SECTION 1
Global experience of digital transformation of the economy

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1.1. DIGITALIZATION OF ENTERPRISE LOGISTICS: GLOBAL EXPERIENCE

Introduction. In today's globalized world, logistics has become one of the key functional areas of any manufacturing enterprise, especially in high-tech industries such as engineering. The speed, accuracy, and efficiency of logistics processes directly affect not only the financial results of an enterprise, but also its competitiveness in international markets. Given the dynamic development of technology, accelerating changes in consumer demands, more

complex supply chains, and increased requirements for environmental sustainability, logistics can no longer operate according to traditional models. That is why the digitalization of logistics is coming to the fore, driving a new industrial revolution.

Digital logistics is not just the automation of individual processes, but a profound transformation of the entire logistics system using digital technologies such as the Internet of Things (IoT), artificial intelligence (AI), big data, cloud computing, digital twins, blockchain, supply chain management (SCM) systems, and robotic systems. In the context of global crises, supply chain disruptions, pandemic and military challenges, digitalization makes it possible to adapt the logistics system to an unstable environment, ensure its flexibility, transparency and sustainability [1].

The automotive industry, as one of the most logistically complex industries, has long been a leader in implementing digital innovations in logistics. According to international research, the world's leading automakers are actively investing billions of dollars in the digital transformation of their supply chains. Tesla, Mercedes-Benz, and Toyota demonstrate successful examples of deep integration of digital technologies at all stages of the logistics process, from supply planning to distribution of finished products. At the same time, Ukrainian manufacturers are only at the beginning of this journey, and their experience is valuable for understanding the real possibilities of adapting global practices in difficult economic and infrastructure conditions.

A study of global experience in the digitalization of logistics on the example of machine-building enterprises allows not only to identify current technological trends but also to assess the real effects, challenges, risks, and potential for scaling such solutions in the national context. This issue is particularly important in Ukraine, which, despite the war, is making efforts to preserve and develop its production potential, including in the machine-building and logistics sectors.

An analysis of global cases of digital transformation of logistics will help identify strategic areas of development for Ukrainian enterprises, formulate recommendations for the introduction of innovative logistics solutions, increase the efficiency of logistics

operations, attract investment, and create a digital infrastructure at the national level. Thus, the issue of digitalization of logistics at the current stage of economic development is not only relevant but also strategically important in the context of global integration and competitiveness of national business.

Presentation of the main results of the study. Digital logistics is a modern paradigm of organizing and managing logistics processes based on the widespread use of information and communication technologies to achieve greater efficiency, accuracy, transparency and adaptability in supply chain management. It covers all stages of the supply chain: procurement, storage, transportation, order processing, inventory management, distribution, and reverse logistics. Unlike traditional logistics, which relies on isolated automated systems, digital logistics is based on an integrated approach that ensures continuous real-time data exchange between all process participants.

In the scientific literature, digital logistics is often seen as a logical extension of the Industry 4.0 concept, which involves a profound transformation of production and logistics processes under the influence of digital technologies. It is not only the modernization of individual functions, but a fundamental change in the way decisions are made, interactions between departments, data exchange, and strategic planning. Digital logistics allows us to move from reactive to proactive management, where decisions are made based on foresight and scenario modeling, not just on actual data about past events [2].

One of the basic technologies of digital logistics is the Internet of Things (IoT), which allows for the integration of physical objects (vehicles, equipment, containers, warehouses, cargo) into a single network with the ability to exchange data. Sensors, chips, trackers, and AI devices record parameters in real time, such as location, temperature, load level, vibration, and equipment condition. This helps reduce the risk of damage, prevent downtime, and improve delivery accuracy.

Artificial intelligence (AI) processes large volumes of logistics data and automatically detects patterns, which allows optimizing transportation routes, forecasting demand, managing inventory, identifying risks, and responding to changes in real time.

Blockchain technology in logistics is a tool for ensuring transparency and trust between supply chain participants. It allows creating unchanging digital records of every transaction – from production to delivery to the end user. This is especially true for international transportation, where it is important to have proof of origin, compliance with transportation conditions, and the absence of falsifications.

Another important aspect of logistics digitalization is robotization. It includes the introduction of autonomous mobile robots in warehouses, robotic systems for sorting and packaging, automatic forklifts, unmanned vehicles, and delivery drones. In the large logistics centers of leading companies such as Amazon, Tesla, or Toyota, robotics allows for logistics operations with minimal human involvement, reducing the risk of errors, shortening order processing times, and improving workplace safety.

The expected effects of the digitalization of logistics are multifaceted. First and foremost, it is an increase in transparency due to the ability to obtain up-to-date information about each stage of the logistics process. Each participant – from the supplier to the customer – has access to relevant data, which minimizes delays, misunderstandings, or fraud. The second key benefit is increased efficiency: digital technologies can cut costs, reduce errors, lower inventory levels, and improve resource utilization. Finally, the system's adaptability to environmental changes is another critical effect. In a digital format, the logistics system can instantly respond to changes in demand, weather conditions, supply disruptions, or even geopolitical risks by changing routes, reorienting suppliers, or activating alternative logistics scenarios [3].

Thus, the digitalization of logistics is not just the introduction of new technologies, but a systemic change in the entire logistics paradigm. It is a way to create more flexible, sustainable and customer-oriented supply chains that can operate effectively in a world of constant change and high competition.

The digitalization of logistics is one of the key factors for increasing competitiveness in a globalized economy. Countries around the world demonstrate different levels of digital development

in this area, which depends on many factors, including economic potential, political situation, and government support. The most prominent leaders in digitalization are the United States, Europe and Asia, while Ukraine is still at the stage of implementing digital solutions [4].

European countries are actively working to create a unified digital transport ecosystem, including initiatives to standardize data exchange, such as eFTI (electronic Freight Transport Information), and support environmentally sustainable development through intelligent transport systems (ITS). In Western European countries, such as Germany, the Netherlands, and Belgium, digital solutions are integrated into supply chains through automated sorting centers, IoT, and cloud platforms. The Netherlands, for example, is a leader in implementing digital integration solutions in logistics, such as the automation of port processes in Rotterdam.

One of the main features of the European approach is the focus on reducing the environmental footprint through the use of digital technologies to optimize routes and reduce resource consumption. Support from government programs such as Horizon Europe ensures a high level of investment in innovation.

The United States remains a leader in the introduction of the latest technologies in logistics, particularly in areas such as Big Data, artificial intelligence, autonomous trucks and drones. Companies such as Amazon and FedEx are actively using these technologies to automate warehouses and optimize delivery routes. Amazon uses more than 500,000 robots in its warehouses to speed up processes and uses algorithms to predict demand.

