible risks, identify the most significant ones, and assess their impact on the project. After that, action plans should be developed to manage each identified risk. These plans should include the identification of responsible persons, necessary resources, and deadlines for completion.

An important step is also to use precautionary measures to prevent risks from occurring or to mitigate their consequences. For example, regularly creating data backups or installing additional information protection systems can be implemented.

Training personnel also plays a key role in reducing risks. Employees must be prepared for potential threats and know how to respond effectively.

Another important aspect is the development of alternative action plans. In the event of risks, it is necessary to have alternative strategies that will allow for a quick response to changes in the situation and minimize project downtime.

1. *Monitoring and Adaptation:* Monitoring and adaptation play a key role in project risk management. This process involves constantly

tracking market situations, changes in internal processes, and any other factors that may affect project execution.

An important aspect of monitoring is the use of data analytics to analyze the current situation. This allows for the identification of potential changes in the environment, as well as tracking project progress and its alignment with set goals.

Based on the data obtained, the project manager and team can promptly adapt risk management strategies. For example, in the event of new risks or changes in their priority, additional precautionary measures can be taken or current action plans can be adjusted.

Additionally, monitoring and adaptation enable responses to changes within the project team or external factors, such as changes in legislation or market trends. This helps ensure project flexibility and its ability to adapt to changing conditions.

It is important to note that monitoring and adaptation should be continuous processes throughout the entire project life cycle. Constant attention to changes in the environment and prompt response to them help minimize risks and ensure the project's successful completion.

Data analytics is the process of using data to draw informed conclusions and make more effective decisions. Project forecasting is the practice of predicting project outcomes, such as costs, timelines, and risks, based on past and current data.

Data analytics is important for project forecasting because it helps project managers to:

- Understand patterns and trends in project performance and resource utilization, which can aid in planning and optimizing future projects.

- Make informed decisions throughout the project life cycle, ensuring that projects stay on schedule and within budget.

- Communicate transparently and effectively with stakeholders, using data visualization and reports to present project status, accurate forecasts, and potential scenarios.

- Identify and mitigate risks early, using predictive analytics to forecast issues and allocate resources accordingly.

- Foster a culture of continuous improvement, using data as a repository of lessons learned and a source of ideas for enhancing project strategies.

Data analytics and project forecasting are essential for achieving project success and business growth. By using data-based information, project managers can improve project outcomes, stakeholder satisfaction, and organizational efficiency.

Data analytics in project management involves using data from past and current projects to improve project processes and results. Data analytics includes collecting, organizing, and analyzing data to identify patterns, trends, and insights that can help in making project decisions. Data analytics can help project managers to:

- Plan and optimize projects based on data-driven forecasts and scenarios.
- Track and monitor project performance and resource utilization through dashboards and reports.
- Identify and mitigate project risks and issues using predictive analytics and modeling.
- Communicate project status and value to stakeholders using data visualization and storytelling.
- Extract data from projects and apply best practices and lessons learned to future projects.

Data analytics transforms traditional project management methods by enabling project managers:

- Transition from a reactive to a proactive approach, anticipating and resolving project issues before they become problems.
- Transition from a prescriptive to an adaptive approach, adjusting project plans and strategies based on feedback and changing conditions.
- Transition from a siloed to a collaborative approach, sharing and integrating data among project teams and stakeholders.
- Transition from a subjective to an objective approach, making project decisions based on actual data and facts rather than opinions and assumptions.

Data analytics is a powerful project management tool that can increase the efficiency, quality, and value of a project. By using data

analysis, project managers can deliver successful projects that meet or exceed stakeholder expectations and organizational goals.

Data analytics helps in assessing risks, allocating resources, and forecasting timelines, providing project managers with:

1. Real-time Data and Analytics: Data analytics can help project managers track and measure project progress, performance, and quality using various metrics and indicators. This can help project managers identify and resolve any issues or deviations from the project plan and adjust the project's scope, schedule, and budget accordingly.

2. Data-driven Decision Making: Data analytics can help project managers make informed and objective decisions based on data and evidence rather than opinions and assumptions. This can help project managers effectively prioritize and allocate resources, proactively mitigate and manage risks, and accurately forecast and plan project outcomes.

3. Data Visualization and Communication: Data analytics can help project managers present and communicate project data and information clearly and compellingly using charts, graphs, maps, and other visual elements. This can help project managers engage and inform stakeholders, report and justify project results, and share and disseminate project knowledge and insights.

Integration of Data Analytics with Project Management Tools can enhance the efficiency of project management, allowing project managers to:

- Access and analyze data from multiple sources and systems on a single platform.
- Automate and optimize tasks and workflows for data collection, processing, and reporting.
- Customize data analytics features according to the project's needs and preferences.
- Collaborate and coordinate with project team members and stakeholders using data analytics tools and platforms.

1. *Data Quality*: The accuracy and reliability of data analytics depend on the quality and trustworthiness of the data used. Poor data quality can lead to incorrect or misleading results and forecasts from

data analytics. Project managers must ensure that the data they collect and analyze is complete, consistent, up-to-date, and timely.

2. *Data Security*: The confidentiality and integrity of data analytics can be compromised due to unauthorized access, use, or disclosure of data. Data breaches can result in legal, financial, or reputational damage to the project and the organization. Project managers must ensure that the data they store and share is protected and encrypted.

3. *Data Literacy*: The effectiveness and usefulness of data analytics depend on the skills and knowledge of the data users and consumers. Data illiteracy can lead to the misinterpretation or misuse of data analytics results and forecasts. Project managers must ensure that they and their stakeholders are trained and educated in data analytics concepts and tools.

Now, let's consider some best practices for overcoming these issues:

1. *Data Management:* This is the process of establishing and ensuring compliance with policies, standards, and procedures for managing and analyzing data. Data governance can help project managers ensure data quality, security, and literacy. Project managers need to define and document roles, responsibilities, and rules for data governance for their projects and organizations.

2. *Data Integration:* This is the process of combining and consolidating data from multiple sources and systems onto a single platform. Data integration can help project managers access and analyze data from different aspects and dimensions of the project. Project managers need to use data integration tools and methods that are compatible and scalable with their project management tools and systems.

3. *Data Validation*: This is the process of verifying and testing the results and forecasts of data analytics against actual data and outcomes. Data validation can help project managers evaluate and improve the accuracy and reliability of data analytics. Project managers need to use data validation methods and measures that are appropriate and relevant to the goals and context of their project.

Some of the upcoming trends and future possibilities of data analytics in project management:

1. *Artificial Intelligence (AI):* This is a technology that enables machines and systems to perform tasks that usually require human intelligence and judgment. AI can help project managers automate and optimize data analytics tasks and workflows, such as data collection, processing, analysis, and reporting. AI can also help project managers improve and extend the capabilities and outcomes of data analytics, such as data interpretation, forecasting, and recommendations.

2. *Internet of Things (IoT):* This is a network of physical devices and objects that are connected and exchange data over the internet. IoT can help project managers collect and transmit data from various project sources and sensors, such as equipment, materials, and the environment. IoT can also help project managers monitor and control project aspects and activities remotely and in real-time using data analytics.

3. *Augmented Reality (AR) and Virtual Reality (VR):* These technologies create and simulate immersive and interactive experiences using digital and virtual elements. AR and VR can help project managers visualize and communicate data analytics results and forecasts using 3D and 4D models and simulations. AR and VR can also help project managers collaborate and coordinate with project team members and stakeholders using data analytics.

The integration of data analytics into forecasting and risk management processes represents a powerful tool that enhances project management efficiency. It not only significantly improves the accuracy of forecasts and the effectiveness of risk identification but also ensures the development of well-grounded and adaptable risk management strategies. In conditions of high uncertainty and a rapidly changing external environment, the application of data analytics becomes not just an optimization tool but a crucial factor in ensuring the resilience and competitiveness of projects.

5.2 Implementing Business Intelligence for Data Analysis and Decision Making

Implementing Business Intelligence (BI) in project management processes represents a strategic approach to data analysis, aimed at improving the quality of decision-making through comprehensive analysis of available information. Business Intelligence integrates methodologies, applications, infrastructure, and tools, allowing organizations to transform data from various sources into decision-making information and present this information in the form of reports, dashboards, charts, and other visual formats.

Let's consider the main components of Business Intelligence:

1. Data Collection: This covers the processes of extracting data from internal and external sources, including operational and transactional systems, social networks, open data, etc.

2. Data Storage: Technologies such as datawarehouses, datalakes, and other forms of data aggregation are used for effective management and access to large volumes of information.

3. Data Processing and Analysis: Analytical tools and algorithms are applied for data processing, including OLAP (Online Analytical Processing), machine learning, and text analysis, with the aim of identifying patterns, trends, and making forecasts.

4. Data Visualization: Data is presented in an easy-to-understand format using dashboards, charts, maps, and other visualization tools, which facilitates the interpretation of analysis results and supports decision-making.

Application of Business Intelligence in Project Management

1. Improving Decision Making: BI tools provide project managers with up-to-date information necessary to substantiate strategic and operational decisions, optimize processes, and resources.

2. Forecasting and Planning: Data analytics allows for more accurate forecasting of future trends, assessing potential risks, and planning measures to prevent or minimize them.

3. Project Monitoring: The implementation of BI systems in project management represents significant progress in modern management. BI enables continuous monitoring of project progress,

allowing for the timely identification of deviations from the plan and the adjustment of management actions. In this work, we will examine the principles of BI implementation, its role in project management, and provide examples of successful BI application in real companies.

Principles of Implementing BI in Project Management include data centralization, report automation, data visualization, as well as the use of analytical tools for forecasting and analysis. Data centralization involves collecting and storing project information in a single system, ensuring its availability and reliability. Report automation allows for timely acquisition of information about the status and performance of projects. Data visualization using charts, diagrams, and dashboards makes information more understandable and accessible for decision-making. BI analytical tools enable forecasting and analysis of various project development scenarios, helping to identify risks and opportunities.

Role of BI in Project Management lies in ensuring access to up-to-date and accurate information about project execution. BI provides the project team with the ability to promptly respond to changes in the external environment and to identify problems and risks at an early stage. Thanks to BI, managers can make well-founded decisions based on data analysis and facts.

An example of successful BI implementation in project management is the company XYZ, specializing in software development. The implementation of a BI system allowed the company to automate the process of collecting and analyzing project data, which significantly increased the efficiency of project management. The project team gained the ability to promptly monitor task progress, identify delays and issues, and take measures to address them. Thanks to BI, the company was able to improve the quality and timelines of project completion, leading to increased client satisfaction and higher profits.

Thus, the implementation of BI in project management enables companies to promptly respond to changes in the external environment and enhances project management efficiency. The application of BI allows companies to identify risks and opportunities

at early stages and make well-founded decisions based on data analysis.

1. Process Optimization: Data analysis on process performance and efficiency helps identify “bottlenecks”, determine areas for improvement, and optimize team performance.

Implementing Business Intelligence in project management is a powerful tool that can significantly enhance decision-making efficiency and provide a competitive advantage for the organization. Business Intelligence enables project managers and stakeholders to gain deep analytical insights, ensuring a higher level of project manageability and increased success rates.

How to make a project successful? This question is asked by project managers around the world every day before starting work. If you take one large-scale project, many different sub-elements within it directly influence the overall project management. From inefficiency, budgeting issues, unrealistic timelines and workloads to numerous other problems, all these continue to cause concern for project managers.

When it comes to business or organization, a large volume of data is collected by various departments: from planning, resources, and supply chain to much more. Project managers do receive this data on time. However, the problem with it is that it provides information separately. There is no consolidation of the data that project managers collect.

A business intelligence system was developed exclusively to provide the best solution to this project management problem. This extensive analytical framework was designed to collect, manage, and evaluate vast amounts of data within an organization to turn raw information into valuable, actionable insights.

The BI system is a powerful technological pinnacle, representing a combination of software, tools, and methodologies. Thanks to such reliable modern tools, BI systems ensure data collection, analysis, and visualization, enabling businesses to make informed decisions. These systems allow users to identify useful trends, patterns, and connections by integrating multiple data sources.

Business intelligence allows project managers to perform a wide range of tasks. This varies from queries, reports, and online analytical processing to breaking down complex data sets into meaningful information, resulting in improved strategic decision-making processes.

The capabilities of this tool are simply limitless. Since it can streamline procedures and give businesses a comprehensive view of internal dynamics and market trends, it enhances operational efficiency and provides them with a competitive advantage in the rapidly changing Singapore market.

Project managers are interested in using BI systems because these tools provide real-time information on project performance, resource utilization, and risk factors. This potential allows project managers to optimize planning, allocate resources effectively, and proactively address issues.

BI systems significantly contribute to time savings in project management by automating the processes of data collection and analysis. Since this facilitates the efficient collection and interpretation of project data, BI systems eliminate the need for manual reporting, saving project managers valuable time.

