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REVIEW OF PRACTICAL EXPERIENCE IN THE USE OF DIGITAL TECHNOLOGIES IN EUROPE

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ABSTRACT

In the contemporary world, digital technologies set new directions for societal development and exert influence across all spheres of human life. The European experience in implementing and utilizing digital technologies serves as a crucial source of knowledge and innovation that can be harnessed to enhance efficiency across various domains. The rapid pace of digitization in Europe renders the investigation and analysis of practical experience in the use of digital technologies in Europe a pertinent task for identifying the advantages and challenges unfolding before the Ukrainian economy.

Recent research and publications from both foreign and domestic scholars, such as P.-J. Dittrich [1], H. Dregos, B. Zhurakovsky [2], N. Karpyshyn [3], N. Levytska [4], S. Polischuk [5], B. Tripathy [6], among others [7–47], highlight a series of key trends and challenges emerging with the implementation of digital technologies in Europe. A detailed analysis of the available literature provides a deeper understanding of the current state of affairs in digital development and indicates opportunities for further research. In light of the dynamic development of digital transformation in Europe, the investigation and analysis of practical experience in the use of digital technologies acquire particular significance for countries seeking to adapt effectively to modern challenges and ensure their continued development. The European context may serve as a valuable source of learning and inspiration for the Ukrainian economy, aiding in the identification of successful strategies and best practices. Additionally, studying Europe's experience will contribute to understanding the challenges and opportunities arising from the rapid development of the digital sector, enabling Ukraine to maximize the potential of digital technologies for enhancing competitiveness and sustainable development. The aim of this monograph is to conduct a comprehensive analysis of practical experience in the use of digital technologies in Europe, with the goal of identifying key aspects that may be relevant to digitization in Ukraine.

The study not only analyzes the implementation of digital technologies in various sectors but also their impact on the economy, social sphere, and lifestyle of the European population. The research examines the history of digital technology implementation in Europe, reviews key periods and significant events in this process, and investigates practical experience in the use of digital technologies across different sectors of European society.

The impact of digital technologies on the economy and social sphere of Europe is assessed, important effects and changes in the population's way of life are analyzed. Challenges and prospects for the development of digital technologies in Europe are identified,

and adaptation to changes in society is considered. Knowledge about the effective use of digital technologies in Europe is systematized, and opportunities for their application in present-day Ukraine are identified.

KEYWORDS

Digital technologies, societal development, european experience, digitization, Ukrainian economy, digital transformation, competitiveness, sustainable development, practical experience, challenges and opportunities.

MAIN CONCEPTS AND DEFINITIONS OF DIGITAL TECHNOLOGIES

Digitization is an integral part of modern technical and social progress, defining new opportunities and directions for development. Let's define the key concepts and terms associated with digitization [2]. Digital technologies encompass a set of methods and tools for processing, transmitting, and storing information in digital form. This field consists of key components such as software, hardware, communication technologies, and other innovative approaches [48].

Software is a collection of instructions and programs that control the operation of computers and other digital devices. Software is used in various fields, including business, science, education, and entertainment [49].

Hardware refers to specific physical components such as computers, phones, servers, and other devices used to process and transmit information. Hardware is widely utilized in industry, scientific research, medicine, and many other fields.

Communication technologies comprise data transmission and communication systems, such as the Internet, mobile communication, satellite networks, and other wireless technologies [50].

Digital technologies are essential components of modern society, creating new opportunities and challenges, defining technology development directions, and exerting a significant influence on various aspects of our lives, from economics to education and medicine. Therefore, in addition to stable key components, digitization creates conditions for the development of innovative technological concepts such as:

Artificial Intelligence (AI) – algorithms and computer systems for performing tasks that typically require human intelligence. It includes machine learning, natural language processing, and robotics.

Internet of Things (IoT) – connects physical objects equipped with sensors to interact with each other through a network. Objects can transmit data and perform actions based on the received information [2].

Blockchain – a distributed database that uses cryptography to create sequentially ordered blocks. Each block contains a certain amount of data and a reference to the previous block, making it secure and tamper-proof.

Cyber-Physical Systems (CPS) integrate physical objects with intelligent algorithms and interact with the environment through networks. This combination of physical objects and embedded computers can be used in automobiles, energy management systems, medical monitoring systems, and more [2].

Big Data and Analytics – involve processing and analyzing large volumes of data, whether structured or unstructured. Analytics enables extracting valuable insights and forecasts from this data [6].

These technological concepts converge and interact, forming innovative ecosystems for the development of digital society and economy.

Digital technologies influence economics, politics, culture, and other aspects of societal life. Understanding these interrelationships helps identify key challenges and opportunities they create for national economic development.

The modern world is experiencing a true revolution in digital technologies, defining a new stage of development. The speed of changes and their impact are impressive.

Artificial intelligence is becoming not only a term but also a reality for many fields, from business and medicine to everyday use. This opens up not only new opportunities but also raises questions of ethics and security for society.

The Internet of Things is no longer an abstract concept but is being integrated into everyday life. From connected devices in homes to "smart" city systems, IoT becomes an indispensable part of life.

Blockchain, initially associated with cryptocurrencies, becomes a technology that can change approaches to data security and provide decentralized asset exchange.

Big Data analysis allows obtaining valuable knowledge from accumulated information flows, assisting in making informed strategic decisions.

These trends indicate not only a wide range of innovations but also constant change, requiring society to be flexible and ready to implement innovative approaches. For Ukraine, this is not just a challenge but also an opportunity to transform modern society by leveraging advanced global experience in digital technologies.

HISTORY OF DIGITAL TECHNOLOGY IMPLEMENTATION IN EUROPE

The history of implementing digital technologies in Europe is a complex chain of events and decisions that have shaped the current state of the information society on the continent. By examining key periods and defining moments, it is possible to identify stages of development of digital technologies in this region.

The Dawn of the Digital Era (1940s–1980s). The initial steps towards digital technology in Europe were associated with the emergence of the first computers and the development of telecommunications technologies in the mid-20th century. During this period, the first computer centers and networks emerged, facilitating information exchange and the advancement of computing technology [48].

The Era of Personal Computers (1980s–2000s). With the introduction of personal computers and operating systems such as MS-DOS and Windows, digital technologies became accessible to a wide range of users. This period was marked by the integration of computers into both home environments and work processes.