In addition, the United States is actively testing autonomous transportation technologies to reduce costs and improve road safety. The country's legal framework is flexible and supports an innovative approach that allows testing new models, particularly in the transportation sector, without significant regulatory restrictions.

Asia, particularly China, Japan, and South Korea, is experiencing rapid development of digital technologies in logistics. China is actively investing in automated logistics hubs, self-driving trucks, and drones.

China is also actively using artificial intelligence and 5G to improve communication and transportation management.

Japan is focusing on integrating digital technologies into manufacturing logistics, using advanced solutions to optimize inventory and delivery, while South Korea is actively testing autonomous trucks and AI innovative solutions for process automation.

In Ukraine, the digitalization of logistics is still in its infancy. Leading companies such as Nova Poshta and Ukrposhta are introducing automated sorting centers, CRM systems, and mobile applications for parcel tracking. In particular, Nova Poshta has opened an automated terminal in Lviv that can handle up to 20,000 parcels per hour [5].

Despite the difficult political and economic situation, the country continues to develop digital solutions in logistics, which allows it to improve delivery efficiency even in times of war. However, the main challenges remain the lack of stable infrastructure, lack of investment, and human resources.

According to Table 1, the United States is a leader due to its large-scale investments in the latest technologies, such as AI, Big Data, autonomous trucks and robots, which allows to significantly improve the efficiency of logistics processes.

Europe demonstrates a high level of integration and standardization within a single transport system, in particular through initiatives that support sustainable development.

Asia stands out among other regions due to its rapid adoption of new technologies, particularly in China, where significant investments are made in advanced infrastructure and process automation. Despite existing challenges, Ukraine is actively developing digital technologies in the logistics sector, especially at the level of individual companies, which is a positive sign for the further advancement of this field.

Digitalization is a crucial factor in the development of modern machine-building enterprises, helping to optimize production processes, reduce costs, and increase efficiency. Contemporary companies are actively implementing technologies such as the Internet of Things (IoT), artificial intelligence, blockchain, robotics, and other advanced IT solutions to enhance their logistics operations.

Table 1

The state of logistics digitalization in the world

Parameter / Region	Europe	USA	Asia	Ukraine
Level of Digitalization	High	Very High	Very High	Medium
Key Technologies	IoT, AI, eFTI, ERP, Blockchain	AI, Big Data, Drones, Robots	IoT, 5G, Blockchain, Robots	ERP, WMS, Mobile Applications
Government Policy	Coordination, Regulation	Flexibility, Incentives	Active Government Support	Limited, No Systematic Approach
Infrastructure	Developed	Highly Developed	High-Tech	Partially Damaged by War
Investment	High (e.g., Horizon Europe)	Very High (e.g., IIJA)	High (Public + Private)	Limited
Strengths	Standardization, Sustainability	Innovation, Scalability	Scale, Flexibility	Adaptability, Flexibility
Key Challenges	System Fragmentation	Cybersecurity, Workforce	Uneven Implementation	War, Finances, Workforce

Source: compiled on the basis of [6; 7]

Digitalization in the machine-building industry is especially relevant due to the increasing demands for delivery speed, supply chain transparency, and the reduction of the carbon footprint. Enterprises that adopt modern digital technologies can significantly enhance their competitiveness and adapt to rapidly changing market conditions. It is important to note that large companies such as Tesla, Mercedes, and Toyota are investing heavily in digital solutions, which allows them to maintain their market leadership. At the same time, Ukrainian manufacturers like KRAZ have great potential for modernization and the adoption of digital technologies, which would improve their operational efficiency and enable integration into global supply chains.

The data presented in Table 2 highlights the disparity in the level of digitalization between leading global car manufacturers and the

Ukrainian enterprise KRAZ. Tesla, Mercedes, and Toyota factories are at the forefront of technological advancement, actively integrating cutting-edge technologies into their production processes and logistics operations. Tesla has invested over $8.5 billion in the development of digital technologies, enabling a high level of automation across all stages of production. This includes robotics, the use of IoT, artificial intelligence (AI), and blockchain technologies for supply chain management. Mercedes-Benz and Toyota also show significant investments in "Industry 4.0" and green logistics, with Mercedes-Benz allocating €3.3 billion to the development of robotics and automation.

Meanwhile, the KRAZ plant, one of Ukraine's leading heavy machinery manufacturers, is currently at a less advanced stage of digitalization. Investments in modernization at the enterprise amount to only about $5 million, mainly from state orders and international military contracts. This is significantly less than what global leaders invest, which limits the company's ability to implement the latest solutions, such as robotics and full automation.

The main challenge for KRAZ is the lack of sufficient funding for large-scale adoption of advanced technologies. As a result, the company only utilizes selected automation elements, such as basic ERP systems for supply chain monitoring and warehouse automation. However, there is considerable potential for modernization, particularly through the integration of IoT, AI, and robotics, which would allow the enterprise to increase efficiency and reduce production costs.

Digitalization is also a key factor in improving product quality and optimizing logistics processes, particularly for the KRAZ plant, which could benefit from implementing more efficient solutions for supply chain management and real-time production monitoring.

The digitalization of logistics in Ukraine is a crucial area for economic development, especially amid current challenges such as globalization, war, and the need to modernize infrastructure. In recent years, there has been significant progress in utilizing digital technologies to optimize transportation and cargo delivery processes.

However, serious problems remain, particularly outdated infrastructure and instability due to external threats.

Table 2

Digital solutions at machine-building enterprises

Parameter	Tesla	Mercedes-Benz	Toyota	KRAZ
Level of Digitalization	High	High	Medium	Low
Investment in Digital Technologies (10 years)	$8.5billion(R&D, automation)	€3.3 billion in automation and Industry 4.0	$2.5 billion for plant digitalization	$5 million in automation (current level)
Key Technologies	IoT, AI, Blockchain, Robotics, TMS, WMS	IoT, AI, Robotics, ERP, Green Logistics	IoT, AI, Robotics, Lean Production	ERP, Partial Robotics, Warehouse Automation
Digital Strategies	Full integration of digital solutions into production	Industry 4.0, Green Logistics, IT System Integration	Lean Production, Supply Chain Digitalization	Process Automation, Monitoring
Level of Robotics	High (fully automated lines)	High (robots on assembly lines)	Medium (robots on assembly lines)	Partial Robotics (warehouse and packaging)
IT Solutions in Logistics	TMS, WMS, Blockchain for supply chain management	ERP, WMS, TMS, Warehouse Automation	AI, IoT, Automated Transport Systems	ERP system for supply chain monitoring
Key Challenges	Data Security, Integration of New Suppliers	Robot Downtime Risks, Integration Complexity	Uncertainty about Future Technologies	Limited Funding, Weak Infrastructure
Future Plans	Expand Automation, Implement New AI Solutions	Deepen Automation and AI Integration	Develop IoT and AI for Supply Chain Optimization	Expand Warehouse Automation, Implement New IT Solutions

Source: compiled on the basis of [8; 9; 10; 11]

One of the main weaknesses of Ukrainian logistics is underdeveloped infrastructure, especially outdated roads, railway tracks, and ports. Nonetheless, investments in infrastructure modernization, including national and international transport routes, are gradually improving the situation. In recent years, over UAH 3 billion has been allocated for infrastructure enhancement. However, the war has once again put many of these projects on hold.