Automation is the key to task efficiency. Such automation streamlines the workflow, allowing managers to focus more on strategic planning and decision-making. Project managers can concentrate on evaluating ideas, identifying patterns, and implementing well-thought-out strategies, ultimately enhancing the overall efficiency of project management procedures. This is because the burden of routine data collection through BI systems is reduced.

As a result, the process becomes more responsive and flexible. This ensures that projects are completed on time and with greater accuracy.

Even if monitoring the performance of resources invested in a project is difficult, it is impossible to guarantee they will meet expectations if handled manually. On the other hand, this is one of the main aspects that a project manager needs to be constantly well informed.

There is no need to worry when implementing such a reliable technological solution as the BI system. It plays a crucial role in improving performance monitoring within project management by offering real-time tracking of key performance indicators (KPIs).

Now, let's consider what these BI tools can do for project managers. These tools encourage project managers to continuously monitor project progress, quickly identify potential bottlenecks, and actively intervene to ensure the project stays on track and within the predefined scope. This means checking whether resources are being used according to stakeholder expectations.

With the help of a BI tool, inefficient resources and resource gaps can be identified in real time. Managers have the opportunity to make informed decisions, quickly allocate resources, and make adjustments as needed thanks to the real-time analytics provided by BI systems.

This helps ensure project schedules are adhered to while simultaneously reducing risks and maximizing productivity in response to changing conditions. All these factors are control factors influencing the ultimate success of the project.

For example, if a BI system identifies that a certain phase of software development is taking longer or requiring more resources than expected, the project manager can take corrective actions, such as redistributing tasks among team members or revising the work schedule. This allows the company to keep the project on schedule, minimize risks, and maximize productivity.

No project can stay free of risks. Risks are important in any project because wise management can lead to operational success.

Project risks are uncertain events that can have a positive or negative effect on one or more project goals (timelines, budget, performance, outcomes).

On the other hand, poor risk management can bring a project to a halt. However, BI systems are designed to help manage risks, and that is the main reason why project managers tend to rely on them. These systems excel at identifying potential threats by thoroughly analyzing performance indicators and data from past projects.

It's said that history is the way to the future. This is true in project management as well. With historical data, project managers can

proactively address emerging issues and strategically reduce risks before they become major problems.

Using BI technologies, project managers can gain valuable insights into risk patterns that help them plan. They can wisely allocate resources and improve tactics by reviewing past performance.

As you can see, this is an analytical approach to risk management. It not only enhances project resilience but also fosters a culture of continuous improvement, taking all potential issues into account.

For example, if data analysis shows that bad weather may lead to construction delays, a project manager can prepare additional resources in advance or adjust the work schedule to minimize lost time.

The success of a business or company depends on the number of projects they complete in a year. If everything is done according to expectations and industry standards, it helps achieve excellent results in every aspect of the business. That is why project management must have 100% accuracy and perfection in all aspects.

BI systems, since modern digital technologies have revolutionized this field, are entering the business environment of Singapore as a crucial software solution in today's dynamic world. However, as a project manager or responsible person, you should align your industry requirements with the specific tool's features before purchasing it blindly. Collaborating with an industry expert is the best decision you can make to avoid unnecessary issues.

5.3. Implementation of Artificial Intelligence and Machine Learning in Project Analytics

In the current context of digital transformation, project analytics is reaching a new level thanks to the integration of Artificial Intelligence (AI) and Machine Learning (ML) technologies. These tools enable not only the automation of routine data collection and processing tasks but also the development of predictive models, the identification of hidden patterns, and the facilitation of well-informed managerial decisions.

Key approaches to applying AI and ML in project analytics:

1. Project Outcome Prediction: Leveraging data to forecast implementation timelines, costs, and risks.
2. Risk Analytics: Machine learning algorithms help identify and classify risks at the early stages of the project life cycle.
3. Resource Allocation Optimization: AI models analyze the efficiency of resource utilization and suggest scenarios for optimal redistribution.
4. Team Performance Analytics: Analyzing communications, task execution, and workload to identify bottlenecks in project management.
5. Unstructured Data Analysis: Using Natural Language Processing (NLP) to analyze reports, comments, email correspondence, and more.

Tools for Project Analytics Using AI and ML (Table 5.1):

1. *IBM Watson.*

IBM Watson is a cognitive artificial intelligence platform that offers tools for big data processing, predictive analytics, and natural language processing (NLP) [61].

Applications:

- Building predictive models for project duration and costs;
- Risk analysis based on textual data from communications or reports;
- Identifying patterns from historical projects using the Machine Learning Assistant.

2. Microsoft Azure Machine Learning.

Azure ML is a cloud platform for deploying machine learning models and AI services. It offers automated model training, integration APIs, and advanced analytics [135].

Applications:

- Automatic creation of models to forecast budget overruns;
- Detection of deviations in project KPIs;
- Building dashboards with integrated ML forecasts in Power BI.

3. Google AutoML.

Google AutoML is a suite of services from Google Cloud that enables non-technical users to create their own ML models without writing code [117].

Applications:

- Creating classification and regression models based on CRM or project management system data;
- Analyzing text feedback or changes in the backlog using AutoML Natural Language.

4. Tableau with AI Analytics (Einstein Discovery + Tableau AI).

Tableau, integrated with Einstein Discovery (Salesforce), enables the creation of interactive visualizations and the use of AI models to identify trends and make predictions [63].

Applications:

- Building predictive project management dashboards;
- Generating explanations for forecasts (understanding the "why" and "how" behind outcomes);
- Detecting trends in large-scale projects, particularly in multi-team Agile environments.

5. Jira + AI Plugins for Backlog and Task Execution Analysis.

Jira is a task management system that, with the help of AI plugins (such as Atlassian Intelligence, Forecast, Swanly, AI Insights for Jira), becomes a powerful tool for forecasting and analysis [99].

Applications:

- Predicting sprint durations based on past task completion velocity;
- Identifying overloaded team members;
- Providing recommendations for backlog prioritization based on historical data and precedents.

6. ML Model Integration in Power BI.

Power BI allows machine learning integration directly into analytical dashboards. This is achieved through connections with Azure Machine Learning, the use of R and Python scripts, and built-in ML features [63].

Applications:

- Creating custom forecasts in financial or resource planning models;
- Building "what-if" scenarios to assess the impact of different development paths;
- Real-time detection of deviations from normal project execution flow.

Table 5.1 – Artificial Intelligence and Machine Learning Tools for Project Analytics

Tool	Brief Description	Application in Project Analytics	Example of Use
IBM Watson	Cognitive AI platform with NLP, analytics, and forecasting capabilities	Risk analysis, schedule and budget forecasting, data classification	Watson Studio builds a project duration forecast model based on Jira data
Azure Machine Learning	Microsoft's cloud platform for building and integrating ML models	Automated KPI modeling, overrun forecasting, integration with Power BI	AutoML in Azure generates a deadline risk prediction model using historical Scrum metrics
Google AutoML	Google Cloud tool for creating ML models without coding	Task classification, text analysis, risk forecasting	AutoML Tables analyzes CRM data and identifies key delay factors
Tableau with AI Analytics	BI platform integrated with AI modules (Salesforce Einstein Discovery)	Trend detection, forecast explanations, performance dashboards	Predictive project management dashboard with AI-based deviation explanations
Jira + AI Plugins	Jira extensions for forecasting, backlog analysis, and performance monitoring	Sprint duration forecasting, velocity analysis, workload optimization	Forecast plugin models release completion based on team performance

Power BI with ML Integration	BI system supporting R/Python and Azure ML connectivity	Predictive analytics, scenario analysis, KPI deviation control	Dashboard alerts on team productivity decline based on historical metrics

Key Advantages of Using AI:

- Increased forecasting accuracy and reduced human error;
- Automation of reporting and accelerated analytics;
- Data-driven decision-making based on large volumes of information (Big Data);
- Real-time decision support.

According to McKinsey (2024), over 50% of companies actively undergoing digital transformation use AI in project management, and projects that leverage predictive analytics based on ML demonstrate up to 30% higher efficiency in meeting deadlines.

The use of AI and ML in project analytics opens new opportunities for improving managerial decisions, but also comes with a range of challenges and limitations:

1. *Need for large volumes of high-quality data*. AI and ML models rely on data, and the more data available, the more accurate the forecasts. However, many projects face the problem of limited or poor-quality data. Incomplete, outdated, or erroneous data can significantly affect analytics results, leading to inaccurate predictions and poor decisions.

2. *High cost of implementation and maintenance*. Developing, deploying, and maintaining AI/ML-based systems requires substantial financial and time resources. This includes investments in hardware, software, hiring data specialists, and continuous adaptation of models to changing project conditions.

3. *Complexity of integration with existing systems.* Integrating AI and ML technologies with existing project management tools and other enterprise systems can be challenging. Compatibility issues, interface adaptation, and ensuring uninterrupted operation during implementation must be addressed.

4. *Need for model validation and verification*. Developing machine learning models requires constant validation and

performance testing. When using these models in project analytics, it is important to ensure that forecasts reflect real conditions and do not lead to incorrect conclusions, especially in critical situations.

5. *Challenges with interpretability of results.* AI and ML models can be difficult to understand, even for experienced specialists. The "black box" problem means it is not always clear why the model made a certain decision, making it harder to use the results in managerial decisions. Understanding the factors behind decisions is crucial for building trust in outcomes.

6. *Ethical and legal issues.* The use of AI and ML in project analytics can raise ethical concerns related to data privacy, especially when handling personal or sensitive data. Regulatory requirements may also limit the use of such technologies in certain countries or industries.

7. *Dependence on expert judgment.* AI and ML can automate many analytical processes, but still rely on human experts for model configuration, contextual understanding, and result interpretation. Human involvement is essential for identifying inaccuracies or uncertainties that may affect decision-making.

8. *Risk of replacing the human factor.* There are concerns that automation via AI and ML could devalue the human role in project management. This may result in the loss of important intuitive knowledge and experience that only seasoned professionals can contribute.

9. *Adaptation to changing conditions.* AI and ML models require ongoing adaptation to new conditions. Projects often face unpredictable changes, such as team changes, new technical requirements, or shifts in the external environment. Adapting models to such changes takes time and resources, reducing their effectiveness in fast-changing environments.

10. *Risk of ineffective use due to improper configuration.* If ML models and algorithms are configured incorrectly or misused, they can lead to ineffective or even harmful decisions. This includes inaccurate forecasts, over- or underestimation of risks, or poor resource management.

11. *Information overload.* The use of AI and ML can result in data overload, especially if filtering and prioritization mechanisms are not properly configured. Project managers may lose focus amid a flood of data, complicating the decision-making process.

To summarize, while the use of AI and ML in project analytics can significantly enhance efficiency and forecasting accuracy, these technologies require careful management, a clear implementation strategy, and continuous adaptation to change.

The integration of AI and ML technologies into project analytics is not just a trend, but a necessity in the face of rapid market dynamics and the complexity of modern projects. These tools offer new opportunities to improve the quality of managerial decisions, reduce costs, and minimize risks.

TEST QUESTIONS:

1. What are the main data analytics methods used for forecasting risks in projects and business?

2. What types of data are commonly used for risk analysis, and how do they help in identifying potential threats?

3. How can data analytics help in assessing the likelihood of risks and their potential impacts?

4. What tools and technologies are widely used for data analysis for risk management?

5. What are the main challenges in using data analytics for risk management, and how can they be overcome?

6. What is business intelligence, and what are the main components of its architecture?

7. How can business intelligence help an organization in data analysis and making more informed decisions?

8. What methods and tools are used for data collection, processing, and analysis within business intelligence?

9. What benefits can the implementation of business intelligence bring to an organization, and how can their effectiveness be assessed?

10. What challenges and obstacles might arise when implementing business intelligence, and how can they be overcome?

CHAPTER 6.
RISK MANAGEMENT METHODS IN PROJECT MANAGEMENT IN THE DIGITAL ECONOMY

6.1 Risk Management Methods

Risk is generally understood as the probability (threat) of a project losing some of its resources, failing to receive income, or incurring additional expenses due to certain production and financial activities.

In modern project management practices, special attention is paid to risk management methods that can adequately respond to the challenges of the external and internal environment, offering innovative strategies and solutions to minimize potential threats to the successful completion of projects. Developing and implementing such methods requires a comprehensive approach, including risk identification, analysis, assessment, and monitoring, as well as response planning.

1. Risk Identification

The first step in risk management is identifying potential threats that may affect the project. Innovative approaches in this area include using big data and analytics to predict risks based on historical data, as well as employing artificial intelligence and machine learning to uncover hidden dependencies and potential risks that might remain unnoticed with traditional approaches.

Risk identification is the determination (primarily) and documentation of the characteristics of risks that may affect the project. This process is iterative and continues throughout the entire project lifecycle.