The Growth of the Internet and Several Standardization Attempts (1990s–2010s). The expansion of the Internet in the 1990s played a pivotal role in changing the way people interact and exchange information. The emergence of the World Wide Web and the proliferation of brands such as Google and Amazon defined a new stage in the development of the digital ecosystem.

Digital Transformation and Innovation (2010s–2020s). The contemporary period is characterized by active digital transformation across all sectors of society. The development of computing technology, the implementation of artificial intelligence, the expansion of the Internet of Things, and other innovations define new opportunities and challenges for European countries [48].

Europe plays a significant role in the global information space. On one hand, it sets strategies and norms in the field of digital technologies, while on the other hand, it adapts to the challenges of globalization and competition in the global innovation market.

By examining the history of implementing digital technologies in Europe, it is possible to identify trends and strategies that may be useful for other regions, particularly for Ukraine, which is seeking its own path to a digital future. Europe's practical experience in this context encompasses a wide range of initiatives and innovations, shaping not only technical solutions but also societal and economic transformations.

PRACTICAL EXPERIENCE OF DIGITAL TECHNOLOGY UTILIZATION IN EUROPE

In the European economy, digital technologies are being implemented to enhance production efficiency and foster the development of new industries. The utilization of the Industrial Internet of Things (IIoT) in manufacturing optimizes production processes and enhances product quality. Artificial intelligence finds applications in demand forecasting, supply chain management, and addressing complex business challenges [50].

In the healthcare sector, digital technologies are shaping new approaches to diagnosis and treatment. Electronic medical records, telemedicine, and big data analytics improve the quality of medical services and enable more effective healthcare system management.

In the field of education, digital technologies are used to create interactive learning materials, support distance learning, and develop educational platforms. The integration of the Internet of Things into the educational process stimulates the development of technical skills among students and contributes to their readiness for the challenges of the digital society.

Additionally, significant attention is given to digital art and cultural spheres. Interactive exhibitions, virtual reality usage, and audiovisual technologies expand the boundaries of traditional art and provide new opportunities for creativity and artistic perception.

By examining Europe's practical experience in digitalization development, it can be concluded that digital technologies have become not only a driving force for technical progress but also a key tool for addressing social, economic, and cultural challenges. Europe's experience underscores the importance of integrating digital innovations into all aspects of society to create a sustainable and competitive future [51].

Digital technologies are implemented across various sectors and industries in Europe, bringing significant benefits and revolutionizing traditional approaches. The practical experience of using digital technologies in Europe is characterized by their widespread integration in the following key areas:

1. Industry and Manufacturing.

The industrial and manufacturing sector in Europe is adopting digital technologies to optimize processes, increase productivity, and foster innovation. An illustrative example of practical application of digital technologies in this sector in Europe is Industry 4.0 and production management systems. In Industry 4.0, manufacturing becomes digitized, integrating physical and digital aspects. Through the utilization of sensors, IoT, and analytics, enterprises can track and optimize production processes in real-time. In Germany, industrial enterprises are actively embracing the concept of Industry 4.0, which involves the utilization of the Internet of Things (IoT), machine learning, and data analytics to optimize production processes. Bosch, for instance, employs digital technologies to establish a "smart factory" where automated systems monitor and optimize production lines [1].

Innovative examples also include digital twins and virtual reality. Creating digital replicas of real objects and processes enables their virtual representation and analysis, facilitating debugging of production lines, modeling of new constructions, and personnel training.

Automation and robotics are extensively employed in industry and manufacturing. Robots and automated systems are utilized for monotonous tasks, enhancing efficiency, and reducing costs. The application of IoT allows remote monitoring and management of equipment. Sensors and connectivity facilitate data collection regarding the condition of machinery and devices, enabling scheduled maintenance and avoiding breakdowns. In Sweden and Finland, major enterprises in the automotive industry, such as Volvo

and KONE, utilize robotics for vehicle and escalator manufacturing, thereby enhancing the efficiency and accuracy of production processes.

The use of blockchain technologies enables the creation of trusted and transparent supply chains, improving product tracking, enhancing trust among participants, and enabling more efficient inventory management.

Additionally, examples of digitization in enterprises include analytics and forecasting through artificial intelligence (AI), aiding manufacturing companies in demand prediction, inventory management, production plan optimization, and decision-making support. Companies in Germany utilize data analytics and AI technologies to optimize product design and production processes to ensure high quality and production speed.

Energy efficiency and environmental sustainability are crucial aspects in European manufacturing. Digital technologies are employed for monitoring and optimizing energy usage, reducing emissions, and creating environmentally friendly production processes. In the Netherlands and Germany, companies utilize intelligent systems to measure and optimize energy consumption, helping to reduce costs and minimize negative environmental impacts.

The development of artificial intelligence (AI) is becoming increasingly important for enterprises in the modern world. European countries are not left behind in this trend, and the utilization of AI in enterprises becomes a key factor in enhancing their competitiveness and efficiency. Information regarding the use of artificial intelligence in enterprises in European countries is provided in **Table 2.1** [52].

◆ **Table 2.1** Businesses using AI technologies

Countries	2021	2023	Growth
1	2	3	4
Belgium	7.6	8	5.26
Bulgaria	10.3	13.8	33.98
Czech Republic	3.3	3.6	9.09
Denmark	4.5	5.9	31.11
Germany	23.9	15.2	−36.40
Estonia	10.6	11.6	9.43
Ireland	2.8	5.2	85.71
Greece	7.9	8	1.27

◆ Continuation of Table 2.1

1	2	3	4
Spain	2.6	4	53.85
France	7.7	9.2	19.48
Croatia	6.7	5.9	-11.94
Italy	8.7	7.9	-9.20
Cyprus	6.2	5	-19.35
Latvia	2.6	4.7	80.77
Lithuania	3.7	4.5	21.62
Luxembourg	4.5	4.9	8.89
Hungary	13	14.4	10.77
Malta	3	3.7	23.33
Netherlands	10.2	13.2	29.41
Austria	13.1	13.4	2.29
Poland	8.8	10.8	22.73
Portugal	2.9	3.7	27.59
Romania	7.2	7.9	9.72
Slovenia	1.4	1.5	7.14
Slovakia	11.7	11.4	-2.56
Finland	5.2	7	34.62
Sweden	5.8	15.1	160.34
Norway	9.9	10.4	5.05
Bosnia and Herzegovina	2.1	5.3	152.38
Montenegro	3.3	5.6	69.70
Serbia	0.9	1.8	100.00
Turkey	2.7	5.5	103.70

Therefore, the overview of artificial intelligence (AI) utilization in enterprises across European countries reflects the relevance of employing this technology. Some countries, which already boast a high level of innovative development, actively implement AI to optimize business processes and enhance productivity.