On the other hand, there is significant potential for the development of digital technologies such as IoT, artificial intelligence (AI), and Big Data for monitoring and managing logistics flows. Ukrainian companies are actively adopting advanced IT solutions to optimize cargo transportation and improve warehouse management. Notably, "Nova Poshta" demonstrates substantial progress in this area by actively implementing warehouse automation and intelligent cargo management systems.

The state plays an important role in supporting digitalization by creating national platforms for transport and logistics flow monitoring, as well as providing incentives for businesses. However, a key issue is the lack of a clear national strategy for implementing cutting-edge technologies in logistics. The private sector is rapidly advancing in this direction, particularly companies like Nova Poshta, which already utilize digital solutions to enhance delivery processes.

As shown in Table 3, investment support from both the state and the business sector is crucial for digitalization. While the private sector is actively investing in new technologies, state support remains insufficient, which limits the potential for rapid development. The issue of cybersecurity, which is critical for implementing digital solutions, also remains unresolved and could hinder the large-scale transition to digital technologies. Given the significant impact of the war on infrastructure, the government needs to strengthen its role in infrastructure recovery and support for digital innovations. In the coming years, we can expect the growth of startups and the startup ecosystem in the logistics sector, which will further motivate investment and collaboration with international partners.

Table 3

State and prospects of logistics digitalization in Ukraine

Aspect	Today	Prospects for the Next 5–10 years
Logistics Infrastructure	Developed transport network (roads, railways, ports), but requires modernization	Infrastructure modernization (road repairs, railway upgrades, port development)
Digital Technologies	Implementation of IT platforms for cargo monitoring, partial use of IoT and Big Data in supply chain management	Development of "smart" logistics platforms, automated warehouses, delivery drones
Investment	Private and public investments, including infrastructure modernization (over UAH 3 billion in 2020)	Increased investment in digital technologies, growth of logistics startups
Data Security	Cybersecurity and data protection issues due to lack of effective security measures	Development of national cybersecurity infrastructure, improved data protection
Impact of War	Disruption of supply chains, blocked ports, infrastructure destruction, partial use of digital solutions	Infrastructure recovery, implementation of new technologies to stabilize logistics
Customs Infrastructure	Gradual automation of customs processes, but significant improvement still needed	Full automation of customs operations, use of electronic documents and blockchain
Transportation and Flows	Partial automation of transport, especially in large warehouses and enterprises	Widespread adoption of autonomous vehicles and electric trucks
Role of the State	Support through infrastructure and digital economy development programs, creation of national monitoring platforms	Enhanced state role in coordinating digital initiatives, creating incentives for investors
Startups and Innovation	Early AI startups and innovation projects in the sector, but limited overall impact	Development of innovative logistics startups, implementation of robotics and drones

Source: compiled on the basis of [12; 13]

Digitalization of logistics in Ukraine holds significant development potential, but it requires large-scale investments in infrastructure, the improvement of digital solutions, and an adequate level of cybersecurity. The role of the state in this process is critically important, as it must create favorable conditions for the development of digital startups and innovative projects. Ukraine also needs to actively work on restoring and modernizing its infrastructure, which is essential for sustainable economic development during wartime and post-war recovery [14].

Conclusions. The digitalization of logistics is a strategic direction for the development of the global economy, and its importance amid globalization and technological transformation cannot be overstated. Studying current trends and global best practices in this field highlights the necessity of implementing digital technologies in logistics for both large international corporations and small and medium-sized enterprises in Ukraine.

Digitalization efforts in Europe, the USA, Japan, and China demonstrate the effectiveness of technologies such as IoT, artificial intelligence, blockchain, and automated supply chain management systems. These technologies help reduce costs, increase transparency, and improve logistics efficiency. In Ukraine, despite challenges with outdated infrastructure and political instability, there is observable progress in implementing digital technologies in logistics – although this process still requires substantial investment and strong governmental support.

Digitalization is particularly vital for Ukrainian businesses, which face numerous challenges due to the war and infrastructure recovery needs. At the same time, it opens new opportunities for modernizing logistics processes and adapting to new realities, especially in a context of instability and limited resources.

To successfully digitalize logistics in Ukraine, it is necessary not only to improve infrastructure but also to promote educational programs for training highly skilled personnel, invest in startups, and actively cooperate with international partners to implement cutting-edge solutions. Governmental support must become a key factor in the logistics transformation process, providing a sound legal framework for the development of digital technologies.

Ukraine's logistics sector has a real chance to become globally competitive if digitalization is accelerated through a comprehensive approach involving infrastructure development, education, investment, and international partnerships. This will allow Ukraine to effectively integrate into the global economic space, ensuring stability and innovative growth in logistics operations.

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1.2. INTERNATIONAL BUSINESS MANAGEMENT IN THE CONTEXT OF THE DIGITAL ECONOMY: THE EUROPEAN DIMENSION

Introduction. The modern digital economy is significantly transforming international business, changing management models, organizational structures, and companies' competitive strategies. In the digital era, traditional business methods are giving way to advanced technologies such as artificial intelligence, big data, blockchain, and cloud computing. Amid globalization and digitalization, companies are

compelled to adapt their management processes to remain competitive in international markets.

The European Union is one of the global leaders in implementing digital technologies in international business, establishing effective regulatory mechanisms and supporting innovative development. The digital transformation policy, particularly the EU initiatives to create a Single Digital Market, contributes to improving business conditions, optimizing logistics, financial operations, and supply chain management.

Studying the European experience helps identify best practices in digital management and their adaptation to the conditions of other countries. Beyond technological changes, digitalization poses new challenges for international business management, including cybersecurity issues, personal data protection, regulation of digital platforms, and automation of business processes.

Therefore, researching the specifics of digital management in international business within the European context is important for understanding current trends, developing effective management strategies, and enhancing the competitiveness of companies in the global economy.

Presentation of the Main Research Findings. The essence of the digital economy consists in the application of digital technologies for the creation, processing, storage, and transmission of information, fundamentally transforming traditional business models and economic relations. It is grounded in internet technologies, big data, artificial intelligence (AI), cloud computing, and blockchain, which collectively provide enhanced speed, flexibility, and accessibility of economic processes.