The risk identification process should involve the entire project team, as well as participants from other projects.

It's best to start the identification with an analysis of documentation (project plans, data from previous projects, contracts, etc.), which can provide the main inputs. Sources of information on risks can include product descriptions (goals), assumptions, historical information, and so on.

Different methods of gathering information can be used for risk identification, such as brainstorming, the Delphi method, surveys, and so forth.

Checklist analysis can also be conducted—lists of risks that are possible for given projects (for example, numerous checklists for software development projects can be found online).

At the end of this stage, a risk register is formed, which contains:

- A list of risks with the necessary degree of detail;
- A list of potential response strategies for identified risks.

Table

Risk Register for XYZ Inc.

Table 6.1.

№	Risk	Description	Probability	Impact	Risk level
1	Loss of key clients	Reduction in sales volumes due to the departure of key clients or their refusal to continue cooperation.	Average	High	High
2	Technical failure in IT systems	Failure in information technology can lead to temporary service unavailability and data loss.	Low	High	Average
3	Non-compliance with regulatory requirements.	Violation of laws and regulations leads to fines, reputational losses, and loss of customer trust.	Average	High	High
4	Termination of key employees	The termination of highly qualified key employees can slow down the development and achievement of company goals.	Average	Average	Average

5	Increase in raw material prices	Rising costs of raw materials and materials can negatively impact company profitability.	High	Average	High
6	Competition from new market players	The emergence of new competitors can reduce the market share and profitability of the company.	High	Average	High
7	Supply chain disruption	Problems in the supply chain can lead to delays in production and product delivery.	Average	Average	Average

Note – composed by the author

This risk register represents the real threats that American company XYZ Inc. might face. It is important to systematically assess and manage these risks to minimize their impact on the business and ensure the company's sustainable development.

After the identification of risks is conducted, it is necessary to perform their qualitative and quantitative analysis.

2. Risk Analysis and Assessment

After identifying risks, it is essential to evaluate their potential impact on the project and their likelihood of occurrence. In this context, innovative methods include the use of quantitative models and simulations, such as Monte Carlo, to assess the probability of risks and their impact on project goals.

Quantitative models include various mathematical and statistical methods that allow for the quantitative assessment of different aspects of a project. These models can be used for data analysis, forecasting results, determining optimal strategies, and evaluating risks. For example, time series models can be applied to forecast project time expenditures, and multi-criteria optimization models can help determine the best solutions given various constraints.

Simulations, such as the Monte Carlo method, allow modeling the behavior of a system or process under different conditions by conducting numerous random experiments.

The process of applying the Monte Carlo method includes the following steps:

- Risk Identification: Determining potential threats and opportunities that may affect the successful completion of the project.
- Probability and Impact Assessment: Evaluating the likelihood of each risk occurring and its potential impact on project objectives. This can be done based on historical data, expert judgments, or analytical models.
- Scenario Modeling: Using the Monte Carlo method to create a large number of random scenarios, taking into account various combinations of risks and their probabilities.
- Results Analysis: Analyzing the obtained data to determine the probability of achieving project objectives under various conditions and scenarios.
- Decision Making: Making informed decisions on risk management, resources, and project planning based on the results of the analysis.

In the context of project management, simulations can be used to model various project development scenarios and assess their likelihood. For example, a simulation can be conducted to evaluate the probability of successful project completion under conditions of changing requirements or delays in work execution.

The use of quantitative models and simulations allows the project manager to more accurately assess project risks and their impact on goal achievement. This helps make informed decisions on risk management, resource allocation, and project planning, ultimately increasing the likelihood of successful project completion and goal attainment.

These methods provide a more accurate picture of potential risks and help develop more effective risk management strategies.

3. Risk Response Planning

Developing risk response strategies involves determining actions that will be taken to reduce the likelihood of risks occurring or to

minimize their impact on the project. Innovative approaches in project management are focused on creating more flexible and adaptive methodologies capable of effectively coping with changing project conditions and requirements. These approaches also include the use of modern digital transformation technologies to automate risk management processes and increase their efficiency.

- Flexible Project Management Methodologies: Traditional project management methodologies, such as Waterfall, are often unable to adapt to changes in the project or external environment. Innovative approaches suggest using flexible methodologies, such as Agile or Scrum, which allow teams to quickly respond to changes, incrementally develop the product, and interact more effectively with customers.

- Digital Transformation Technologies: Digital transformation offers a wide range of tools and technologies that can be applied in project management. This includes the use of project management systems (PMS), data visualization tools, content management systems, automated notification and monitoring systems, as well as artificial intelligence and machine learning for data analysis and decision-making.

- Automation of Risk Management Processes: Traditional risk management methods can be resource-intensive and inefficient. The use of digital transformation technologies allows for the automation of processes and the integration of tools for identifying, analyzing, assessing, and managing risks within the project. This enables a more rapid response to risks and minimizes their negative impact on the project.

- Enhancing Risk Management Efficiency: Innovative approaches also aim to enhance risk management efficiency through the use of data analytics, AI-driven forecasting, development of adaptive risk response strategies, and active involvement of all project participants in the risk management process.

All these innovative approaches in project management contribute to increased flexibility, efficiency, and successful project implementation in today's dynamic and competitive environment.

4. Risk Monitoring and Control

Continuous risk monitoring and control are necessary to ensure the relevance of risk data and the effectiveness of response measures taken. The implementation of innovative IT solutions, such as real-time big data and analytical platforms, enables organizations to promptly monitor changes in the project's risk profile and adapt risk management strategies to the current situation.

Real-time in the context of big data refers to the ability to process and analyze data as it is received, without delays or time constraints. This allows companies to obtain up-to-date information and respond to events almost instantly, which can be crucial in various fields, such as the financial sector, internet services, telecommunications, healthcare, marketing, and others.

The main components of real-time big data analysis include:

- Data Collection: For real-time operations, mechanisms are needed to ensure the continuous and rapid flow of information from various sources, such as sensors, sensors, online platforms, etc.
- Data Processing: After collection, data must be processed with minimal delays. This includes structuring, filtering, aggregating, and analyzing data on the fly.
- Data Storage: Real-time operations require efficient and scalable data storage that ensures quick access to information and maintains high performance.
- Data Analysis: Real-time analytics allow detecting trends, identifying anomalies, forecasting events, and making decisions based on up-to-date information.
- Visualization and Reporting: Presenting the results of the analysis in an understandable and accessible form allows quickly identifying important trends and events, and taking prompt measures.

The use of real-time big data analytics allows companies to quickly respond to changes in the environment, identify new business development opportunities, optimize processes, and improve operational efficiency.

Analytical platforms are software products or services designed for data analysis to extract valuable information, identify trends, detect patterns, forecast events, and make informed decisions. They have a

wide range of functions and tools designed to work with data of various volumes and structures.

The main components of analytical platforms include:

- Data Integration: Analytical platforms typically provide tools for integrating data from various sources, such as databases, data warehouses, external APIs, file systems, etc. This allows for the collection of all necessary data in one place for subsequent analysis.

- Data Storage: To ensure efficient work with large volumes of data, analytical platforms typically provide data storage mechanisms. This can be a traditional relational database, a distributed data store, or a cloud storage.

- Data Processing and Analysis: One of the key components of analytical platforms is the ability to process and analyze data. This includes performing various operations such as filtering, aggregation, transformation, statistical analysis, machine learning, and more.

- Visualization and Reporting: To make the results of data analysis understandable and accessible to end-users, analytical platforms typically provide tools for data visualization in the form of charts, graphs, tabular reports, and more.

- Collaboration and Security: Some analytical platforms also provide capabilities for collaboration on data and projects, as well as data security mechanisms, including access management and encryption.

Examples of analytical platforms include products such as Microsoft Power BI, Tableau, QlikView, Google Analytics, Apache Hadoop, IBM Watson Analytics, and many others.

Table 6.2.

Comparison of Analytical Platforms

Platform	Producer	Main features	Programming language	Price
Microsoft Power BI	Microsoft	Intuitive interface, extensive data visualization capabilities, integration with other Microsoft	DAX, M	Paid (there is a free version available)

		products, powerful tools for analytics and reporting.		
Tableau	Tableau Software	Ease of use, rich visualization capabilities, ability to create interactive dashboards, wide range of data sources.	Tableau Calc, SQL, R, Python	Paid (there is a free version available)
QlikView	QlikTech	Associative data search, dynamic dashboards, built-in capability to create analytical applications.	QlikView Expressions	Paid version
Google Analytics	Google	Powerful web traffic analysis tools, visualization of key metrics, ability to create custom reports and audience segmentation.	JavaScript	Free version
Apache Hadoop	Apache Software	Distributed storage and processing of large data volumes, scalability, support for various programming languages for application development and analytics.	Java, Python	Free version
IBM Watson Analytics	IBM	Using artificial intelligence for data analysis, automation of the	Python, R, SQL	Paid (there is a free

		analytics process, integration with IBM cloud services.		version available)

Note – composed by the author

This is just an overview of the main characteristics of each platform. The choice of a specific platform depends on the business needs, functional requirements, budget, and user expertise.

They are widely used in various industries and fields for data analysis and strategic decision-making.

Innovative risk management methods, which consider potential challenges and provide advanced strategies and solutions, are key elements of successful project management in highly uncertain and rapidly changing environments. Integrating such methods into project management practices requires not only the application of the latest technologies and analytical tools but also the development of a culture of innovation within the organization, readiness for continuous learning, and adaptability to changes.

6.2 Application of Blockchain Technologies for Ensuring Transparency and Security in Project Management

Currently, the concept of the Internet of Things (IoT) is gaining popularity and finding wide application in various fields, including healthcare, transportation, agriculture, and many others. However, collecting and storing data from IoT environments pose complex challenges, requiring the resolution of many issues such as the lack of standards, device and communication protocol incompatibility, and vulnerabilities in information security.

The Internet of Things will encompass virtually every segment in industry, business, healthcare, and consumer goods. It is essential to understand the consequences of this process and explain why these significantly different sectors need to adapt their approach to producing goods and providing services [39].

The volume of interconnected objects has reached unique scales. When discussing the evolution of this field, it is impossible to ignore

the associated risks. The range of values is quite extensive, but the order of magnitude is approximately similar. This is confirmed by the findings of IoTAnalytics, which state that in 2020, 11.7 billion devices were connected to the Internet of Things, compared to 11 billion devices connected to the regular Internet. According to a study by ARM Corporation, it is projected that by 2035, the number of devices connected to the Internet will reach 1 trillion. Apparently, related projects will continue to develop and realize their potential at a growth rate of 20% annually in the very near future.

To overcome these problems, various strategies have been created, including centralized and decentralized systems for collecting and storing information. However, these methods have their limitations, such as a lack of transparency and data reliability.

However, collecting and storing data in the context of the Internet of Things presents complex challenges, as it occurs in conditions where many devices operate autonomously, without direct human intervention, and may be subject to cyber attacks and other security threats. The use of blockchain technology, which ensures the security and reliability of data storage and transmission, can be a solution to these problems.

Blockchain technology is a decentralized system for exchanging data through secure channels. This technology allows a group of selected participants to exchange data, and blockchain cloud services provide the ability to collect, integrate, and exchange transaction data from various sources. Blockchain represents a chain of blocks, where each block is added in chronological order, containing information about all previous transactions, a timestamp, and a link to the previous block.

Blockchain technology guarantees inherent data integrity, providing a single source of reliable information, eliminating data duplication, and increasing security levels.

Blockchain represents a decentralized system for recording transaction histories, where each block is linked to the previous one and remains immutable in the peer-to-peer network. Each transaction in the blockchain has a unique identifier or digital fingerprint, formed using cryptographic methods to ensure trust and guarantees.

This sequence of blocks provides trust, accountability, transparency, and security. This consensus-based mechanism allows companies and their trading partners to exchange and access data using third-party trust.

All participants in the system make an encrypted record of each transaction in a decentralized, scalable, and flexible environment that cannot be reversed. Blockchain technology provides a decentralized source of reliable information, reducing the costs of trust-based commercial transactions between parties that do not fully trust each other. Enterprises actively use exclusive blockchain technology, where participants can join the network and make an encrypted record of each transaction.

This innovative technology offers numerous advantages for organizations or consortia of companies that require secure and instant transaction registration with the ability to exchange data. The absence of a single centralized data storage enhances security and accessibility, as there is no vulnerable central point.

Blockchain represents a decentralized database, stored simultaneously on multiple autonomous computing devices.

Due to the continuous chain of blocks and decentralized structure, making changes to the information of previous transactions becomes technically impossible (see Figure 1).