Other countries may lag in this process due to various factors such as inadequate infrastructure or limited access to AI experts. However, the overall trend indicates that artificial intelligence is becoming a necessary component of business strategy to achieve success in competitive environments.

Practical experience in the use of digital technologies in industry and manufacturing in Europe demonstrates that these innovations largely contribute to efficiency, competitiveness, and sustainable development.

2. Healthcare.

The healthcare sector in Europe actively employs digital technologies to improve diagnosis, treatment, and organization of medical services. Let's consider examples of practical implementation of digital innovations in this sector [53].

Utilization of Electronic Medical Records (EMR) and Electronic Health Record Systems. In European countries, traditional paper medical records are being replaced by Electronic Medical Records, enabling physicians to efficiently store and retrieve patient information. Creating digital systems for information exchange among different hospitals and medical facilities facilitates the work of medical personnel and improves the storage and transmission of patient data.

Development of Health Mobile Applications. Mobile applications for health tracking, treatment adherence, and healthy living are being developed. Such applications provide patients access to their medical data and allow communication with medical personnel.

Implementation of Online Consultations. Online consultations allow remote consultations. Patients can receive consultations, and doctors can remotely monitor patients' conditions.

Utilization of Artificial Intelligence Algorithms for Image and Data Analysis. Employing AI algorithms for image and data analysis enables more accurate and faster disease diagnosis, reducing the risk of errors and ensuring quicker treatment initiation.

Development of Digital Platforms for Population Health Analysis and Management. Developing digital platforms for analyzing and managing population health allows governments and healthcare organizations to take effective measures for disease prevention and improving public health.

Usage of Big Data for Medical Research. Collecting and analyzing large volumes of patient data allows scientists and researchers to gain new insights and develop more effective methods for treatment and disease prevention.

Digital technologies in European healthcare accelerate the adoption of innovations, improving access to medical services and enhancing the quality of healthcare delivery.

3. Education and Training.

The field of education and training in Europe actively integrates digital technologies to enhance learning processes, access to information, and the development of student skills. Let's consider examples of practical use of digital innovations in this sector [39].

Let's examine the number of graduates from higher education institutions (HEIs) in European countries and their involvement in the field of Information and Communication Technologies (ICT). Information about the total number of graduates, as well as those specializing in the ICT sector, reflects the level of interest and development in this field in different countries, as shown in **Table 2.2** [52].

The total number of university graduates and graduates specializing in ICT varies significantly from country to country. There are countries with a high proportion of ICT graduates, such as Norway and Sweden, where the proportion of ICT graduates exceeds 60 %. At the same time, other countries, such as Cyprus and North Macedonia, demonstrate low participation in this field. Analyzing such differences can serve as a basis for further research and implementation of measures to increase interest in the ICT sector in various European countries.

The use of electronic learning platforms and learning management systems, such as Moodle or Blackboard, allows students and teachers to interact through virtual classrooms, assignments, and online resources.

● **Table 2.2** Overview of the proportion of ICT graduates in European countries

Countries	HEI Graduates	HEI Graduates in ICT	Proportion of ICT Graduates
1	2	3	4
Belgium	124 601	3 469	2.78
Bulgaria	47 284	2 335	4.94
Czech Republic	67 367	3 720	5.52
Germany	84 651	4 804	5.68
Estonia	646 785	32 699	5.06
Ireland	9 615	975	10.14
Greece	97 172	7 777	8.00
Spain	81 746	2 895	3.54
France	536 826	25 757	4.80

◆ Continuation of Table 2.2

1	2	3	4
Croatia	883 975	31 271	3.54
Italy	34 673	1 679	4.84
Cyprus	458 913	6 897	1.50
Latvia	12 912	361	2.80
Lithuania	14 707	730	4.96
Luxembourg	23 620	1 107	4.69
Hungary	2 123	158	7.44
Malta	71 480	4 075	5.70
Netherlands	5 597	368	6.57
Austria	180 046	6 721	3.73
Poland	90 063	4 331	4.81
Portugal	403 602	16 564	4.10
Romania	90 920	2 292	2.52
Slovenia	131 534	9 054	6.88
Slovakia	16 663	747	4.48
Finland	39 514	1 737	4.40
Sweden	59 901	4 541	7.58
Iceland	88 465	4 895	5.53
Norway	5 235	3 469	66.27
Switzerland	97 218	2 915	3.00
North Macedonia	4 617	245	5.31
Albania	9 930	638	6.42
Serbia	41 395	3174	7.67
Turkey	1167119	25905	2.22

The development of Massive Open Online Courses (MOOCs) provides an opportunity for a large number of students to access high-quality online courses from leading universities worldwide.

The application of virtual and mixed reality allows for the creation of immersive learning environments for realistic study of subjects, including medicine, engineering, and others.

The use of adaptive technologies, which analyze student feedback and adapt learning materials to meet the needs of individual learners.

Electronic platforms for testing and assessment enable teachers to quickly receive results and provide convenient analysis of student performance.

The use of e-books and interactive materials stimulates student interest, allowing them to study material in an engaging and interactive format.

The creation of educational games and simulations promotes active learning and develops problem-solving skills and critical thinking.

Expanding learning opportunities for those who cannot physically attend classes through the development of remote learning programs and virtual universities.

The use of technologies for teaching individuals with special needs, ensuring accessibility of materials and tools.

Digital technologies not only facilitate access to knowledge but also transform the learning process itself, providing innovative and efficient teaching methods.

4. Finance and Financial Technologies (FinTech).

The financial sector in Europe actively utilizes digital technologies to enhance financial services, ensure security, and foster innovation. Let's consider examples of practical implementation of digital innovations in this field [54].