Data serves as the cornerstone of the digital economy, representing a novel form of valuable resource analogous to oil or capital within the traditional economic framework. A defining characteristic of the digital economy is the transition from physical assets to digital platforms and services, thereby reshaping approaches to the production, distribution, and consumption of goods and services.

Furthermore, the digital economy facilitates the globalization of business by enabling enterprises to access international markets without necessitating a physical presence. Digitalization also

fosters the automation of business processes, the emergence of new employment modalities such as freelancing and remote work, and induces structural changes within labor markets.

Nonetheless, the digital economy introduces significant challenges, including issues of data security, digital divides among countries and economic sectors, and the imperative to adapt legal and regulatory frameworks. The deployment of digital technologies mandates robust cybersecurity measures, a requirement of particular importance for the financial sector and international business operations.

Simultaneously, digitalization presents novel opportunities for economic growth, productivity enhancement, and the establishment of competitive advantages within the global economic environment.

These conceptual frameworks delineate contemporary approaches to business management in the digital milieu and constitute the foundation for corporate competitiveness at the international level (see Table 1).

Table 1

Key Concepts of Digital Management

Concept	Essence	Main Tools and Approaches
1	2	3
Digital Transformation	Comprehensive transition of a company to digital technologies aimed at enhancing business process efficiency	Big Data, AI, cloud technologies, automation, IoT
Agile Management	Flexible management approach that enables rapid adaptation to market changes	Scrum, Kanban, Lean, DevOps
Platform Economy	Utilization of digital platforms to facilitate interactions between consumers and providers of goods or services	Marketplaces (Amazon, Alibaba), fintech platforms, crowdsourcing
Virtual Teams Management	Managing distributed teams working remotely through digital technologies	Zoom, Microsoft Teams, Slack, Trello

Continuation of Table 1

1	2	3
Business Process Automation (BPA)	Application of digital technologies to minimize manual labor and improve process efficiency	RPA (Robotic Process Automation), ERP systems, CRM systems
Digital Marketing	Promotion of brands, goods, and services via digital channels	SEO, content marketing, social media, targeted advertising
Cybersecurity Management	Ensuring protection of company information resources from cyber threats	Data encryption, multi-factor authentication, antivirus software

Source: compiled based on [2–6]

The European Union's digital economy policy is aimed at developing digital technologies, strengthening the competitiveness of European companies, and creating a secure digital environment. One of the key initiatives is the Digital Europe Programme, which supports the development of supercomputers, artificial intelligence, cybersecurity, and digital skills.

Moreover, the EU actively works on establishing the Digital Single Market (DSM), which seeks to eliminate barriers between member states by simplifying e-commerce, ensuring the free flow of data, and protecting user rights in the digital environment.

European initiatives and programs support digital business by investing in new technologies and facilitating their adoption in entrepreneurial activities. For instance, the Horizon Europe Programme finances innovative projects, particularly in the fields of digitalization and artificial intelligence. Additionally, the Digital Innovation Hubs Programme assists small and medium-sized enterprises in adapting digital technologies to enhance productivity and competitiveness.

Regulation of the digital market within the EU also plays a crucial role in ensuring transparency and fair competition. The Digital

Services Act and the Digital Markets Act aim to oversee the activities of digital platforms and protect consumer rights. Furthermore, the General Data Protection Regulation (GDPR) establishes stringent requirements for the processing of personal data, ensuring security and trust in the digital space.

All these initiatives collectively shape the European digital ecosystem (see Table 2), which fosters the development of international business.

Table 2

EU Digital Economy Policy and Initiatives to Support Digital Business

Direction	Description	Key Programs and Regulations
Digital Europe	EU program focused on the development of digital technologies including supercomputers, AI, cybersecurity, and digital skills	Digital Europe Programme (DEP)
Digital Single Market (DSM)	Removal of barriers between member states to simplify e-commerce, enable free data flow, and protect user rights	Digital Single Market Strategy
Funding for Innovation in the Digital Economy	Support for research and development in digital technologies	Horizon Europe
Support for Digital Business Transformation	Assistance to small and medium-sized enterprises in implementing digital solutions	European Digital Innovation Hubs (EDIH)
Regulation of the Digital Market	Oversight of digital platform activities to ensure transparency, fair competition, and user protection	Digital Services Act (DSA), Digital Markets Act (DMA)
Personal Data Protection	Establishment of strict requirements for personal data processing and ensuring information security	General Data Protection Regulation (GDPR)

Source: compiled based on [11; 15]

These initiatives contribute to creating a favorable environment for the development of the digital economy in Europe and enhance the competitiveness of European companies in international business.

In light of the EU's digital economy policy, the use of Big Data, AI, IoT, and Blockchain represents a strategic direction for the development of European companies (see Table 3). The EU actively invests in these technologies through programs such as Digital Europe and Horizon Europe, fostering innovation, scientific research, and digital technology advancement.

The use of Big Data enables European companies to analyze vast amounts of information to create new business models and improve services. Artificial Intelligence (AI) is integrated into production processes, optimizes managerial decision-making, and supports intelligent systems for personalized marketing campaigns. The Internet of Things (IoT) helps European companies optimize supply chains and production by enhancing efficiency through real-time monitoring of assets and processes. Blockchain is utilized to ensure the security and transparency of financial transactions, which is a key priority for the EU in the context of developing the Digital Single Market. Business process automation and electronic document management are also important components of EU policy. Within the framework of the Digital Single Market (DSM) initiative, the EU works on integrating business processes into the digital environment, which involves simplifying cross-border operations and access to services.

ERP and CRM systems are actively employed by European companies to automate management, financial, and logistics processes. Robotic Process Automation (RPA) enables companies to reduce costs and increase data processing efficiency, particularly in sectors such as finance and insurance. Electronic document management is becoming a standard across all EU countries, ensuring greater efficiency in information exchange between public authorities, businesses, and citizens.

Virtual teams and remote personnel management have become an important part of the EU's digital transformation policy, especially following the COVID-19 pandemic. The EU actively supports

initiatives that enable companies to develop remote work processes through the Digital Europe Programme and digital skills development programs. The use of cloud platforms for collaboration allows European companies to work with teams across the continent, reducing office space costs and attracting talent from various countries.

At the same time, the EU imposes strict data protection requirements in the context of remote management, ensured through the General Data Protection Regulation (GDPR).