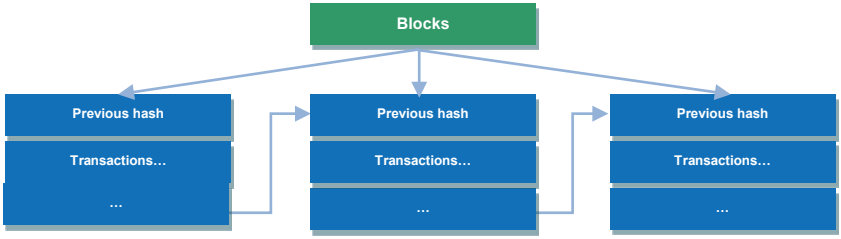

Figure 6.1. Organization of the Blockchain Chain

Note – composed by the author

The use of IoT technology is accompanied by a significant increase in data volume, which poses a challenge for traditional information technologies in processing such data volumes efficiently. The size, speed, and variety of data generated by IoT networks can become a problem for corporate systems, limiting their ability to make timely decisions based on reliable data. The implementation of blockchain technology in the distributed ledger provides a potential solution to these problems, ensuring scalability, increased security, and transparency:

1. Ensuring IoT Data Reliability Using Blockchain Technology: Blockchain technology can address issues related to data reliability in IoT networks. Each transaction is recorded in a secure and immutable data chain, ensuring data transparency and security.

2. Simplifying Error Detection in IoT Using Blockchain Technology: Blockchain assigns a unique key to each device, which accelerates the detection of inconsistencies and errors.

3. Application of Smart Contracts for Process Automation in IoT: Blockchain-based smart contracts automate IoT network processes, facilitating rapid automation.

4. Ensuring IoT Security Through Blockchain Decentralization: Blockchain decentralization enhances data storage security, preventing cybercriminal attacks on centralized servers.

5. Facilitating Employee Performance Evaluation Based on IoT Usage Logs: Blockchain technology allows tracking user actions, such as device usage, making the performance evaluation process more objective and simplified.

Let's consider an example of using blockchain technology to solve problems in the field of IoT:

The company "SmartHomeSolutions" develops smart management systems for homes. However, they faced the problem of insufficient IoT data reliability and the need to simplify the error detection process and ensure data security.

To solve these problems, the company decided to use blockchain technology in their devices and management systems. Here is how it works:

- Ensuring IoT Data Reliability: Each transaction and event in the smart home system is recorded in the blockchain ledger, ensuring data security and reliability. For example, data on temperature, lighting, and the use of electrical appliances are recorded in the blockchain, providing transparency and confirmation of their authenticity.

- Simplifying the Error Detection Process: Each device in the smart home has its unique key recorded in the blockchain. This allows for quickly identifying discrepancies and errors in device operations, as any deviation from the norm will be immediately recorded in the blockchain.

- Application of Smart Contracts for Process Automation: Smart contracts in the blockchain automate various processes in the smart home, such as energy management or automatically performing certain actions under specific conditions.

- Ensuring Security Through Decentralization: The decentralized nature of the blockchain enhances data storage security, preventing cybercriminal attacks on centralized servers where smart home data is stored.

- Employee Performance Evaluation Based on IoT Data: Thanks to the blockchain, the company can track how employees use smart devices in the smart home, making the performance evaluation process more objective and automated.

Thus, the implementation of blockchain technology helps "SmartHomeSolutions" improve the reliability, security, and transparency of its smart management systems for homes.

1. Supply Chain Management: Blockchain can significantly improve transparency and efficiency in supply chain management, allowing all network participants to track the movement of goods from the manufacturer to the end consumer. Smart contracts can also automate order and payment processes, simplifying interactions between different parties.

2. Project Data Management: Blockchain can be used to store and exchange project data, ensuring its integrity and security. This can include storing information about the budget, work schedule, issues and solutions, as well as communication between project participants.

3. Voting and Decision-Making: Blockchain-based smart contracts can be used to organize voting and decision-making within a project. This can be useful for making strategic decisions, allocating resources, or choosing the direction of project development.

4. Budget and Finance Management: Blockchain can provide transparency and continuous control over project expenses and revenues. Smart contracts can automate supplier payment processes, payroll, and budget compliance monitoring.

5. Risk and Security Management: Blockchain technology can be used to track and manage risks in the project, as well as to ensure the security of sensitive data and information.

6. Stakeholder Relationship Management: Blockchain can ensure transparency and reliability in relationships with stakeholders, including customers, partners, and investors. This can help improve communication and interaction between all project participants.

Overall, blockchain technology has the potential to significantly improve project management by ensuring transparency, efficiency, and security in all aspects of its implementation.

Blockchain technology has become a crucial moment in various industries, and project management is no exception. Blockchain in project management has opened up several possibilities thanks to its decentralized and secure nature. By creating an immutable and transparent registry of information, blockchain development services enhance the transparency, accountability, and efficiency of project management processes.

In this rapidly evolving environment, project managers and organizations are exploring the potential of blockchain. This technology can optimize project workflows, simplify communication, and revolutionize collaboration among stakeholders.

With the integration of smart contracts, data security, and real-time updates, blockchain offers a new approach to project management. This approach can minimize risks, accelerate decision-making, and strengthen trust among team members and clients.

Blockchain technology can offer several advantages when applied to project management processes. Let us consider the impact of blockchain on project management:

1. Project Data Security: Blockchain uses advanced cryptographic methods, making it extremely secure. Once a block of data is added to the chain, it becomes nearly impossible to alter or delete it without the consent of the majority of the network. Thus, it ensures the integrity of the information related to the project.

As an example, let's consider the use of blockchain technology to ensure the security and integrity of medical data in an electronic medical record (EMR) project. Suppose doctors, laboratories, and insurance companies interact through a blockchain-based EMR system. Each time a doctor or laboratory creates a new record about a patient's health or test result, this information is recorded in a new block and added to the blockchain. Each block contains the hash of the previous block, ensuring a continuous link between them.

As data is recorded on the blockchain, it becomes impossible to alter or delete without the consent of the majority of network participants. This means that patient health information remains unaltered and intact. Any attempts to modify or tamper with the data will be detected and prevented by the blockchain network.

Thus, by using blockchain technology, the electronic medical record project ensures a high level of security and integrity of medical data, protecting it from unauthorized access, changes, and tampering.

2. Automation with Smart Contracts: Smart contracts are self-executing contracts with predefined conditions. They can automate various project management tasks, such as allocating funds after reaching specific milestones or executing actions based on predefined events. Such automation optimizes workflows, reduces administrative costs, and minimizes the risk of contract breaches.

Suppose we have a company that develops software, and we want to use smart contracts to automate the payment process for development and testing.

- Creating a Smart Contract: We create a smart contract on the blockchain, where we define the payment conditions for each stage of development and testing.

- Contract Conditions: In the smart contract, we specify that payment will be made after the completion of each stage of development and testing. For example, after completing the

development of functionality, testing its performance, and getting client approval.

- Project Stage Completion: The development team works on each stage of the project. After completing each stage, they upload the results to the system, which automatically checks them against the contract conditions.

- Automatic Fund Disbursement: Upon successful completion of a stage, the smart contract automatically disburses funds to the developers according to the predefined conditions. This occurs without the involvement of intermediaries or project administrators.

Thus, the use of smart contracts allows the company to automate the project management process, reduce administrative costs, and minimize the risk of contract breaches, while ensuring transparency and reliability in dealings with project executors.

Effective Collaboration. Blockchain ensures secure and direct communication between team members and stakeholders. This eliminates the need for intermediaries and expands collaboration opportunities. Such streamlined communication can lead to faster decision-making and problem-solving.

Imagine a supply chain project involving manufacturers, suppliers, logistics companies, and retailers. By using a blockchain platform, they can interact directly without intermediaries, ensuring secure and transparent communication.

An example could be Hyperledger Fabric, which provides tools to create private blockchain networks tailored to specific business needs.

- Supply Chain Tracking: Every stage of the supply chain from factory to end consumer can be recorded on the blockchain, ensuring transparency and reliability of information about the movement of goods. This allows all participants to see up-to-date information on the status of deliveries without having to contact intermediaries.

- Inventory and Order Management: With blockchain, companies can automate inventory and order management processes. Smart contracts can be used to automatically place orders based on stock levels and make decisions about redistributing goods.

- Dispute and Issue Resolution: In case of disputes or issues, the blockchain platform can serve as a single source of truth, providing a transparent and immutable event log. This allows for quick and efficient resolution of arising problems and avoids lengthy legal proceedings.

Thus, blockchain ensures secure and direct interaction between project participants, contributing to faster decision-making, problem-solving, and improving the efficiency of the supply chain.

4. Improved Supply Chain Management. IoT sensors integrated with blockchain can track the movement of goods and materials throughout the supply chain. This ensures transparency and traceability in project logistics and procurement.

One example of improved supply chain management using blockchain and IoT sensors is the IBM FoodTrust project.

IBM FoodTrust is an initiative developed by IBM in collaboration with several major food companies such as Walmart, Nestle, Unilever, and others. It uses blockchain technology and IoT sensors to ensure transparency and traceability in the food supply chain.

The project allows each participant in the supply chain to record information about the movement of goods on the blockchain. IoT sensors can be used to monitor transportation conditions (temperature, humidity, etc.) and automatically record this data on the blockchain.

Here's how it works in practice:

- Product Origin Tracking: Producers can record information about the origin of raw materials and production processes on the blockchain. This allows consumers to obtain information about the origin of products and the conditions under which they were produced.

- Storage and Transportation Conditions Monitoring: IoT sensors can track temperature, humidity, and other environmental parameters during product transportation. This data is recorded on the blockchain, allowing supply chain participants to detect and respond to any anomalies or storage condition violations.

- Combating Counterfeiting and Fraudulent Products: Thanks to the transparency of the supply chain, consumers can verify the

authenticity of products using data recorded on the blockchain. This helps fight counterfeits and fraudulent products.

Thus, the IBM FoodTrust project demonstrates an example of improved supply chain management using blockchain and IoT sensors, ensuring transparency, traceability, and security in the food supply process. Blockchain creates a common and immutable ledger in which each transaction or event in the supply chain is recorded. This transparency allows all stakeholders to track the movement of goods, verify the origin of products, and control each stage of the supply chain process. As a result, it becomes easier to identify shortcomings, determine sources of problems, and ensure compliance with quality standards and regulations.

5. Reliable Auditing and Compliance. Blockchain helps project management ensure reliable auditing and compliance by ensuring the immutability and transparency of recorded data. Its transparent nature allows auditors and regulators to access unaltered data, reducing discrepancies and ensuring accuracy.

Additionally, blockchain timestamps each transaction, providing a chronological order of events, which helps track the history of project activities for audit purposes. Project managers can optimize the audit process by using blockchain for auditing and compliance. They can also demonstrate compliance with regulations and gain the trust of stakeholders and regulatory bodies.

One example of using blockchain for reliable auditing and compliance is the Ernst & Young (EY) project called EY BlockchainAnalyzer.

Ernst & Young (EY) is an international auditing and consulting company with a presence in many countries around the world. EY has offices and branches in many countries, including the USA, UK, Germany, China, Japan, India, Australia, and many others. The company operates internationally and serves clients worldwide.

EY BlockchainAnalyzer is an audit tool developed by EY for verifying blockchain transactions and ensuring regulatory compliance.

Here's how EY BlockchainAnalyzer can be used for project management and ensuring reliable auditing:

- Data Integrity Verification: Blockchain records all transactions in an immutable and transparent manner. EY BlockchainAnalyzer leverages this feature of blockchain to verify data integrity and detect any changes or anomalies in the transaction history.

- Timestamp Analysis: Blockchain timestamps each transaction, allowing for the analysis of the chronological order of events. EY BlockchainAnalyzer uses this information to track the history of project activities for audit and compliance purposes.

- Regulatory Compliance: EY BlockchainAnalyzer allows auditors and regulators to access unaltered data on the blockchain, reducing discrepancies and ensuring accuracy. This helps companies demonstrate compliance with rules and regulatory requirements.

6. Enhanced Payment System. Blockchain can ensure continuous and instantaneous cross-border payments. This eliminates the need for intermediaries or currency conversion. This feature is especially useful for international projects involving multiple parties.

One example of an enhanced blockchain-based payment system is RippleNet by Ripple.

RippleNet is an international payment system based on blockchain technology that provides fast and low-cost cross-border payments. Unlike traditional international money transfer systems, which can take several days and include high fees and currency conversion risks, RippleNet uses its cryptocurrency XRP for instant transactions.

Here's how it works in practice:

- Network Participants: Participants in the RippleNet network can be banks, payment providers, financial institutions, and other companies that make international payments.

- Use of XRP: Payments on the RippleNet network can be made using the cryptocurrency XRP. XRP provides fast and low-cost transactions that can be carried out in seconds compared to traditional bank transfers that can take several days.

- No Intermediaries: By using blockchain technology and XRP cryptocurrency, RippleNet allows for instant cross-border payments without intermediaries such as intermediary banks or payment

systems. This reduces transfer costs and eliminates risks associated with intermediary stages and currency conversion.