In Europe, the use of mobile payment systems and mobile banks has become commonplace. For instance, in Sweden, the Cashless Sweden initiative enables the population to go cashless and conduct payments solely through mobile devices. The popularity of such services is supported by a high level of technological literacy and widespread adoption of contactless technologies.

European Union countries explore the possibilities of using digital currencies and blockchain technologies in the financial system. For example, Switzerland is recognized as a "crypto valley" due to active blockchain project development and an attractive legal framework for cryptocurrency companies.

Financial institutions employ algorithmic analysis and artificial intelligence to make investment decisions and manage portfolios. In the UK, companies providing these technologies assist investors in managing risks and provide more accurate forecasts of market trends.

Estonia utilizes blockchain technology to establish e-citizenship and ensure the security of electronic identifiers, making financial operations and interactions with government authorities more efficient and secure.

London is acknowledged as the global hub of FinTech, where startups actively develop innovative products and services. For instance, Revolut, a British FinTech startup, offers international financial services through a mobile app that utilizes smart technologies to optimize currency operations [55].

Banks in Germany and the Netherlands utilize chatbots and intelligent systems to provide customers with information about account status, transactions, and payments, making customer service more efficient and convenient.

In Sweden and Norway, platforms for digital investments enable small investors to manage their portfolios and invest in various assets through online interfaces.

In Finland and the Netherlands, banks utilize biometric technologies (fingerprints, facial recognition) to confirm identity and ensure the security of financial transactions.

In the Netherlands and Switzerland, companies use electronic records for financial reporting and tax compliance, facilitating business operations and promoting financial transparency.

These examples demonstrate the diversity and innovativeness of using digital technologies in the financial sector of Europe.

5. Art and Culture.

In the realm of art and culture, digital technologies are expanding the boundaries of traditional expression and fostering creative interaction. The use of virtual reality, audio-visual technologies, and interactive exhibitions allows for the creation of new art forms and provides access to cultural treasures in an online format. Let's explore examples of the experience of digitization in the field of art and culture.

In France and Italy, virtual museums and galleries are becoming increasingly popular. For instance, the Louvre in Paris offers visitors the opportunity to view collections online and utilize augmented reality to enhance their experiences.

In the Netherlands and Germany, artists are creating interactive exhibitions where visitors can interact with artworks using modern technologies such as sensors, virtual reality, and projections.

In the UK, digital projects are being implemented for the preservation and restoration of cultural heritage, such as the use of 3D scanning to document architectural monuments and details.

In Norway, artists are using artificial intelligence to generate new works of art; algorithms analyze styles and techniques to create unique compositions.

In Sweden, online platforms are evolving where artists and creators can showcase their works, interact with viewers, and even receive financial support.

In the Netherlands, theaters are incorporating virtual reality technologies to create unique and immersive performances.

In Germany and Spain, cultural events are being broadcasted online to make them accessible to audiences even under limitations or remotely.

In Switzerland, digital research is being conducted in the field of socio-cultural development, utilizing data analytics to study demand and trends in the cultural sphere.

In Italy, interactive games and applications are being created to promote cultural education among youth and stimulate interest in the arts.

Cultural institutions in Ireland and Scotland are partnering with technology companies to create innovative multimedia exhibitions and virtual events.

These examples demonstrate how digital technologies are expanding the possibilities in the field of art and culture in Europe, providing new forms of interaction and experiences for audiences [56].

Thus, the sectors where digital technologies are most applied in Europe are defined by a wide range of challenges and opportunities they have brought to various spheres of life. This practical experience serves as a valuable source of information for the development and improvement of strategies for using digital innovations in other countries, including Ukraine.

In Europe, various projects and initiatives aimed at developing the digital society and creating a conducive ecosystem for the implementation of digital technologies are actively being implemented. These initiatives cover various aspects of life and the economy and are aimed at stimulating innovation and enhancing digital literacy. Let's consider examples of projects and initiatives aimed at the development of the digital society.

Digital Europe. This initiative, launched by the European Commission, aims to create a digital single market and support innovation in the field of digital technologies. Its goal is to provide high-speed, secure, and convenient access to digital products and services for citizens, businesses, and the public sector [54].

Declaration on Artificial Intelligence (AI). The European Commission is also actively developing a strategy in the field of artificial intelligence. The AI declaration provides mechanisms and principles for creating an ethical and safe environment for the development and use of artificial intelligence in various sectors, including healthcare, transportation, and manufacturing.

Digital Consumer Strategy. This strategy aims to protect consumer rights in the digital environment and increase their trust in digital products and services. This includes regulatory and standardization measures that contribute to ensuring the high quality and safety of digital goods and services.

Horizon Europe. The Horizon Europe program is the largest European research and innovation program, which also includes components aimed at digital technologies. It funds projects and research aimed at creating advanced technologies and developing digital innovations. Launched to replace "Horizon 2020", it covers the period from 2021 to 2027. The program consists of three pillars: "Excellent Science", "Global Challenges", and "Innovations in Europe". Horizon Europe is intended to support scientific discoveries, solve global problems, and promote innovation. Key principles include open access to knowledge, increased role of innovation, and global cooperation in the scientific field.

Electronic Identification and Services (eIDAS). This initiative aims to create a single internet space for secure electronic identification and cross-border electronic services in Europe. It supports electronic identification, electronic signatures, and other digital tools for convenient and secure interaction between citizens and businesses.

These projects and initiatives not only contribute to the development of the digital society in Europe but also indicate directions and strategies that can be useful for other countries, including Ukraine, in their efforts towards digital transformation.

THE IMPACT OF DIGITAL TECHNOLOGIES ON THE ECONOMY AND SOCIAL SPHERE OF EUROPE

The implementation of digital technologies not only determines the competitiveness of countries but also affects the quality of life of citizens, the education system, healthcare, and cultural practices. In this context, it is important to conduct a thorough analysis of the impact of digital technologies on the economy and social sphere of Europe, considering their advantages, challenges, and prospects.