Table 3

EU Policy on Digital Technologies in Business

Technology / Approach	Description	European Initiatives and Programs
Big Data	Utilization of large data sets for forecasting and improving business models	Horizon Europe, Digital Europe Programme
AI (Artificial Intelligence)	Integration of AI for automating business processes, personalizing marketing, and management decisions	AI for Europe, Digital Europe Programme
IoT (Internet of Things)	Connecting devices to the Internet for monitoring and optimizing business processes	Digital Single Market, Horizon Europe
Blockchain	Use for secure and transparent transactions, including smart contracts	Digital Services Act, Blockchain Partnership
Business Process Automation (RPA)	Automation of routine tasks to enhance efficiency	Digital Europe Programme, Horizon Europe
Electronic Document Management	Transition to digital documents to simplify business operations and reduce costs	eIDAS (Electronic Identification and Trust Services)
Virtual Teams	Management of remote teams via digital platforms	Digital Skills and Jobs Coalition, Digital Europe Programme

Source: compiled based on [5]

These technologies and programs help the EU ensure the competitiveness of European companies in the global digital environment and promote the integration and development of the Digital Single Market within the European Union.The European Union actively implements digital technologies in the business environment, considering them a key factor for economic development (see Table 4). The main directions of digital policy include the development of artificial intelligence, cybersecurity, cloud computing, and digital finance. Under the Digital Europe Programme (2021–2027), an investment of €7.5 billion is allocated to digital innovations, which will contribute to enhancing the competitiveness of European companies. Special emphasis is placed on supporting small and medium-sized enterprises (SMEs) through European Digital Innovation Hubs (EDIHs), which provide companies access to advanced technologies and consulting services. Initiatives on digital education and the expansion of the 5G network to ensure high-speed internet connectivity are also being implemented. In 2023, the level of digitalization of companies in the EU reached 75 %, which is 10 % higher than in 2020.

At the same time, there are challenges, notably the varying levels of digital maturity among companies across different countries, which complicates unified digital transformation. For example, 85 % of companies in Denmark have a digital strategy, whereas in Bulgaria this figure is only 45 %. To bridge this gap, the EU has introduced the Digital Markets Act (DMA) and the Digital Services Act (DSA), which regulate digital competition and online security.

Table 4

Key indicators of business digital transformation in the EU

Indicator	2020	2023	Expected 2027
Business digitalization level (%)	65	75	85
Investments in Digital Europe (billion EUR)	–	7.5	9.2
Share of SMEs using cloud technologies (%)	40	55	70
5G coverage in urban areas (%)	30	68	90
Number of EDIHs	81	151	200+

Source: compiled based on [4; 5; 6]

The analysis of the table indicates a dynamic development of business digitalization within the EU. Specifically, the level of digitalization among enterprises increased from 65 % in 2020 to 75 % in 2023, with a forecasted rise to 85 % by 2027. This reflects the active adoption of digital technologies, which contributes to enhanced business efficiency and competitiveness in the global market. Investments in the Digital Europe programme have significantly increased, enabling wider access for companies to cloud technologies, artificial intelligence, and 5G networks. For example, the share of small and medium-sized enterprises (SMEs) using cloud computing rose from 40 % in 2020 to 55 % in 2023, with an expected increase to 70 % by 2027. Significant progress is also evident in the deployment of 5G networks: urban coverage expanded from merely 30 % in 2020 to 68 % in 2023 [5].

Despite positive trends, the digital divide among EU countries remains a challenge. The expansion of European Digital Innovation Hubs (EDIHs) from 81 in 2020 to 151 in 2023, and an expected 200+ by 2027, assists small enterprises in adapting to the digital economy. Thus, the EU continues its targeted policy aimed at removing technological barriers and ensuring the equitable implementation of digital technologies in business.

The level of business digitalization varies significantly across EU countries. The highest indicators are observed in Denmark, Finland, Sweden, the Netherlands, and Estonia (Table 5). These countries possess advanced 5G infrastructure and actively implement cloud technologies, artificial intelligence, and automated business processes. For example, 85 % of companies in Denmark use digital technologies for operational management, while in Estonia, 98 % of enterprises employ electronic document management.

Besides technological readiness, government support plays a crucial role. For instance, Finland has programs funding digital startups, while the Swedish government invests in training entrepreneurs in digital skills. In the Netherlands, 90 % of companies utilize Big Data analytics to enhance business efficiency. This demonstrates that digitalization depends not only on technology but also on the country's development strategy.

Table 5

Comparative Indicators of Business Digitalization in Leading EU Countries

Country	Level of Business Digitalization (%)	Use of Cloud Technologies (%)	Use of Artificial Intelligence (%)
Bulgaria	45	32	20
Romania	48	35	22
Greece	42	30	18

Source: compiled based on [5–6]

This contrast with the leading countries (Denmark, Estonia, Netherlands, etc.) highlights the existence of a digital divide within the EU. The EU's efforts are focused on overcoming these inequalities through support for digital education, infrastructure development, and investment in innovation.

Table 6

Use of Digital Technologies by Businesses in Countries with Lower Indicators

Country	Business Digitalization Level (%)	Use of Cloud Technologies (%)	Use of Artificial Intelligence (%)
Greece	50	40	25
Romania	48	35	20
Bulgaria	45	30	18

Source: compiled based on [7–8]

Overall, successful EU countries demonstrate that digital transformation is a key factor for business competitiveness. Other states that are currently lagging in this process receive EU support to implement new technologies and digital strategies.

The digital transformation of business in the countries of the European Union varies in its level of development, depending on economic capabilities, government support, and infrastructure. Scandinavian countries, as well as the Netherlands and Estonia, are leaders thanks to a high level of company digitalization, active

use of artificial intelligence, and developed digital infrastructure. Meanwhile, countries in Southern and Eastern Europe, such as Bulgaria, Greece, and Romania, have low rates of digital technology adoption, creating a certain gap within the EU.

The main factors for successful digitalization include government incentives, investment in digital education, and access to modern technologies. For example, in Sweden, 87 % of companies use financial technologies for payment automation, while in the Netherlands, 90 % of enterprises have implemented big data for business process analytics (Table 7). These countries also have advanced 5G infrastructure that provides high-speed internet and stable connectivity for businesses.

In contrast, countries lagging behind in digital transformation exhibit insufficient integration of the latest technologies into business processes. For instance, in Bulgaria, only 30 % of enterprises use cloud computing, and in Greece, this figure reaches 40 % [8]. The lack of adequate digital infrastructure and a shortage of qualified personnel are the main barriers to business digitalization in these countries.