Thus, using blockchain for cross-border payments eliminates the need for intermediaries and intermediary banks, reducing fees and lowering the cost of money transfers. This allows companies to significantly save on international financial transactions. Cross-border blockchain-based payments are processed much faster than traditional bank transfers, which can take days or even weeks. Thanks to blockchain technology, transactions can be carried out instantly, which is especially important for high-priority or urgent operations.

Blockchain ensures the transparency and security of cross-border payments, as all transactions are recorded in a distributed ledger and data cannot be changed without the consent of all network participants. This increases the level of trust between participants in international projects. Thanks to the use of blockchain, international payments become more convenient and accessible to project participants anywhere in the world. There is no need to contact banks or payment systems, it is enough to have access to the internet and a portal for conducting operations.

Overall, blockchain technology significantly improves the process of international payments, making them faster, more reliable, and accessible to various parties involved in international projects.

7. Risk Reduction and Resilience. The decentralized nature of blockchain can significantly reduce the risk of data loss and system failures during project execution by eliminating single points of failure and ensuring data redundancy. Each participant (node) in the network stores a copy of the entire blockchain. This ensures that even if some nodes go offline or encounter issues, the network as a whole remains operational.

Imagine a global project to develop a medical information system that will be used to exchange medical information between hospitals, laboratories, and insurance companies worldwide. By using blockchain technology, this system ensures secure and reliable storage of medical data, as well as resilience to failures and data loss.

Each participant in this medical network is a node in the blockchain network and stores a copy of all medical records. If one of

the nodes stops functioning or goes offline, the remaining nodes continue to operate, maintaining the integrity and availability of the data. This ensures the continuity of the system and the protection of medical data from loss or damage.

For example, if a hospital in a country temporarily loses internet access due to technical issues or natural disasters, it can still access medical records through other blockchain network nodes located in other parts of the world. Thus, using blockchain technology reduces the risk of data loss and ensures system resilience even if individual nodes encounter problems.

Additionally, blockchain uses a consensus mechanism to verify and approve data for addition to the block. This redundancy ensures that the network has multiple copies of the same data. This reduces the risk of data loss in case of failure or unavailability of several nodes.

While blockchain offers numerous advantages for project management, it is essential to understand that its implementation requires careful planning, analysis, and understanding of the technology. When used effectively, blockchain can transform and optimize various aspects of project management.

TEST QUESTIONS:

1. What are the main stages involved in the risk management process in projects and business?

2. What methods and tools are used to identify potential risks and assess their impact?

3. How are risk management strategies determined, and how do they vary depending on the nature of the risk?

4. What measures are taken to monitor and control risks during project execution or business operations?

5. How is the effectiveness of the risk management process evaluated, and what steps are taken for its continuous improvement?

6. What is blockchain technology, and how does it ensure data transparency and security?

7. What advantages can the application of blockchain technology in project management bring compared to traditional methods?

8. How can blockchain technology help improve document management and supply chain processes in projects?

9. What challenges may arise when implementing blockchain technology in project management, and how can they be addressed?

10. Which business sectors are most suitable for the application of blockchain technology, and why?

CHAPTER 7.
DEVELOPMENT AND MANAGEMENT OF PROJECT TEAMS

7.1 Effective Collaboration in a Project Team

So, having analyzed process models, gathered the appropriate project structure, team, and goals, and found project management tools that meet the requirements, it's important to act as a unified whole with individual team members throughout the project lifecycle.

Just because the right team members with the right skills have been chosen does not mean they will work together as you think. Unfortunately, differences in work habits, communication styles, and short- and long-term goals can also turn the entire team (and project) from their purpose.

The Importance of Collaboration in Project Management

Before we enter into the details of creating an optimal collaborative environment, it's crucial to first understand why collaboration is so important. Without collaboration, a team will stand still. Only when the whole team contributes ideas and works together is it possible to successfully execute complex projects, develop intelligent innovations, and create proposals that surpass competitors.

Close teamwork is important for two reasons:

1. Internal collaboration increases productivity.

If teams use tools and workflows that make interaction and collaboration within the project more effective, goals can be achieved faster and with higher quality results. Smooth collaboration ensures greater productivity.

There is evidence to support this: a study by McKinsey & Company showed that global software development teams increased their productivity by 20–30% by implementing collaborative processes and network tools.

The California-based chip manufacturer Xilinx also found that the productivity of its technical specialists increased by 25% when they were able to use tools that facilitated collaboration among colleagues.

2. Collaboration with external stakeholders supports innovation.

Whether it's customers, partners, or suppliers, if you gather feedback from external stakeholders and use it to improve your products or services, they will also meet the desires and needs of customers.

Few companies today attempt to handle everything internally because it's simply impossible to manage all tasks efficiently. Growth always requires ideas and feedback from outside. The same goes for your project team. When teams work together as a unified whole, they can achieve remarkable results.

All this clearly shows that collaboration is a critical component of a project. Now let's consider what a project team is and how to create one. Important: simply assigning tasks to employees is not the same as creating a project team.

A project team is a group of people who work towards a common goal while contributing their individual skills. Selecting team members, developing team identity, and standardizing workflows are crucial to the success of the project.

So, what should be considered when forming a project team?

1. Project Requirements. To strategically select team members, it is necessary to clearly understand the scope and content of the project.

2. Skills. Rely on team members who possess a variety of unique and relevant skills. If your team lacks certain skills needed for the project, the task may not be completed correctly. However, if the team has too many members with the same skills, there might be confusion about who is responsible for what.

3. Capacity. Even if you have found the perfect person for a specific project task, problems can arise if your specialist is overloaded. Therefore, it's essential to pay attention to the available capacity among your team members.

4. Work Methods. We all have different ways of working and personalities. It's also necessary to consider how these differences may impact team dynamics and how to best utilize them throughout the project.

Let's imagine two team members: Alex and Natasha. Alex prefers diversity in work methods and characters within the team, which is inevitable and can significantly impact work dynamics and project effectiveness. For example, a team may have members who prefer working alone, while others thrive in team activities. It's important to leverage this diversity to achieve optimal results.

Alex prefers to work independently, strives for autonomy, and likes to solve tasks on his own. Natasha, on the other hand, prefers teamwork, actively initiates discussions, and prefers joint decision-making.

To make use of this diversity in the team, you can assign tasks according to the preferences of the members. Give Alex more autonomous tasks, while Natasha can handle tasks requiring teamwork and discussions. Additionally, assign roles that align with the strengths of the members: Alex could be given the role of executor of specific tasks, while Natasha could be assigned as the coordinator of team activities.

It's important to ensure open feedback and communication within the team. This helps members express their preferences and expectations regarding the work process. Additionally, utilizing each member's strengths for the benefit of the project is also key. For example, leverage Natasha's teamwork skills for effective coordination, and Alex's expertise in independent work for tackling complex tasks.

Thus, using the diversity of work methods and personalities within the team helps make the work more efficient and productive, taking into account the needs and preferences of each member. It also contributes to creating a harmonious and balanced work environment.

Although a project team may look different depending on the scale of the project and required skills, the characteristics of a successful project team remain roughly the same.

1. Strong Team Leadership: Every team needs a leader who can bring out the best qualities in their team members. Knowing the individual strengths of team members and optimizing their use is crucial for the overall success of the team.

2. Clear Goals and Objectives: When the plan and goals are clear, it's much easier for team members to see the direction they need to move in and how their work contributes to the bigger picture. Encourage their commitment to the common cause by presenting a tangible vision.

3. Standardized Work Processes: When conflicts arise or tasks need to be assigned, the team needs to know how to handle them. Standardized processes and workflows, along with clear role distribution, eliminate ambiguities and allow the team to overcome obstacles.

4. Diversity: Research repeatedly shows that diversity delivers better results. A strong project team is diverse in terms of skills, as well as ethnic, cultural background, and gender.

5. Team Building: Team building is the process of creating and strengthening interaction, cooperation, and trust among team members. The goal of team building is to enhance the efficiency of the team by developing team spirit, improving communication, resolving conflicts, and encouraging mutual understanding and collaboration. Team building can include various games, exercises, training, outings, and other activities aimed at improving relationships and team performance.

If team members have enough time to get to know each other and build good relationships, it strengthens mutual trust, eliminates barriers, and facilitates communication. Spending time on team-building exercises and celebrating big and small successes can make a significant difference. A kickoff meeting at the start of a project can also help ensure everyone is on the same page from the beginning.

Organize a kickoff meeting before the official project launch to align everyone from the start. A kickoff meeting is an event held at the beginning of a project or work process to introduce team members to the main tasks, goals, plans, and expectations of the project. During the kickoff meeting, key aspects of the project are usually discussed, roles and responsibilities are distributed, success criteria are outlined, and a common understanding of how the project will be organized and conducted is developed. This important event helps participants

synchronize, create an understanding of common goals, and foster team spirit.

Successful kickoff meetings require good preparation. Let's consider how to achieve that:

1. Prepare an Agenda: Outline the main topics to be discussed, including project goals, roles, responsibilities, timelines, and success criteria.

2. Identify Key Stakeholders: Make sure all relevant team members and stakeholders are invited and informed about the meeting's purpose.

3. Set Clear Objectives: Define what you aim to achieve during the kickoff meeting, such as aligning on project goals, establishing communication protocols, and fostering team collaboration.

4. Provide Relevant Materials: Share any necessary documents or resources before the meeting to ensure everyone is prepared and informed.

5. Foster Open Communication: Encourage team members to voice their thoughts, ask questions, and share their expectations and concerns.

6. Document Decisions and Actions: Keep a record of key decisions, action items, and next steps to ensure everyone is on the same page moving forward.

By following these steps, you can ensure that your kickoff meeting sets a strong foundation for the project's success.

1. Anchor Vision and Outcomes: Set a common goal that applies to everyone. Describe what needs to be done and when.

2. Gather the Team and Define Roles: Who is doing what? Create a detailed list and add contact information to facilitate communication.

3. Create a Draft Project Plan: Have a basic structure ready, but involve your team in discussing the final details at the first meeting. Plan your approach but stay flexible.

4. Define Success Metrics: How should the project's progress be evaluated? What makes the project successful? Set expectations early on.

5. Identify Potential Risks and Bottlenecks: Prepare your team for potential obstacles and develop a process for quickly addressing any issues.

6. Establish Team Communication Processes: How will you keep each other updated? Develop a fixed process (e.g., daily or weekly meetings) and decide on the conferencing technologies to use.

7. Choose a Workflow or Project Management Methodology: Create methods and frameworks for your team to ensure consistency in work methods and expectations.

8. Decide on Tools to Use: Ensure everyone has access to the necessary tools and knows how to use them optimally.

When the project begins, the leader will be responsible for maintaining motivation, setting the course, and fostering collaboration. Motivational speaker Brian Tracy came up with the following motto: "Successful people are those who have successful habits." Thus, team productivity is indeed the magic ingredient for project success. If the team has the right habits, they will complete the project on time and mostly work harmoniously.

However, if the team does not yet have the right work habits, it is necessary to help them adopt new, more productive behaviors right now. Just remember that it takes 66 days to 8 months to form a new habit. Moreover, approach this delicately, as everyone resists change to some extent.

Let's consider five ways to stimulate the formation of new habits in the team:

1. Lead by Example: Identify the new habit you want your team to adopt, and then demonstrate it yourself. Be a role model. Team members will follow your example when they see the benefits this new habit brings to their daily work.

2. Identify Pioneers in the Team: Get help from your pioneers - enthusiastic team members who quickly adopt new tools or behaviors and promote their implementation within the team.

3. Use Small Progress for Big Success: Small progress can motivate the team to persevere to the end, even if it initially seems difficult. Celebrate even the smallest progress and encourage team members to stay focused.

4. Motivate Your Team: Even the best arguments are not convincing if they lack emotion. Stimulate your team to adopt a new habit by challenging them with fun, creative methods involving the entire team.

5. Combine New and Old Habits: It's always easier to form new habits if they are based on old, existing behaviors. This makes the new habit feel more familiar, and the transition occurs more naturally. Identify which behaviors the team already practices well, and help them improve further.

A collaborative work environment requires not only the right tools, processes, and procedures but also providing employees with the appropriate framework to achieve common goals. Despite different work methods, personal goals, or cultural traditions, it is important to create a safe space where everyone feels supported and has the opportunity to express their opinions.

While effective collaboration is ultimately possible only if the project team is ready for it, there are several tips and methods that can be used to encourage it:

- Create a collaborative workspace. Organize an open work area away from individual workstations where team members can meet and collaborate during the project.

- Ensure effective remote collaboration. Set up a video conferencing system that can be used at any time, so remote team members are available at all times during work.

- Use information-sharing tools. Effective collaboration requires the right tools and technologies. You will need at least one real-time chat tool, one project or task management tool, a knowledge base, and a file-sharing tool. Of course, the best solution is a comprehensive one that performs all these functions.