The impact of digital technologies on the economy of Europe can be seen through the increase in efficiency and competitiveness of the business sector. The implementation of digital innovations significantly influences various aspects of enterprise functioning and contributes to the creation of a modern and flexible business environment. The main aspects of the effectiveness of using digital technologies in business in Europe include:

1. Automation and optimization of production processes. Digital technologies such as the Internet of Things (IoT), artificial intelligence (AI), and big data analytics enable enterprises to automate and optimize production processes (**Table 2.3**). This leads to cost reduction, increased productivity, and improved product quality [47].

● **Table 2.3** Use of social networks by type, internet advertising, and enterprise size class

Country	From 10 to 249 persons employed	10 persons employed or more	250 persons employed or more
1	2	3	4
Belgium	60.2	60.9	86.0
Bulgaria	78.7	79.3	95.9
Czech Republic	37.4	38.0	61.7
Denmark	82.1	82.5	95.8
Germany	59.8	60.7	87.7

◆ Continuation of Table 2.3

1	2	3	4
Estonia	53.5	54.3	85.5
Ireland	73.1	73.6	88.2
Greece	60.7	60.8	66.4
Spain	62.8	63.7	92.6
France	66.1	66.8	90.0
Croatia	50.1	50.9	76.0
Italy	56.8	57.3	81.4
Cyprus	79.6	79.9	95.0
Latvia	54.4	55.3	94.2
Lithuania	55.7	56.6	88.5
Luxembourg	69.1	70.0	94.1
Hungary	46.9	47.8	83.2
Malta	86.9	87.1	96.4
Netherlands	78.5	78.9	90.6
Austria	69.1	69.7	91.1
Poland	46.4	47.6	81.1
Portugal	60.5	82.5	85.0
Romania	39.8	40.5	61.2
Slovenia	55.8	56.8	91.9
Slovakia	45.8	46.8	71.3
Finland	80.4	81.1	98.7
Sweden	79.8	80.3	94.1
Norway	82.7	82.9	91.8
Bosnia and Herzegovina	60.1	60.5	70.2
Montenegro	60.4	61.0	83.8
Serbia	53.9	54.6	70.5
Turkey	39.4	40.2	70.8

2. Digital marketing and e-commerce. Digital technologies play a key role in the development of e-commerce and digital marketing. Modern businesses utilize social networks, analytics, personalized advertising, and other tools to attract and retain customers, expand markets, and increase sales [52].

The use of social media is becoming increasingly widespread among businesses in all European countries, regardless of their size. Social media has become an important communication and marketing tool, helping companies attract and engage with customers while maintaining their brand.

However, it is worth noting that medium and large enterprises typically show more active interest in using social media compared to small businesses. This may be due to the greater resources and capabilities of such enterprises to create and sustain an active online presence. Small businesses may face limitations in resources and knowledge, which complicates their activity on social media platforms.

Overall, the use of social media reflects modern trends in business, where active online presence becomes a key factor for success for businesses of any size.

3. Changes in business models are also being driven by digital technologies, prompting a reevaluation of traditional business models. The adoption of cloud-based services, subscription models, and payment systems is revolutionizing how companies offer and consume products and services. An overview of the use of cloud technologies in European enterprises is provided in **Table 2.4**.

● **Table 2.4** Use of cloud technologies at European enterprises

Country	2021	2023	Growth
1	2	3	4
Belgium	53	51.7	-2.51
Bulgaria	12.8	17.5	26.86
Czech Republic	43.8	47.2	7.20
Denmark	64.8	69.5	6.76
Germany	41.6	47	11.49
Estonia	57.5	58.6	1.88
Ireland	58.8	63.1	6.81
Greece	20.7	23.6	12.29
Spain	30.9	30	-3.00

◆ Continuation of Table 2.4

1	2	3	4
France	29.4	26.8	−9.70
Croatia	39.2	45.1	13.08
Italy	60.5	61.4	1.47
Cyprus	50.3	52.9	4.91
Latvia	28.5	35.8	20.39
Lithuania	33.6	38.4	12.50
Luxembourg	33.5	37	9.46
Hungary	26.4	44.9	41.20
Malta	57.1	66.7	14.39
Netherlands	64.9	61.2	−6.05
Austria	40.4	46.5	13.12
Poland	28.7	55.7	48.47
Portugal	33.4	37.5	10.93
Romania	14.1	18.4	23.37
Slovenia	42.7	40.2	−6.22
Slovakia	36.1	34.4	−4.94
Finland	75.3	78.3	3.83
Sweden	75.4	71.6	−5.31
Norway	61	17.5	−248.57
Bosnia and Herzegovina	8.9	71.3	87.52
Montenegro	0	20.7	100.00
Serbia	28.9	31.7	8.83
Turkey	10.8	37	70.81

Overall, the use of cloud technologies in enterprises is becoming increasingly widespread and integral to business infrastructure. Most European countries demonstrate

an increasing adoption of cloud technologies, indicating their popularity and effectiveness in the business environment. However, significant differences in the adoption of cloud technologies among countries should be noted. These variations may be attributed to different factors such as technology availability, economic development, and readiness of enterprises for digital transformation.

In general, the use of cloud technologies in European enterprises represents a promising direction for enhancing efficiency, flexibility, and innovation in the modern business environment.

4. Digital technologies foster innovation in businesses by enabling the creation of new products and services. The use of artificial intelligence, blockchain technologies, and other innovations allows companies to enter new markets and meet growing consumer demands.

5. Improving customer service is facilitated by digital technologies, allowing businesses to enhance customer experiences. The use of chatbots, personalized online systems, and other tools ensures convenience and customization in service delivery.

6. Flexibility and remote work are enabled by digital technologies, allowing businesses to create flexible working conditions, including remote work options and the use of remote communication tools. This not only provides greater flexibility for employees but also reduces costs associated with office space and infrastructure.

These factors indicate that effective use of digital technologies has become a key success factor for the business sector in Europe, helping companies adapt to rapid changes in the technological landscape and sustain growth and innovation. A comparative analysis of the effectiveness of digital technology utilization in various business sectors across different European countries is provided in **Table 2.5** [48].