Table 7

Use of Digital Technologies in Business in EU Countries

Country	Use of Cloud Technologies (%)	Integration of Big Data (%)	Use of 5G (%)
Sweden	68	78	90
Netherlands	72	90	88
Finland	70	75	85
Estonia	78	70	80
Denmark	75	72	87

Source: compiled based on [7–8]

Table 7 shows the level of digital technology adoption in business across selected EU countries. Estonia leads in cloud technology adoption (78 %), while the Netherlands ranks highest in Big Data integration (90 %). Sweden has the highest use of 5G (90 %). Denmark and Finland also demonstrate high, albeit slightly lower,

levels of digitalization. Overall, all the analyzed countries actively use modern technologies, indicating a high level of digital transformation in business across the region.

Table 8

Use of Digital Solutions in Countries with Lower Indicators

Country	Use of Cloud Technologies (%)	Integration of Big Data (%)	Use of 5G (%)
Greece	40	35	50
Romania	35	30	45
Bulgaria	30	25	40

Source: compiled based on [9–10]

The overall level of digital business transformation in the EU increases each year, but the digital gap between leading countries and those lagging behind (Table 8) remains significant. The most successful states, such as Sweden, the Netherlands, and Estonia, have well-developed infrastructure, support for digital startups, and actively use cutting-edge technologies. Meanwhile, countries with lower performance need to increase investment in digital infrastructure and education in order to catch up with the leaders. The EU is already implementing special funding programs to reduce this gap, which will contribute to the overall digital integration of European business in the future.

The digital economy is significantly reshaping business practices, especially at the international level. In the European Union, digitalization has become a key factor in competitiveness and innovative development in international business. EU countries are implementing digital strategies to transform their business models, adapting them to emerging technologies such as artificial intelligence, blockchain, the Internet of Things, and big data.

One of the key aspects of effective international business management is the integration of digital technologies into business processes. In EU countries, platforms for e-commerce, online financial technologies, and cloud-based services are actively developing,

enabling businesses to operate in international markets with reduced costs and increased efficiency. Digital infrastructure – including high-speed internet, platforms for digital payments, and data automation and analytics technologies – plays a critical role in this transformation.

An important component is also risk management in international business in the context of the digital economy. This includes data protection, cybersecurity, and adaptation to rapidly changing global conditions. European companies operating in international markets often face the challenge of complying with digital regulations in different countries. The EU is actively working on unifying digital standards and norms to ensure fair business conditions at all levels.

Key trends in international business management in the digital economy are presented in Figure 1.

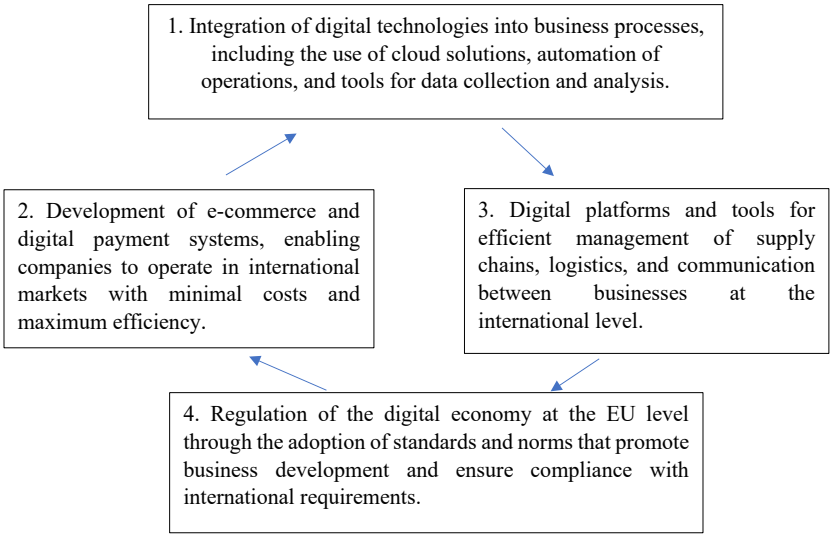

Fig. 1. International Business Management in the Digital Economy

Source: compiled based on [6]

International business management in the context of the digital economy within the European Union is undergoing significant

transformation. The use of advanced digital technologies, such as artificial intelligence and big data, enables European companies to expand their presence in global markets. However, along with new opportunities come new risks – including cyber threats and regulatory challenges – that require attention from both governments and businesses.

1. Integration of digital technologies into business processes. The integration of digital technologies into business processes is one of the key trends in the digital economy. This includes the use of cloud technologies, artificial intelligence (AI), big data analytics, and business process automation. In EU countries, companies are actively implementing these technologies to optimize operations and improve efficiency.

Cloud solutions allow enterprises to store and process data without the need for significant investment in physical infrastructure. AI is used for managerial decision-making, demand forecasting, supply chain optimization, and customer interaction. The use of big data analytics enables companies to better understand consumer behavior and adapt their strategies to evolving market conditions.

1. Development of E-commerce and Digital Payment Systems

E-commerce and digital payment systems have become the foundation for companies entering international markets. Thanks to the growth of e-commerce platforms (such as Amazon, eBay, Alibaba), businesses can sell their products globally without requiring a physical presence. This significantly reduces operational costs, particularly in logistics and marketing, making business more accessible for small and medium-sized enterprises.

2. Digital payment systems (such as PayPal, Stripe, Apple Pay) enable companies to efficiently process transactions worldwide, ensuring high payment speed and reduced transaction costs. These technologies allow businesses to enter new markets more rapidly, attract more customers, and operate with international buyers without the complications of currency restrictions.

3. Digital Platforms and Tools for Efficient Supply Chain, Logistics, and Communication Management

Digital platforms for managing supply chains, logistics, and communication have become critically important for businesses operating in international markets. This includes supply chain management platforms (such as SAP, Oracle), which allow companies to track product movement, monitor inventory, and forecast demand. These systems help businesses reduce storage costs, avoid overstocking or stockouts, and improve overall efficiency.

In logistics, digital tools assist in optimizing delivery routes, reducing delivery times, and lowering transportation expenses [11]. Additionally, digital platforms facilitate efficient communication among all stakeholders in international business operations, simplifying interactions with partners, suppliers, and customers.

4. Regulation of the Digital Economy at the EU Level Through the Adoption of Standards and Norms

The regulation of the digital economy at the EU level plays a crucial role in fostering business development and ensuring compliance with international requirements. By adopting unified digital standards and legal frameworks, the EU creates a consistent regulatory environment that supports fair competition, protects consumer rights, and enhances trust in digital services. These regulations help harmonize digital business practices across member states, allowing companies to operate more smoothly within the Single Market and beyond. This regulatory consistency is especially important for cross-border transactions, data protection (such as GDPR), and cybersecurity compliance.