- Encourage interaction everywhere. Place boards in hallways and conference rooms and invite team members to draw plans on them and discuss ideas. Reward team members who participate.

Remote collaboration is becoming increasingly common and, in some cases, the norm. Modern workers and workplaces must be adapted for remote workers and support collaboration regardless of their location and time zone.

When managing a distributed project team, a collaboration tool (or project management tool) is an effective means of getting everyone on the same page and centralizing all project information in one place. However, simply using a tool does not guarantee successful collaboration. Therefore, let's consider the following recommendations for using a collaboration software tool:

- Actively share information. Assign tasks to team members that they need to know about, and mention them in comments so they are notified when their actions are required.

- Record every project in your collaboration or project management tool. Use this tool as the central source for all project-related materials and notes, so everyone has easy access, even if they join the project later.

- Set up channels for virtual "coffee breaks." Through channels in your communication tools where team members can discuss non-work-related topics, they get to know each other better and build positive relationships even over long distances.

- Celebrate small successes. Collaboration tools are a great place to highlight big and small achievements. Even a short message can make a big difference.

- Distribute work well. You can't work well with others when you're overloaded. Use your collaboration tool's status and resource management features to ensure an even distribution of project tasks among your team members.

Communicating with team members is always a bit more challenging if you’re not sitting directly across from each other. However, new technologies make virtual meetings easier. Let's consider some recommendations for virtual meetings:

- Indicate who you are talking to. Avoid repeating by naming the person before asking something.

- Always introduce yourself. Never assume everyone knows how you sound or look. Always state who you are and set a good example for others.

- Have backup technology ready in case of an emergency. Nobody wants to scramble to find a new conference line at the start of a meeting or require everyone to quickly download new video

conferencing software. Therefore, having a backup plan in case your preferred technology fails is advisable.

- Establish meeting etiquette. Teleconference or video conference policies increase the effectiveness of virtual meetings. For example, ask participants to mute themselves when not speaking.

Collaboration is undoubtedly extremely important not only for the success of your projects but also for the long-term growth of your company. It is a fundamental requirement for daily project work, but above all, it is a defining aspect of corporate culture that makes a company attractive to top talent.

7.2 Supporting an Innovation Culture Within the Team, Encouraging Ideas and Suggestions

An innovation culture is characterized by openness to new ideas, willingness to take risks and experiment, and a constant drive to improve processes, products, and services. In the context of project management, maintaining such a culture requires a systematic approach and the implementation of specialized mechanisms to motivate and support innovation at all levels of project management.

Let's consider the strategic aspects of supporting an innovation culture:

1. Formulating Vision and Values that Support Innovation: It is essential for project and organizational leadership to clearly articulate their expectations regarding innovation and to embed values that encourage a creative approach, initiative, and readiness for change.

2. Developing and Implementing an Innovation Strategy: Defining the strategic directions for innovation development, including investments in research and development, technological upgrades, and employee training.

3. Creating Infrastructure for Innovation: Organizing spaces for idea exchange, including virtual collaboration platforms, as well as physical spaces like creative labs and innovation hubs.

Operational Mechanisms to Stimulate Innovation are specific methods, procedures, and tools used by organizations to encourage and support innovative activity within the company.

1. Mechanisms for Collecting and Evaluating Ideas: Implementing processes for systematically collecting, analyzing, and selecting proposals from employees, including internal startup programs, hackathons, and ideathons.

2. Incentive and Motivation Programs: Developing a reward system for initiators of innovative ideas and projects, including monetary bonuses, professional development opportunities, and public recognition.

3. Training and Competency Development: Organizing training programs aimed at developing skills in critical thinking, creativity, project management, and mastering new technologies.

To maintain and develop an innovation culture, it is critically important to regularly measure and analyze innovation activity within the team and projects. This may include assessing the quantity and quality of proposed and implemented ideas, measuring the impact of innovations on the efficiency of projects and the organization as a whole, and analyzing feedback from employees regarding the innovation environment.

Maintaining an innovation culture requires a holistic approach, including strategic planning, operational management, and continuous evaluation of results. Successful implementation and support of an innovation culture in project teams contribute not only to achieving specific project goals but also ensure the long-term development and competitiveness of the organization.

An innovation culture is an environment that encourages and supports creativity, experimentation, and risk-taking. It values new ideas and perspectives, and failure is viewed as an opportunity for learning and growth. An innovation culture promotes the continuous improvement and development of new products, services, and processes.

An innovation culture refers to the shared values, beliefs, and practices within an organization that foster and support innovation. It encompasses the relationships and behaviors of individuals, as well as the overall environment that encourages creativity, experimentation, and the generation of new ideas. A strong innovation culture is crucial for organizations seeking to adapt to changes, remain competitive, and

continuously improve. This culture is closely intertwined with the innovation process, which includes systematic steps and methods used by the organization to transform creative ideas into tangible products, services, or improvements.

Creating and developing an innovation culture requires leadership commitment, supportive organizational structures, and investment in employee development.

An innovation culture involves an organizational environment that leaders create to encourage thinking outside the box and its practical application. Workplaces that promote an innovation culture typically hold the view that innovation is not the exclusive prerogative of senior management but can originate from anyone within the organization.

An innovation culture is the heartbeat of forward-looking organizations, pulsating with shared values, practices, and mindsets that constitute the essence of continuous improvement and unbridled creativity. It goes beyond the mundane routine of the workplace, transforming into an environment where ideas are not just conceived but meticulously brought to life. This dynamic culture is characterized by a fearless willingness to take risks and an acknowledgment that within the realm of uncertainty lies the foundation for revolutionary discoveries.

The success of an innovation strategy is inextricably linked to the innovation culture of an organization, serving as a catalyst for bringing the innovation strategy to life.

An innovation strategy is a thoughtful and structured plan that outlines how an organization intends to foster innovation to achieve its business goals. This involves setting clear objectives, allocating resources, and creating processes to systematically stimulate innovation. An effective innovation strategy aligns with the overall business strategy and is flexible enough to adapt to changing market conditions.

Innovation culture does not stop at mission statements; it breathes life into every aspect of the organization. It acts as a catalyst, prompting teams to think beyond conventions, creating an atmosphere where experimentation is not only welcomed but encouraged. The

mindset ingrained in this culture sees failures not as setbacks but as invaluable lessons on the path to progress. It thrives on adaptability, recognizing that change is not a threat but an opportunity to evolve and stay ahead in an ever-changing landscape.

This refers to the shared values, beliefs, practices, and behaviors within an organization that foster and support the continuous generation and implementation of new ideas and solutions. It is a dynamic and adaptive environment where creativity, experimentation, and risk-taking are not only encouraged but are embedded in the organizational mindset.

Innovation culture is important for several reasons:

— *Strategic Imperative*: Innovation culture is not just a trend but a strategic necessity for organizations striving for sustainable success.

— *Navigating Market Changes*: It acts as a compass, allowing companies to anticipate and effectively navigate market changes, staying ahead of competitors.

— *Adaptation and Leadership*: Organizations with an innovative mindset can quickly adapt to changes in the business environment and even lead transformational trends, positioning themselves as industry leaders.

— *Attracting Top Talent*: A strong innovation culture acts as a magnet for top talent in a knowledge-based economy, creating an environment that fosters creativity and provides opportunities for professional growth.

— *Employee Engagement*: Employees in an innovation culture feel empowered and engaged, contributing to a positive work environment and increased productivity.

— *Customer and Stakeholder Perception*: It goes beyond internal dynamics and shapes the perception of customers and stakeholders. An innovative organization is seen as adaptable and forward-thinking, attracting support and loyalty.

— *Competitive Advantage*: Companies with a strong innovation culture gain a competitive edge, constantly improving and remaining relevant in an ever-changing market.

— *Resilience and Prosperity*: In a world of constant change, an innovation culture becomes a cornerstone for enhancing resilience, relevance, and sustainable prosperity.
— *Forward-Thinking Leadership*: Fostering innovation is not just about meeting current needs but positioning the organization as a forward-thinking leader ready to address future challenges.
— *Continuous Improvement*: It provides a foundation for proactivity and a commitment to continuous improvement, ensuring long-term success in a dynamic business environment.

Let's consider examples of innovation culture:

— *Amazon, a pioneer in e-commerce*, has transformed retail by prioritizing customer-centric innovations. The company's culture encourages experimentation and views failure as a crucial step towards success.
— *Tesla, a leader in electric vehicles and sustainable energy*, thrives on a culture that encourages risk-taking and challenges norms. Innovations permeate all aspects, from product design to manufacturing processes.
— *Pixar, the renowned animation studio, has innovation embedded in its DNA*. With a collaborative and creative atmosphere, Pixar consistently produces groundbreaking animated films.
— *Microsoft's transformation* from a software giant to a tech innovator is attributed to its commitment to an inclusive and forward-thinking culture. Employees are encouraged to explore new ideas, fostering the company's continuous transformation.
— *Google is famous for its innovation culture*, promoting creativity and a willingness to take risks. The company allows employees to dedicate time to personal projects, leading to revolutionary products like Gmail and GoogleMaps. Google’s open work environment and focus on collaboration create a culture where new ideas are valued.
— *IBM boasts a rich history* of innovation and successful adaptation to evolving technologies. The company's innovation culture prioritizes research and development, collaboration with clients, and solving complex global challenges. IBM promotes a culture of continuous learning and remains at the forefront of

technological advancements, including artificial intelligence and quantum computing.

Understanding and developing three dimensions - innovation capabilities, readiness for innovation, and opportunities for innovation - lay the foundation for a sustainable innovation culture. Addressing each dimension, organizations can create an environment where people are empowered, open to change, and have ample opportunities to contribute to innovative initiatives.

Innovation culture includes three main dimensions that collectively shape the organization's approach to innovation:

1. **Capability – Innovation Ability**:

- *Skill Enhancement*: Implement training programs to improve the skills and competencies of the organization's employees.

- *Continuous Learning Culture*: Foster a culture of continuous learning to keep employees informed of the latest industry trends and innovative practices.

- *Investment in Skill Development*: Allocate resources to skill development initiatives, providing employees with the knowledge and tools needed to make meaningful contributions to innovation efforts.

2. **Readiness – Willingness for Innovation**:

- *Leadership Role*: Leaders should actively champion an environment where change and experimentation are valued.

- *Encourage Risk-Taking*: Cultivate a culture that encourages risk-taking and values new ideas, creating a willingness among employees to explore innovative solutions.

- *Open Communication Channels*: Establish channels for idea generation and feedback, so employees feel free to voice their ideas, knowing their contributions are valued.

3. **Opportunity – Opportunities for Innovation**:

- *Resource Availability*: Create an environment that provides the necessary resources, both financial and technological, to support innovation initiatives.

- *Supportive Platforms*: Develop platforms that encourage innovation, such as specialized innovation labs or collaborative workspaces.

- *Cross-Functional Collaboration*: Promote collaboration between departments to ensure diverse perspectives and ideas contribute to innovative solutions.

Integrating the Business Model Canvas into these dimensions is crucial. It serves as a guiding framework, ensuring that innovative thinking is easily integrated into all aspects of the organization's structure, operations, and strategic vision. The canvas becomes a dynamic tool that aligns and reinforces the organization's commitment to fostering an innovation culture.

Innovation capability has become a critical success factor for organizations. Creating an innovation culture is not just a trend but a strategic imperative. In this detailed guide, we delve into the key steps to developing an innovation culture in organizations, with a focus on practical strategies and real-life examples.

1. Cultivate an Innovation Mindset: Define and Communicate a Clear Innovation Strategy.

At the core of an innovation culture lies a shared mindset. Organizations need to articulate a clear innovation strategy, emphasizing the importance of experimentation, collaborative creativity, and tolerance for failure. Disseminating this strategy ensures alignment throughout the organization, empowering employees at all levels to contribute to the innovation journey.

2. Leadership Commitment.

Leadership commitment is crucial in shaping organizational culture. Leaders must actively champion and demonstrate a commitment to innovation. Their actions set the tone for the entire organization, showing that innovation is not just encouraged but is an integral part of the company's DNA. Leadership commitment creates a cascading effect, inspiring employees to embrace and implement innovative thinking.

Integrating the UNITE CultureCanvas into this initiative provides a valuable framework for understanding and enhancing innovation culture. This framework offers a structured approach to comprehending, assessing, and enhancing the innovation culture within an organization. It serves as a powerful tool for self-assessment and collective understanding. Initially, team members independently

contribute their perspectives on innovation, culture, and mindset to the overall picture. The canvas becomes a visual representation of the diverse cultural perspectives within the team.

3. Create a Diverse Team.

Diversity drives innovation. Building a team with diverse perspectives, skills, and experiences fosters creativity and problem-solving. Embrace diversity in all its forms to create a rich palette of ideas within your organization. A diverse team brings varied experiences and ideas, creating a dynamic environment where innovation can thrive.