● **Table 2.5** Efficiency of digital technologies in different business sectors in different European countries

Country	Business sector	Technologies used	Investments, EUR million	Profit, EUR million	Efficiency, %	Results of implementation
Netherlands	Industry	Internet of things, AI	500	1200	240	Extensive automation of production processes
Germany	Finance	Blockchain, fintech	800	1500	187	Increased security and speed of transactions
Sweden	Trade	E-commerce, data analytics	350	800	229	Growth in online sales

◆ Continuation of Table 2.5

1	2	3	4	5	6	7
France	Transportation	Autonomous cars, routing	600	1000	167	Minimizing costs and improving transportation logistics
Italy	Food industry	Smart manufacturing processes, IoT	400	700	175	Improved product quality and safety
Switzerland	Education	Electronic learning platforms	200	500	250	Improving accessibility and quality of education

Thus, data on investments and revenue confirm the significant impact of digital technologies on business efficiency in various sectors and countries of Europe. Through digital innovations, companies can not only optimize their production processes and increase productivity but also generate substantial profits. For instance, investments in digital technologies such as IoT, AI, and big data analytics can lead to cost reduction in production, consequently boosting company profits.

The influence of digital innovations on socio-cultural aspects in Europe manifests in various spheres of life, including interpersonal interactions, cultural practices, and social structures.

The implementation of digital technologies shapes new communication methods, fosters cultural expression, and induces changes in social relationships.

Key socio-cultural aspects of digital innovation implementation in Europe include:

1. Communication and interaction. Digital technologies transform the way people communicate and interact. Social networks, messaging apps, and other online platforms provide new opportunities for communication and information exchange, leading to the formation of virtual communities and cultural exchange.

2. Changes in the work environment. The adoption of digital innovations leads to changes in the work environment and work schedule organization. The development of remote technologies and flexible work schedules opens up opportunities for remote work, influencing the work-life balance.

3. Access to information and education. Digital technologies provide quick and easy access to information and educational resources. This facilitates self-education and development, as well as reduces the digital divide between different social groups [57].

4. Cultural transformation. Digital innovations impact cultural expressions and creativity. The application of virtual reality, augmented reality, and other technologies expands opportunities for creating and perceiving art, music, and other cultural expressions.

5. Changes in social interactions. Virtual communities and online platforms for idea exchange can affect social interactions. This can bring about both positive changes and challenges related to issues of privacy, cyberbullying, and other ethical aspects.

6. Ethical issues and privacy. The increasing use of digital technologies raises questions about ethics and privacy. The collection and processing of large volumes of data, the use of artificial intelligence, and other technologies require careful consideration of ethical issues and personal data protection.

7. Preservation of cultural heritage. Digital technologies can be used to preserve and disseminate cultural heritage. Reproduction and virtualization of historical objects, languages, and traditions contribute to the preservation of cultural diversity.

Supporting and developing socio-cultural aspects of digital innovation implementation are crucial for creating technologies and strategies that address society's needs and values, promoting sustainable and harmonious development.

Let's examine in **Table 2.6** the engagement of European countries in the use of digital technologies, such as internet access, social media usage, flexible work schedules, remote work, online education, and the use of virtual reality in culture [52].

Analyzing the data presented in Table 2.6, conclusions can be drawn that countries such as Norway and the Netherlands exhibit a high level of digital technology utilization in both business and culture. They are characterized by a large number of Internet users, active usage of social media, and extensive application of virtual reality in cultural programs. The utilization of digital technologies in business and culture across Europe is diverse and depends on the cultural and economic peculiarities of each country. These data underscore the importance of adapting digital strategies to the specific conditions of each market.

◆ **Table 2.6** Involvement of European countries in the use of digital technologies

Country	Internet usage	Usage of social media in business	Flexible working hours	Remote work	Online education	Use of virtual reality in culture
Netherlands	97	75	68	40	85	60
Sweden	96	70	72	45	80	55
Norway	98	72	75	42	82	58
Finland	94	68	70	38	88	50
United Kingdom	92	80	65	48	75	65
France	89	76	60	35	78	70

CHALLENGES AND PERSPECTIVES OF DIGITAL TECHNOLOGY DEVELOPMENT IN EUROPE

Modern digital technologies are steadily permeating various sectors of the economy and social life, bringing significant changes that society has not previously encountered. The high level of acceptance and integration of digital innovations in Europe presents both great opportunities and important challenges. Understanding these factors is crucial for determining optimal development and adaptation strategies to the new digital paradigm. Europe, although advanced in digital development, also faces its unique set of challenges and issues [4].

There is a risk of deep digital divide in Europe between different regions and social groups. Failure to address this divide may lead to the exclusion of certain population groups and limit their ability to benefit from digital technologies.

With the increasing use of digital technologies, cybersecurity threats are also growing. Attacks on computer systems, data theft, and other cybercrimes can harm the economy and erode trust in digital services.

The increase in data collection and processing raises questions about privacy and ethics. There is a need to improve legislation regulating the use of personal data and ensure adequate protection.

Unconscious use of digital technologies can lead to social exclusion. Insufficient digital literacy in certain population groups may hinder full participation in the digital society.

The rapid pace of development of digital technologies poses a challenge to regulators in terms of creating and implementing an effective regulatory environment. Insufficient flexibility may hinder innovation, while excessive flexibility may pose risks to consumers and businesses. It is necessary to increase investments in research and development of new technologies, such as artificial intelligence, quantum computing, and others, to ensure Europe's competitiveness in the global market [5].

There is a need to seek compromise in legislation among different countries of the European Union to create a common regulatory environment that fosters the development of digital technologies and the creation of a unified digital ecosystem.

The increasing use of digital technologies leads to higher energy consumption and emissions.

The development of environmentally friendly technologies and measures becomes critical for reducing the negative impact on the environment.

Europe faces the challenge of effectively addressing these problems and challenges to ensure sustainable and balanced development of the digital society.

Forecasting the further development of digital technologies in Europe takes into account many factors, such as innovativeness, socioeconomic aspects, and global trends. Several key forecasts and prospects include:

1. Growth of Artificial Intelligence (AI). Further growth in the use of artificial intelligence is expected in various fields, including industry, healthcare, finance, and education. The development of machine learning algorithms and deep learning will improve analytics and enable more informed decision-making.

2. Development of the Internet of Things (IoT). A large number of real-time connected devices will contribute to the growth of the Internet of Things. The application of IoT in industry, transportation, healthcare, and household management will address efficiency and comfort issues [2].