The European Union is actively working on the harmonization of regulatory frameworks concerning the digital economy to ensure fair conditions for businesses. This includes the development of standards for data protection (such as the General Data Protection Regulation – GDPR), ensuring cybersecurity, and creating legal frameworks for the use of emerging technologies such as artificial intelligence, blockchain, and the Internet of Things. The EU is also actively adopting legislation to support innovation while protecting the rights of consumers and small businesses. This includes the development of instruments to ensure equal competition conditions and

to safeguard citizens' interests in the digital space [12]. Such initiatives help businesses operate under a unified set of rules across the entire EU, which is essential for international operations.

Overall, the digital economy creates new opportunities for international business by allowing companies to significantly reduce costs and increase the efficiency of their operations. EU countries, by implementing digital strategies, foster innovation and competitiveness, supporting businesses in adapting to new technologies. However, successful management of international business in the digital age requires consideration not only of technical capabilities but also of legal and ethical aspects that define the proper functioning of the market.

The European Union pays particular attention to the development and regulation of the digital economy through the adoption of legislative acts and the creation of common standards for all its member states. The regulatory system of the digital economy in the EU aims to ensure fair competition, consumer rights protection, and cybersecurity. One of the key regulatory instruments is the General Data Protection Regulation (GDPR), which establishes strict requirements for the processing of personal data within the EU and governs their transfer outside the Union. GDPR (Table 9) helps prevent the misuse of personal information, creating conditions for more transparent and ethically responsible business practices.

In particular, the EU is actively working on standards for the development of cloud technologies, blockchain, artificial intelligence, and other advanced technologies. Within the framework of the European Digital Strategy, plans are also being implemented to create common infrastructures for the digital economy, such as platforms for electronic payments, digital identities, and product certification. These initiatives promote innovation and reduce barriers for companies entering the EU's single digital market.

At the same time, European digital market policy is focused on protecting intellectual property rights and ensuring a level playing field for businesses through the standardization of rules and regulations across all member states. On the other hand, the EU is actively taking

measures to regulate cybersecurity, which is critical for ensuring the security of information technologies and protecting businesses from cyber threats. One such step is the adoption of the Directive on Network and Information Security (NIS2), which establishes requirements for protecting critical infrastructure from cyberattacks.

Regulation also includes standards to ensure transparency of algorithms used in artificial intelligence and machine learning, aiming to protect consumer rights and prevent discrimination in automated decision-making.

Table 9

Key regulatory initiatives of the EU in the digital economy

Initiative	Description	Year Implemented
GDPR	Regulation for the protection of personal data and privacy	2018
Digital Single Market	Creating conditions for free trade of digital products and services within the EU	2020
NIS2 Directive	Cybersecurity regulation to ensure protection of critical infrastructures	2022
European Data Act	Standards for data processing, ensuring data availability and security	2021
Artificial Intelligence Act	Regulation of AI use to ensure ethical application and transparency of algorithms	2022

Source: compiled based on [2–6]

The EU's regulatory initiatives in the digital economy are aimed at creating a secure, transparent, and competitive digital environment. The GDPR, introduced in 2018, became a key document for personal data protection. The "Digital Single Market" initiative (2020) simplified the trade of digital services within the EU. To enhance cybersecurity, the NIS2 Directive was adopted in 2022, while the European Data Act (2021) established standards for data processing. The latest significant step was the regulation of artificial intelligence

(the Artificial Intelligence Act, 2022), which ensures the ethical use of algorithms. These initiatives contribute to the development of the digital economy by maintaining a balance between innovation and security.

The regulation of the digital economy in the EU (Table 10) is comprehensive and aims to create a safe and transparent environment for technological development. The introduction of the GDPR is an example of how the EU strives to control the processing of personal data and protect user privacy. This is a crucial element, as the growing use of big data, artificial intelligence, and the Internet of Things poses risks to personal security and citizens' privacy. GDPR implementation places requirements on organizations across the EU and sets fundamental data processing standards that foster trust in digital platforms.

On the other hand, the creation of the Digital Single Market stimulates the growth of innovative companies, lowers barriers for businesses, and allows them to enter new markets within the EU. This provides companies with significant development opportunities without the need to adapt to different national legislations, thus facilitating international business. Furthermore, the NIS2 Directive and other cybersecurity initiatives promote the development of a secure digital environment, which is necessary to protect critical infrastructure and ensure safety amid increasing cybersecurity threats.

It is also important to note that the EU is actively working on the standardization and regulatory framework for emerging technologies such as artificial intelligence and blockchain. This enables the establishment of ethical norms for the use of these technologies, ensuring their transparency and accountability. Against the backdrop of the growing adoption of artificial intelligence and automated decision-making, the EU is developing regulations that help maintain fairness and equality in relationships between consumers and businesses. These initiatives allow the European Union to become a leader in digital economy regulation on the international stage, providing businesses and consumers with a high level of security, transparency, and fairness.

Table 10

Statistics on the digital economy and regulation in the EU

Initiative	Key Indicators and Statistics	Impact/Changes
GDPR	400,000 infringement complaints, fines over €1 billion	Increased trust in digital platforms, improved personal data protection
NIS2 Directive	150,000 cyberattacks in 2022, rising cybersecurity incidents	Enhanced critical infrastructure security, standardization of cybersecurity measures
European AI Act	50 % of enterprises use AI, growth plan to 25,000 companies by 2025	Regulation of ethical AI use, ensuring transparency and fairness of algorithms
Digital Single Market	14 % growth in internal trade of digital services in 2021	Legalization and support of free trade in digital goods and services within the EU

Source: compiled based on [13; 14]

GDPR and personal data processing**:** According to the European Commission, the number of organizations violating GDPR requirements continues to rise. In particular, during the period 2020–2021, fines totaling over €1 billion were imposed for data protection breaches. Since its implementation in 2018, more than 400,000 GDPR infringement complaints have been filed. These figures demonstrate how seriously the EU treats compliance with data protection standards across all member states.

1. Cybersecurity and the NIS2 Directive: According to the report by the European Union Agency for Cybersecurity (ENISA), EU countries recorded over 150,000 cyberattacks in 2022, most of which targeted critical infrastructures and digital platforms. The NIS2 Directive aims to reduce these numbers through standardized security requirements and the prevention of cyber threats for critical sectors. It is forecasted that by 2025, the majority of companies in the EU will be required to comply with cybersecurity standards under this directive.

2. Artificial Intelligence and European Regulations: The European Union is also actively working on regulating artificial intelligence. According to data from the European Commission, more than 50 % of European enterprises already use AI for process automation and data analysis. In 2022, the Artificial Intelligence Act was adopted to regulate the use of such technologies, aiming to prevent potential ethical issues and ensure algorithmic transparency. Over 25,000 companies in the EU plan to implement AI by 2025, which necessitates the establishment of clear ethical standards for its application.