4. Provide Resources.

Innovation requires resources – financial, human, and technological. Ensure that your teams have the necessary tools and support to bring innovative ideas to life. Adequate resource allocation is a fundamental factor that enables innovation, allowing teams to experiment, iterate, and realize groundbreaking concepts.

5. Create Physical and Virtual Environments.

The physical and virtual workspace profoundly impacts creativity and collaboration. Create spaces that inspire innovation, whether it's a well-designed office or virtual collaboration platforms that facilitate idea exchange. An environment that encourages open communication and the free flow of ideas is crucial for fostering an innovation culture.

6. Recognize and Reward Innovative Efforts.

Recognition and rewards mainstream the innovation within the organization. Implement a system that acknowledges both small and significant contributions, fostering a culture that welcomes innovative efforts. Recognition can take various forms, from internal praises to tangible rewards, creating a positive feedback loop that encourages continuous innovation.

7. Encourage Cross-Functional Collaboration.

Break down disunity and encourage collaboration between departments. Cross-functional teams bring diverse experiences, creating holistic and innovative solutions. Collaboration across different divisions ensures a comprehensive approach to problem-

solving, leading to innovative breakthroughs that a single department might overlook.

8. Training and Development.

Invest in continuous learning and development programs that enable employees to enhance their skills and stay updated with industry trends. An innovation culture thrives on a workforce equipped with the latest knowledge. Training and development initiatives not only enhance individual capabilities but also contribute to the overall innovation potential of the organization.

9. Foster Customer Orientation.

Innovation should ultimately serve customer needs. Develop a customer-oriented mindset that encourages teams to empathize with end-users and create solutions that truly add value. By prioritizing customer needs and preferences, organizations align their innovation efforts with market demands, ensuring that their products or services resonate with the target audience.

10. Measure, Learn, and Iterate.

Implement metrics to measure the success of innovation initiatives. Learn from both successes and failures, iterating strategies for continuous improvement and growth. Measurements provide valuable insights into the impact of innovation efforts, guiding future initiatives. A culture of continuous learning and iteration is the cornerstone of sustainable innovation.

Measuring innovation is crucial for organizations as it allows them to assess the effectiveness of their efforts, allocate resources wisely, and track progress in achieving strategic business goals. Innovation metrics should align with the organization's objectives and the specific nature of its innovation activities. Assessing innovation culture within your organization is critical for growth. Evaluating innovation culture within the organization is an essential step in driving growth and adaptability.

Here are key methods for effectively measuring and enhancing innovation culture:

1. Employee Perception:

- Innovation Comfort: Evaluate the comfort level of employees in proposing ideas and their perception of the company's commitment to innovation.

- Collaboration: Assess the level of collaboration and communication for idea exchange within the organization.

2. Idea Generation and Implementation:

- Quantity and Quality: Measure both the volume and quality of generated ideas to ensure a balance of innovations.

- Time to Implementation: Track how quickly ideas move from conception to implementation, reflecting the organization's agility.

3. Leadership and Innovation:

- Support: Assess leadership support for innovation initiatives, including resource allocation and encouragement of risk-taking.

- Role Modeling: Evaluate whether leaders actively exhibit innovative behavior, serving as role models for employees.

4. Training and Development:

- Engagement in Learning: Measure employee participation in innovation-related training programs, indicating a commitment to continuous learning.

- Skill Enhancement: Assess the development of innovation skills among employees through tools, problem-solving, and adaptability.

5. Project Outcomes and Impact:

- Project Success: Track the success rate of innovation projects, demonstrating the organization's ability to translate ideas into tangible results.

- Impact on Key Performance Indicators: Measure how innovations affect key business metrics, aligning innovation efforts with tangible outcomes.

The path to an innovation culture has its challenges. Acknowledging these barriers is the first step towards overcoming them. Let's delve into some common obstacles organizations face:

1. Lack of Resources for Creating an Innovation and Creativity Culture.

Innovation requires investments in terms of both time and resources. Organizations often fail when they do not allocate sufficient

resources to support creative and innovative initiatives. Addressing these resource shortages is crucial for sustainable innovation, ranging from budget constraints to limited workforce.

2. Resistance to Change.

People are creatures of habit, and resistance to change is a natural instinct. Transforming a traditional culture into an innovative one may face resistance from employees who are comfortable with the status quo. Overcoming this resistance requires effective communication, demonstrating the benefits of innovation, and involving employees in the process.

3. Traditional Organizational Structures.

Hierarchical organizational structures can stifle innovation by limiting communication and collaboration. Breaking down these traditional structures and adopting a more flexible and decentralized approach can pave the way for innovation to flourish.

4. Fear of Failure in Creating an Innovation Culture.

Fear of failure can paralyze creativity and willingness to take risks. Innovation inherently involves experimentation, and not every idea will be successful. Creating a culture that views failure as a stepping stone to success is vital for encouraging innovative thinking.

5. Unclear Innovation Strategy

Without a clearly defined innovation strategy, organizations risk implementing innovations unsystematically. A clear roadmap outlining the organization's innovation goals, methodologies, and success metrics is crucial for guiding and coordinating efforts.

6. Measuring Innovation.

Measuring the effectiveness of innovations is a complex yet essential task. Establishing metrics that go beyond traditional KPIs and account for the unique aspects of innovation helps organizations accurately assess their progress.

7. Lack of Customer Orientation.

Innovation should not occur in a vacuum but rather in response to customer needs. Failing to prioritize a customer-oriented approach can result in disjointed innovations that do not resonate with the market.

8. Sustainability Challenges.

Creating an innovation culture is an ongoing process that requires continuous effort. Many organizations struggle to sustain the momentum and culture of innovation in the long term.

To assess whether a company truly fosters an innovation culture and climate, it is essential to look beyond superficial indicators. Let's consider the key aspects that indicate a commitment to innovation:

- *Openness to Employee Ideas*: An innovation culture values contributions from all levels of the organization. Companies that actively seek and implement employee suggestions demonstrate a commitment to fostering creativity.

- *Freedom to Experiment*: Employees should feel free to test new ideas and approaches without fear of punitive measures for failure. A culture that encourages experimentation fosters innovation.

- *Cross-Functional Collaboration*: Innovation cultures break down disunity and promote collaboration between departments. When teams from different disciplines work together, differnet pointds of vieew coincide, leading to creative solutions.

- *Learning Opportunities*: A commitment to continuous learning is a hallmark of an innovation culture. Companies that invest in training programs and professional growth opportunities signal their intent to stay at the forefront of industry trends.

- *Adaptability and Flexibility*: Innovation thrives in an adaptable and flexible environment. Companies that quickly adapt to changes and implement new methodologies demonstrate innovative thinking.

Understanding the key characteristics that define an innovation culture provides organizations striving to create such an environment with a roadmap:

- *Openness and Willingness to Experiment*: An innovation culture encourages employees to think outside the box and experiment with new ideas without fear of judgment.

- *Collaboration and Cross-Functional Teams*: Break down silos and foster collaboration between departments. Cross-functional teams combine diverse expertise, promoting a holistic approach to problem-solving.

- *Customer Orientation*: Successful innovations are based on understanding and meeting customer needs. An innovation culture places a strong emphasis on maintaining a customer-oriented approach.

- *Continuous Learning and Development*: A commitment to continuous learning ensures that employees stay updated with industry trends and the latest technologies, fostering ongoing improvement.

- *Leadership Support and Vision:* Leadership plays a crucial role in shaping organizational culture. Supportive leaders with a clear vision for innovation inspire and guide teams toward creative solutions.

- *Clear Goals and Objectives*: Clearly defined goals provide direction and purpose for innovation efforts. Teams need to understand the broader objectives and how their contributions align with business goals.

- *Adaptability and Flexibility*: Innovation requires adaptation to change. A culture that values flexibility and embraces new ideas is better suited to navigate changing business environments.

- *Celebration of Success and Learning*: Recognizing both successes and failures fosters a culture of learning and improvement. Celebrate milestones and use failures as opportunities for growth.

- *Allocation of Resources for Innovation*: Supporting innovation initiatives requires adequate resource allocation. This includes financial investments, dedicated teams, and access to advanced technologies.

- *Diversity and Inclusion*: An inclusive environment that values diverse perspectives fosters creativity and problem-solving. Encourage diversity at all levels of the organization.

An environment where innovation thrives is as important as the strategies employed. Organizations need to create an environment that fosters creativity, experimentation, and collaboration:

- *Flexible Workspaces*: Create physical and virtual spaces that promote collaboration and free thinking.

- *Open Communication Channels*: Foster a culture of open communication where ideas can flow freely, overcoming hierarchical boundaries.

- *Incentives for Innovation*: Implement incentive and recognition programs to motivate employees to contribute innovative ideas.

- Technology Integration: Utilize technology to facilitate innovation, whether through collaboration platforms, project management tools, or innovation management software.

Creating an innovation culture is not a one-size-fits-all task; it requires a detailed approach tailored to the unique characteristics of each organization. By embracing the following principles and strategies, entrepreneurs can pave the way for a thriving innovation culture in their companies.

7.3 Managing Remote and Multicultural Teams in the Digital Economy

Digital transformation has changed not only the ways we communicate but also the format of organizing team collaboration. More and more companies are forming distributed (remote) teams that include specialists from different countries, time zones, and cultural backgrounds. This format provides access to the global talent market and increases business flexibility, but it also poses new challenges for managers – especially in the areas of communication, coordination, trust, and cross-cultural interaction.

A remote team is a group of employees who work together on shared tasks from different geographic locations using digital tools for collaboration.

A multicultural team is a team consisting of representatives of different national, ethnic, or cultural groups who may have different approaches to work, communication, time, authority, and hierarchy.

Remote Work: characteristics, benefits, and challenges. In the context of digital transformation and business globalization, remote work has shifted from being an exception to becoming a fully recognized form of labor organization. This trend gained particular relevance after the COVID-19 pandemic, which accelerated the mass transition of companies to digital business models. For the modern manager, it is crucial to understand the specifics of managing remote

teams in order to effectively organize workflows, maintain productivity, and motivate employees.

Key Characteristics of Remote Work

1. Lack of physical presence in the office. Employees can work from anywhere in the world, which opens access to the global talent pool.

2. Dependence on digital technologies. Communication, task coordination, supervision, and feedback rely heavily on digital tools (e.g., Zoom, Microsoft Teams, Slack, Trello).

3. Flexible schedules. Often involves asynchronous collaboration, especially in multicultural teams across different time zones.

4. Higher employee autonomy. Requires a high level of self-organization, discipline, and responsibility.

The advantages of remote work are presented in Table 7.1. The challenges and problems of remote work are presented in Table 7.2.

Table 7.1. - Advantages of remote work

Advantage	Description
Access to global frames	Companies can hire the best specialists without geographical restrictions.
Cost reduction	Savings on office space, utilities, and personnel transportation.
Flexibility for employees	The ability to balance personal and professional life.
Increased job satisfaction	Effective management increases employee engagement and loyalty.
Environmental efficiency	Reduced CO_2 emissions due to less mobility.

Table 7.2. - The challenges and problems of remote work

Challenge	Potential consequence	Recommendations
Communication barriers	Misunderstandings, delays in completing tasks	Using clear digital channels, establishing regular meetings
Decreased team cohesion	Loss of sense of belonging	Online events, informal meetings, culture of recognition

Problems with motivation and self-discipline	Decreased productivity	Clear planning, regular feedback, individual meetings
Digital Overload (Zoom-fatigue)	Burnout, reduction in the quality of decisions	Scheduled breaks, use of asynchronous channels
Challenges of control and performance evaluation	Complicated management processes	Results orientation, use of KPIs and OKRs

Tasks of managers when organizing remote work:

- Create a transparent communication system with clear rules.
- Provide the team with modern tools for work.
- Develop a culture of trust and responsibility.
- Support the mental health of employees.
- Provide opportunities for training and professional development.

Successful management of a remote team requires adapting traditional management approaches to new digital realities. This includes flexibility, digital literacy, empathetic leadership and continuous improvement of internal processes.

Case Studies of International Companies:

GitLab (USA). GitLab is one of the first examples of a fully remote company with over 1,800 employees in more than 60 countries. The company has no physical offices, and all processes – from hiring to firing – are carried out online.

Features of the model:

- Clearly structured documentation of all internal processes in the public domain.
- Daily synchronizations in Zoom, asynchronous work in GitLab Issues, Slack, Google Workspace.
- A culture of «written management» and «self-reporting» that replaces control.

Zapier (USA). An automation platform that has been working completely remotely since its inception. In 2020, the company even paid $10,000 bonuses to employees who agreed to leave major cities.

Model features:

- Trust as the basis of culture.
- A detailed onboarding system for remote employees.
- Use of Notion, Zoom, Asana, 1Password and other digital services.