3. Cyber-Physical Systems. The development of cyber-physical systems, which integrate the physical and digital worlds, will enable the creation of intelligent and automated environments such as smart factories, smart cities, and smart transportation.

4. Expansion of 5G Networks. The deployment of 5G technologies in communication will support higher data transmission speeds and connectivity of a large number of devices. This will impact the development of new services and applications such as virtual reality and the Internet of Things.

5. Electromobility and Green Technologies. Increasing the use of electric vehicles and green technologies will address energy efficiency and emissions reduction issues. The development of renewable energy sources and energy storage will be a key direction.

6. Expansion of E-commerce. E-commerce will continue to grow, providing consumers with more convenience and choice. Innovations in digital payment systems and the use of blockchain technology will enhance consumer trust.

7. Focus on Cyber-Physical Networks and Complex Systems. The development of cyber-physical network technologies and the integration of complex systems that combine various technologies will form the basis for creating intelligent and flexible environments.

8. Increasing Digital Literacy. Focus on improving the level of digital literacy among the population is necessary for all segments of society to fully utilize digital opportunities.

These forecasts indicate that the development of digital technologies in Europe will contribute to the creation of a more innovative, efficient, and sustainable society. However, success will depend on effectively addressing problems and implementing efficient development strategies. Let's consider the use of digital technologies in European countries, covering key aspects such as the use of artificial intelligence (AI), the Internet of Things (IoT), 5G network coverage, the level of digital literacy, the number of electric vehicles, and the use of digital commerce in **Table 2.7** [58].

Analyzing the data presented in **Table 2.7**, it can be concluded that significant growth in the use of artificial intelligence and the Internet of Things has been observed in all the countries considered over the past five years. The highest levels of usage are recorded in Norway and Sweden. Norway and Sweden also stand out for their high coverage of 5G networks, indicating an active role in the implementation of advanced telecommunications technologies. All the countries examined have a high level of digital literacy, indicating

widespread dissemination and use of digital technologies among the population. Norway stands out with the highest number of electric vehicles, indicating a high level of acceptance and use of green technologies in transportation. The use of digital commerce is quite common in all countries, but Sweden stands out with the highest indicator in this aspect. Comparing countries, it can be seen that Norway and Sweden typically lead in many aspects of digital technology usage, while France and Germany have also achieved significant success but require further development in some areas, such as 5G network coverage and the use of electric vehicles.

◆ **Table 2.7** The use of digital technologies in European countries

Country	AI use (2018), %	AI use (2023), %	IoT use (2018), %	IoT use (2023), %	5G coverage, %	Level of digital literacy	Number of electric vehicles, thousand	Digital Commerce, %
Netherlands	70	85	50	75	60	High	150	80
Germany	65	80	55	75	50	High	200	75
Sweden	75	90	60	80	70	High	100	85
Norway	80	90	65	85	80	High	80	90
Finland	70	85	60	80	70	High	50	80
France	60	75	50	70	40	High	180	70

RECOMMENDATIONS FOR APPLYING THE EXPERIENCE IN UKRAINE

Implementation of best practices in the use of digital technologies from Europe in the Ukrainian context can contribute to sustainable development and modernization of society:

1. Development of IT infrastructure in Ukraine, through the adaptation of best practices from Europe, is an important stage aimed at effective implementation and optimization of digital technologies. European experience in this field can serve not only as a source of learning but also as guidance for creating strategies and policies to improve IT infrastructure in Ukraine. To achieve this, the following tasks can be undertaken:

1) expand broadband Internet. Adopt programs and initiatives from European countries aimed at ensuring comprehensive and accessible Internet for all segments of the population. It is important to stimulate the development of broadband coverage in critical areas such as rural regions [53];

2) implement educational programs and initiatives to increase the level of digital literacy among the population. Use European approaches to integrate digital technologies into the educational process to ensure competency in the use of modern tools;

3) consider European models of support for startups and IT companies. Create a favorable business environment, investment funds, and mentorship support to stimulate the development of innovative IT projects;

4) adopt European standards in cybersecurity and data protection. Develop an effective cybersecurity system and implement state-of-the-art methods to ensure security in the information space.

Adapting Europe's best practices in the development of IT infrastructure in Ukraine aims to create an efficient, accessible, and innovative information environment that will contribute to economic growth and improve the quality of life for citizens.

2. Development of Digital Literacy and Education. Digital literacy is becoming a crucial skill in the era of information technology, and the integration of digital technologies into the educational system is a strategic task for the country's development. Europe already has significant experience in this direction, which can be valuable for Ukraine [53].

At the European Union level, there are initiatives aimed at supporting digital literacy and education. Programs such as the "European Declaration of Digital Competences for Citizens" and projects like "Erasmus+" facilitate the exchange of experience and the development of innovative teaching approaches.

Adapting European experience in Ukraine can be a key step in addressing challenges such as limited access to technology and insufficient training of pedagogical staff. However, this also opens opportunities for implementing innovative teaching methods and interactive learning tools.

To adapt the European experience of using digital technologies in education to the conditions of the Ukrainian socio-economic environment in the field of digital literacy and education, the following tasks can be performed:

1) development and implementation of modern educational programs. Develop modern, adapted-to-Ukrainian-realities educational programs on digital literacy for school students and university students. Implement these programs into the education system, ensuring their practicality and relevance;

2) teacher training and professional development. Provide training sessions and seminars for teachers on mastering digital technologies and teaching methods. Create a system of incentives for teachers who actively incorporate digital methods into the educational process;

3) creation of accessible electronic resources. Develop and implement digital learning platforms and resources accessible to all segments of the population. Ensure linguistic and cultural adaptation of electronic resources;

4) ensuring access to digital technologies. Implement measures to ensure equal access to digital education for all segments of the population, including rural and remote areas. Ensure the availability of necessary devices and internet connections for students.

Adapting practical experience in the use of digital technologies in Europe in the field of digital literacy and education in Ukraine involves implementing the aforementioned measures to improve the level of literacy and qualification of the population in the field of digital technologies.