Spotify (Sweden). In 2021, Spotify introduced a "Work From Anywhere" policy, which allows employees to choose where and when they work.

Model features:
- Increasing staff satisfaction.
- Expanding access to the international talent market.
- Maintaining a creative culture through regular online meetings and virtual team activities.

Case Studies of Ukrainian Companies:

Genesis (Ukraine). Genesis is one of the largest IT products in Ukraine, which even before the pandemic was actively implementing a hybrid work model.

Model features:
- An internal team interaction system with Scrum/Kanban elements has been built.
- Using its own and third-party tools (Jira, Slack, Notion, Miro).
- Online academy for adapting new employees and developing soft skills.

SoftServe (Ukraine). A company that works with over 1,000 clients in 40 countries has implemented an expanded flexible work model "Your Work, Your Way".

Model features:
- Employees can independently choose their work mode: fully remote, hybrid or in the office.
- Creation of special mental health programs to support employees.
- Investments in cybersecurity to maintain a safe remote environment.

Intellias (Ukraine). One of the leading Ukrainian outsourcing IT companies that has implemented the Remote-First concept, which involves a digital-centric approach to management.

Features of the model:

- Complete transformation of corporate culture to a remote model.

- Creation of virtual spaces for team interaction.

- Gamification of communications and online celebrations.

Successful implementation of remote or hybrid work requires not only digital tools, but also an appropriate organizational culture, trust, structured communication and flexible leadership. As the examples of GitLab, Spotify, SoftServe and Genesis show, the key to effective management lies in adaptability, openness to change and investment in team development.

Multicultural Teams: characteristics, challenges, and effective management practices

In the digital economy, multicultural teams have become a widespread phenomenon, particularly in international companies and the IT sector, where globalization and remote work offer broad opportunities for engaging professionals from different countries.

Characteristics of Multicultural Interaction

1. Diverse Communication Styles: Some cultures favor direct communication (e.g., USA, Germany), while others rely on indirect, contextual communication (e.g., Japan, China).
2. Different Perceptions of Leadership: In certain cultures, a leader is seen as an authoritarian figure, whereas in others—as a team facilitator.
3. Time Orientation: Polychronic cultures (Latin America, Middle East) are flexible with deadlines, while monochronic cultures (Scandinavia, USA) strictly adhere to schedules.
4. Perception of Hierarchy: Vertical management models are common in Asia and Eastern Europe, while horizontal models are typical in Western Europe and North America.

Challenges in Managing Multicultural Teams:

- Language barriers and misinterpretation of information.
- Cultural conflicts, stereotypes, and biases.
- Differences in decision-making approaches.
- Uneven engagement and varied understanding of goals.

*Best Practices for Managing Multicultural Teams^*

1. Cross-cultural Training: Conducting intercultural communication workshops.
2. Using a Common Digital Language: Establishing communication standards and clear reporting formats.
3. Transparent Interaction Rules: Setting unified protocols for online meetings, discussions, and decision-making.
4. Role of the Global Leader: The manager should act as a facilitator, building trust and ensuring equality among team members.
5. Digital Tools: Using collaboration platforms (Notion, Miro, MS Teams) that support language localization and flexible planning.

Case Studies from International and Ukrainian Companies

IBM: Global Projects with a Focus on Cultural Adaptation. IBM implements large-scale digital technology projects involving teams from countries such as India, the USA, and Poland. To ensure effective collaboration, IBM introduced the Cultural Navigator program, which helps team members understand the cultural backgrounds of their colleagues.

EPAM Ukraine: International Project Teams. EPAM actively works with multicultural teams, involving specialists from Ukraine, Kazakhstan, India, the USA, and the UK. To ensure efficient teamwork, they use a flexible management system, regular one-on-one meetings, and a culture of continuous feedback.

Multicultural teams in the digital economy are both a challenge and an opportunity. Their effective management requires empathy, flexibility, digital literacy, and cultural sensitivity. The manager of the future is a leader who builds bridges between cultures, not barriers.

Strategies for effective management of remote and multicultural teams in the digital economy:

1. Digital Infrastructure. Utilize tools such as Slack, Zoom, Notion, Miro, and Jira to ensure transparent communication, task management, and collaborative work.

2. Cross-Cultural Competence. A manager should possess knowledge of the cultural backgrounds of team members (e.g., Hofstede's cultural dimensions, Lewis Model) and be able to adapt their leadership style accordingly.

3. Flexible Scheduling and Asynchronous Work. Implement the «follow the sun» approach, document all decisions, and maintain project timelines within a digital environment.

4. Regular Feedback and Virtual Meetings. Conduct regular online stand-ups, one-on-one meetings, and informal virtual gatherings to support team cohesion and morale.

5. Building Trust Through Transparency. Set clear expectations, define performance indicators (KPI, OKR), and provide open access to progress updates and outcomes.

6. Inclusive Leadership. Respect cultural differences and ensure equal participation of all team members in the decision-making process.

7.4 Leadership in Digital Project Teams: The Manager's Role in Digital Transformation

Digital Leadership is the ability of a leader not only to manage a team in a digital environment but also to inspire, adapt to rapid technological changes, make innovative decisions, and build a culture of continuous learning and open communication. In the digital age, a leader does not merely control but guides the team toward creating value in conditions of uncertainty and intense competition.

«Digital leadership is not about mastering technology; it's about inspiring people through technology» – George Westerman, MIT Sloan [167].

Characteristics of Digital Project Teams

Project teams in a digital environment possess a number of unique features:

- High level of dynamism – frequent changes in tasks, technologies, and market conditions;
- Remote or hybrid work – team members may be located in different cities or even countries;

- High team autonomy – decisions are made collectively or at the sub-team level;
- Multi-role participation – team members may perform several functions simultaneously;
- Digital collaboration tools – widespread use of cloud platforms, messengers, task trackers, video conferencing and collaboration systems.

The Role of the Leader in Digital Transformation

In digital teams, the leader takes on more than just managerial functions. They also act as:

- **Facilitator** – helps the team effectively discuss and make decisions;
- **Mentor** – supports the development of team members' skills and fosters a learning environment;
- **Innovator** – initiates and supports change, implements new technologies;
- **Communicator** – ensures effective information exchange within the team and with external stakeholders;
- **Proponent of agile methodologies** – supports Agile approaches, where the leader acts more as a *servant leader* than a traditional manager.

Key Competencies of a Digital Leader

A modern digital leader should possess the following competencies (see Figure 7.1):

- Digital literacy (understanding of IT tools, platforms, and data analysis methods);

Cognitive flexibility (adaptability, agility);

- Empathy and emotional intelligence (understanding team members' needs, managing team morale);
- Communication skills (clear expression of ideas, feedback, active listening);
- Systems thinking (seeing the interconnections between people, processes, and technologies).

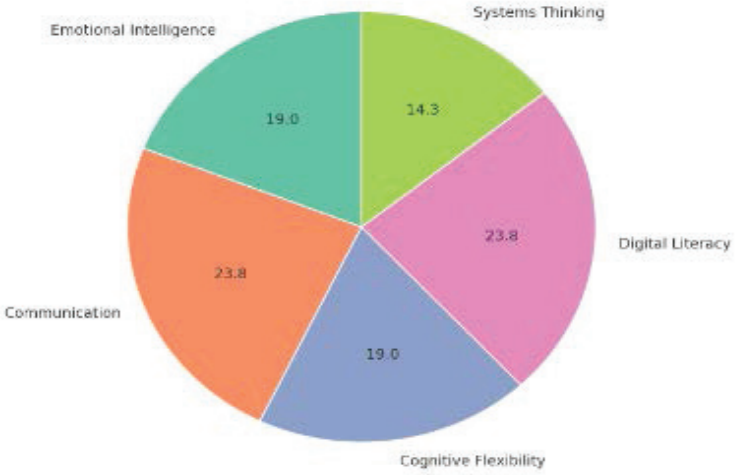

Figure 7.1. Competencies of a Digital Leader

Digital Tools in the Arsenal of a Digital Leader

Leaders of digital teams actively use:

Project management tools: Jira, Trello;

Communication platforms: Slack, MS Teams, Zoom;

Analytical systems: Power BI, Tableau;

Feedback and survey platforms: Officevibe, Typeform;

Personnel development systems: Coursera for Business, LinkedIn Learning.

In today's rapidly evolving digital transformation environment, not only technologies are changing, but also leadership approaches. Table 7.1 illustrates the key differences between traditional and digital leadership across five criteria that define management style, tools, and values.

Table 7.1. - Differences between a traditional and a digital leader

Criteria	Traditional leader	Digital leader
Leadership style	Ієрархічний	Facilitating, supportive
Concentration	Under control	On trust and autonomy
Tools	Паперова документація, офлайн-наради	Cloud services, task trackers, video conferencing
Management model	Command and administrative	Agile (Agile, Scrum)
Priority	Process	People, innovation, speed of change

Challenges for the Digital Leader

Leaders in digital teams face a number of challenges:

1. **Lack of personal contact** → difficulties with motivation;
2. **Digital overload** → the need to regulate digital interaction;
3. **Cultural diversity of teams** → the necessity for cross-cultural competence;
4. **High pace of change** → continuous learning and readiness for transformation.

Digital leadership is not just about technological awareness. It is the ability to create an environment where the team is motivated, flexible, adaptive, innovative, and effective. Successful digital leaders combine strategic vision with a deep understanding of human nature, foster a digital culture, and serve as agents of change within their organizations.

Digital Leadership Case Studies: Global and Ukrainian examples

1. *Jeff Bezos (Amazon).* Jeff Bezos built Amazon as a digital-first company focused on customer centricity, innovation, and speed. He implemented a culture of experimentation and data-driven decision-making, which enabled Amazon to become a global giant in e-commerce, cloud computing (AWS), and logistics.

2. *Satya Nadella (Microsoft).* Under Nadella's leadership, Microsoft pivoted toward cloud services, open-source software, and artificial intelligence. He emphasized the importance of empathy in

leadership, which helped transform the corporate culture and enhance the company's innovation potential.

3. *Elon Musk (Tesla).* Elon Musk, CEO of Tesla, became a symbol of digital leadership by introducing cutting-edge technologies into the traditional automotive industry. He created a software-centric company built on autonomous driving and over-the-air (OTA) updates. Musk fosters a culture of rapid experimentation, agility, and ambitious goals, which allowed Tesla to pioneer electric vehicles and scale digital services for customers.

4. *Reed Hastings (Netflix).* Leadership through business model transformation. Under Reed Hastings, Netflix evolved from a DVD rental service into a global streaming giant. Hastings emphasized the use of big data for content personalization and decision-making, as well as the development of a culture of innovation and team autonomy. This digital approach allowed Netflix not only to adapt to a fast-changing market but also to become a world leader in entertainment.

5. *Steve Jobs, Tim Cook (Apple).* Leadership in digital product and service ecosystems. Under Steve Jobs and later Tim Cook, Apple created a holistic digital ecosystem integrating hardware, software, and services (App Store, iCloud, Apple Music). Apple's leaders emphasize design, user experience, and innovation, which ensures a high level of customer loyalty. Apple's digital leadership lies in the ability to constantly innovate products and expand its ecosystem while adapting to new technological trends.

6. *Oleksandr Dubilet (Monobank).* Oleksandr Dubilet, co-founder and former chairman of Monobank, built Ukraine's first fully digital bank without physical branches. He fostered a culture of fast and agile teams that actively adopt new technologies and are highly customer-focused. Dubilet's digital leadership helped Monobank quickly earn the trust of millions of users.

7. *Max Levchin (Grammarly).* Max Levchin, co-founder of Grammarly, led a team that created a successful IT product for automated text checking. His leadership approach includes flexibility, support for innovation, and the use of digital tools for remote work, which helped Grammarly become a global leader in its segment.

8. *Yaroslav Kachmar (Jooble).* Yaroslav Kachmar leads Jooble – an international job search engine that actively uses digital technologies to grow its business. He focuses on team autonomy, rapid development cycles, and leveraging analytics to improve the product, which enabled the company to successfully compete in the global market.

TEST QUESTIONS:

1. What are the main principles and strategies that contribute to effective collaboration within a project team?

2. How are the roles and responsibilities of team members defined to achieve optimal levels of collaboration?

3. What tools and methods are used to improve communication and collaboration among project team members?

4. How is conflict managed within the project team, and how can conflicts be overcome to maintain effective collaboration?

5. How is the effectiveness of collaboration within a project team assessed, and what measures are taken for its continuous improvement?

6. How is an innovation culture cultivated within a team, and why is it important for project success?

7. What methods and approaches can be used to encourage suggestions and ideas from team members?

8. How is the process of evaluating and selecting innovative ideas for implementation in project activities organized?

9. How can leadership support and stimulate an innovation culture within the team?

10. How is the effectiveness of supporting an innovation culture within the team assessed, and what measures can be taken to enhance it?

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