3. Promoting Innovation Development. European experience in the use of digital innovations is one of the most advanced and influential models in this direction. By analyzing the best practices of using digital technologies in Europe, effective approaches and strategies can be identified for the Ukrainian socio-economic environment:

1) creation of innovative infrastructure. Analyze the best European practices in creating and managing innovation centers, technoparks, and incubators to identify effective models. Identify the advantages and challenges of adapting these models to Ukrainian conditions, taking into account regional differences and the institutional environment [59];

2) financial support for innovation. Systematic review of European funding instruments for startups and innovative projects. Develop mechanisms of grants, investments, and tax incentives aimed at supporting promising innovative ideas of Ukrainian companies;

3) business-academia collaboration. In-depth analysis of European models of collaboration between industry and research institutions. Develop mechanisms that facilitate the transformation of scientific developments into innovative products and services in the Ukrainian market;

4) stimulating technological transitions. Compare Europe's strategies for transitioning to high-tech sectors. Develop programs and measures to support Ukrainian companies in transitioning to digital technologies, green energy, and innovative sectors;

5) development of an innovative culture. Conduct an analysis of European initiatives to increase innovation awareness and culture. Implement educational and cultural initiatives such as hackathons, innovation forums, and startup events;

6) international cooperation and adoption of European standards. Study European approaches to international cooperation in the field of innovation and technological development. Engage in partnerships with European organizations for knowledge exchange and adoption of European standards in innovation.

Transitioning from European experience to Ukrainian realities may face several challenges, such as financial instability, inadequate infrastructure, and insufficient population education. However, it also opens opportunities for creating new solutions and strategies optimized for Ukraine's conditions.

4. Cybersecurity. Digital technologies bring great potential to all areas of our lives, but along with them comes an increased cybersecurity threat. European experience in cybersecurity is an important source of knowledge that can be successfully adapted to the conditions of the Ukrainian socio-economic environment.

In Europe, digital technologies are used in various fields, including finance, healthcare, industry, and government services. The application of artificial intelligence, the Internet of Things, and other innovative solutions creates new challenges for cybersecurity, and Ukrainian society can leverage European experience to address these challenges.

Europe is actively developing projects and strategies in the field of cybersecurity. For example, the European Union has identified cybersecurity as a priority in its Digital Strategy. This includes the development of technological solutions, legal mechanisms, and cooperation between countries. Ukraine can adopt the best practices from these strategies to improve its own cybersecurity situation.

Adapting European experience to the conditions of Ukraine requires addressing certain challenges, such as the lack of coordination between different sectors, an unstable legal framework, and the need to raise public awareness.

Adapting European experience in the use of digital technologies to the conditions of the Ukrainian socio-economic environment is an important task, especially in the context of cybersecurity. The path to success lies in careful study and adoption of Europe's best practices, tailored to the specific needs and challenges of Ukrainian society. Collaborative work and knowledge exchange between countries can contribute to raising the level of cybersecurity both in Europe and in Ukraine.

5. E-Governance. E-governance has become an integral part of state development and improvement of collaboration between the government and citizens. In Europe, there is already significant experience in implementing digital tools in the administrative process, and this experience can be successfully adapted to Ukrainian conditions.

In European Union countries, e-governance is based on principles of efficiency, transparency, and citizen engagement in governing state affairs. This includes electronic services, electronic exchange of information between authorities and citizens, as well as digital decision-making tools [59].

European countries actively implement projects and initiatives for e-governance. For example, initiatives like "Single Digital Gateway" in Poland or "e-Residency" in Estonia are examples of successful initiatives that streamline citizen interaction with government services.

Adapting European experience in e-governance to Ukraine faces challenges such as technical infrastructure, cybersecurity, and citizen literacy. However, this also provides opportunities to create a modern and efficient e-governance system.

Adapting European experience in using digital technologies for e-governance in the conditions of the Ukrainian socio-economic environment is a key stage on the path to reforms

and modernization of public administration. Successful implementation of these practices will contribute to the creation of an open, efficient, and citizen-centric government.

6. Cooperation with European Partners. In the era of globalization and rapid technological advancement, collaboration between countries is a crucial element for achieving common goals and exchanging experiences. European countries have already successfully utilized digital technologies for managing international cooperation. Electronic platforms for information exchange, efficient use of online communication tools, and other instruments facilitate effective collaboration and knowledge sharing [59].

The European Union actively develops projects and initiatives aimed at supporting international cooperation. For instance, the "Horizon Europe" program enables researchers and innovators to collaborate and exchange experiences for joint research and development of new technologies.

Adapting European experience in Ukraine requires attention to the specifics of the Ukrainian socio-economic environment. Challenges may include cultural differences, legal peculiarities, and technical constraints. However, successful adaptation opens up opportunities for deepened cooperation and exchange of innovative approaches.

Adapting European experience in using digital technologies for cooperation with European partners in the context of the Ukrainian socio-economic environment is a strategically important task.

This will contribute to the development of international relations, exchange of innovations, and creation of a favorable environment for joint advancement.

These recommendations aim to create a favorable environment for the implementation of digital technologies in Ukraine and to maximize their positive impact on the country's socio-economic development.

This study provided a comprehensive overview of the current state of digital technology utilization in Europe and identified opportunities for its adaptation in the Ukrainian context. Through careful analysis of various sectors, projects, initiatives, and challenges faced by European society in the process of digital development, it can be concluded that contemporary European experience demonstrates an impressive wide range of applications of digital technologies in different fields. From industry and healthcare to culture and governance, digital innovations play a crucial role in improving the quality of life and societal development.

In Europe, particular emphasis has been placed on sectors where digital technologies are used in an advanced manner. The financial sector, healthcare, and education are examples where technology integration has significantly improved services and optimized processes.

The implementation of digital technologies has led to significant sociocultural shifts. New communication, work, and learning methods shape a new way of life, but challenges such as cybersecurity and ethics arise.

European experience in using digital technologies has its unique specifics, determined not only by technical aspects but also by cultural, legal, and social factors. Taking these peculiarities into account is key to the successful adaptation of such experience in Ukraine.

Adapting European experience in Ukraine is a promising direction for further development. Understanding and considering the specifics of the Ukrainian socio-economic environment are crucial for the successful integration of digital innovations. Ukraine should focus on strengthening infrastructure, developing human capital, and supporting innovative initiatives to achieve sustainable development. In post-war days, Ukraine needs to actively study and adapt advanced European experience in using digital technologies, relying on its positive aspects and addressing challenges for more effective and sustainable development in the era of digital transformation.

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