Regulation of the EU digital economy through initiatives such as GDPR, the NIS2 Directive, and the European AI Act significantly contributes to the development of digital markets within the EU by reducing risks for companies and ensuring data and infrastructure security. The establishment of clear norms and standards, for example regarding artificial intelligence, allows the EU to maintain leadership in innovative technologies while ensuring fairness and transparency. Thus, regulation promotes not only the growth of the digital economy but also the creation of a safe and ethical environment for businesses and consumers across Europe.

The European Union is actively working on regulating the digital economy to ensure transparency, security, and ethical use of emerging technologies. One of the key initiatives (Table 11) is the General Data Protection Regulation (GDPR), adopted in 2018 with the aim of strengthening the protection of personal data of EU citizens. GDPR sets strict requirements for the collection, processing, and storage of personal data, forcing companies worldwide to adapt their processes to comply with these standards. Violations of these regulations result in significant fines, encouraging adherence to high security standards.

Another important EU initiative is the NIS2 Directive (Network and Information Systems Directive), which came into effect in 2022. It focuses on improving cybersecurity across the EU, especially for critical infrastructures and key sectors such as energy, healthcare, and finance. The NIS2 Directive obliges companies to implement mechanisms to protect their information systems from cyber threats and to report cybersecurity incidents. This contributes to raising the overall security level of the Single Digital Market [15].

Table 11

Key EU Initiatives in Regulating the Digital Economy

Initiative	Description	Impact on Business and Society
GDPR	General Data Protection Regulation in the EU. Ensures high transparency and security in personal data processing	Enhances data privacy protection, reduces risks of consumer rights violations
NIS2 Directive	Regulates the strengthening of cybersecurity for important and critical infrastructures in the EU	Strengthens cybersecurity across sectors, improves reliability of infrastructure and data
European Artificial Intelligence Act	Establishes legal frameworks for the use of artificial intelligence in the EU, ensuring safety, transparency, and ethical AI application	Introduces rules for responsible AI use, reduces risks of abuse and discrimination
Digital Services Directive	Regulates digital service platforms, ensuring fair business conditions in the digital environment	Promotes healthy competition and consumer protection in digital markets

Source: compiled based on [16–17]

The third key initiative is the European Artificial Intelligence Act, adopted in 2021, which establishes legal norms for the use of artificial intelligence in the EU. This act aims to create a safe and ethical environment for AI applications, ensuring transparency and trust in automated systems. At the same time, it introduces clear rules for the development and use of AI systems to prevent discrimination, manipulation, or other abuses, thereby maintaining a balance between innovation and consumer rights protection.

The digital economy of the EU is actively regulated through key initiatives such as GDPR, the NIS2 Directive, and the European Artificial Intelligence Act, which enhance the security, ethics, and transparency of the digital market. The adoption of these standards is an important step toward creating a sustainable and secure digital

environment that fosters trust between consumers and businesses. For businesses, this means the need to adapt to new regulatory requirements, which reduces the risks of violations, improves reputation, and opens opportunities to operate within the EU's single digital market.

The EU also implements specific projects that demonstrate the effectiveness of its digital economy policies (Table 12).

The eIDAS Initiative ensures secure electronic identification and electronic signatures across all EU countries. This significantly reduces bureaucratic barriers, cuts administrative costs, and improves the efficiency of business processes, especially in the financial sector.

Table 12

Successful EU Projects to Promote Initiatives in the Digital Economy

Project	Description	Impact on Business and Economy
eIDAS	Initiative to ensure secure electronic identification and signatures across the EU	Simplifies transactions and enhances business security, reduces administrative costs
Digital Single Market	Development of a single digital market to provide seamless access to digital goods and services within the EU	Expands markets for businesses, improves competition, and stimulates e-commerce growth
Horizon 2020	Program funding innovations in technology, science, and research	Supports startups, fosters development of innovative technologies, and increases investment in the digital economy

Source: compiled based on [18]

The Digital Single Market Project aims to establish a single digital market by removing cross-border restrictions on digital goods and services. This allows businesses to expand their activities throughout the EU, promoting growth in online trade and competition among small and medium-sized enterprises.

The Horizon 2020 Program funds innovative research in artificial intelligence, cybersecurity, and big data. It supports the development

of high-tech startups and the commercialization of innovations, strengthening the EU's position in the global digital economy.

The implementation of projects such as eIDAS, Digital Single Market, and Horizon 2020 demonstrates the effectiveness of the EU's policy in supporting the development of the digital economy. These initiatives contribute to simplifying business processes, improving access to new markets, and stimulating innovation. Thanks to such projects, the European Union is actively moving towards the creation of a unified digital space, which holds significant potential for further economic and technological development in the region.

Conclusions. The digitalization of the economy has fundamentally changed approaches to organizing and managing international business. The use of cutting-edge information technologies, such as big data, artificial intelligence, and automation, enables enterprises to improve the efficiency of managerial decisions, reduce costs, and increase competitiveness in global markets. The transformation of business processes through digital technologies opens new opportunities for company development in a rapidly changing international environment. European countries are actively adapting to these new realities by integrating digital innovations into international business strategies. European enterprises strive to ensure a high level of security and data protection, which is a crucial aspect in the context of international operations. The integration of digital technologies also allows businesses to operate more effectively within the European Union's single digital market, reducing barriers to international trade and promoting the development of European startups and innovative companies.

For the successful development of international business in the digital economy, it is important to ensure further integration of cutting-edge technologies into corporate strategies, develop employees' digital skills, and create infrastructure for secure data exchange. It is also recommended to strengthen cooperation between governments, businesses, and academic institutions to create a favorable environment for innovation and support digital startups. Additionally, raising consumer trust in digital platforms and maintaining transparency in data usage are vital.

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1.3. DIGITAL TRANSFORMATION OF INVENTORY ACCOUNTING: EUROPEAN PRACTICE AND UKRAINIAN REALITIES

Introduction. Digital transformation of inventory accounting is becoming an important stage in the development of modern enterprises, as it opens up new opportunities for optimizing material resource management, reducing costs and increasing the efficiency of production processes. In the context of rapid globalization and technological development, the use of innovative information systems in the field of inventory accounting allows for significantly simplifying

and automating data processing, which leads to more accurate control over resources and prompt response to changes in market conditions.

The relevance of the topic is due to several important factors.

Firstly, digitalization is a global trend that covers all sectors of the economy, including the inventory accounting sector. European countries are already actively implementing modern information technologies to automate this process, which allows them to achieve high results in resource management, ensure accurate accounting and reduce costs for storage and processing of inventories. This includes the use of solutions based on artificial intelligence, the Internet of Things (IoT), automated inventory management systems, and blockchain technologies to ensure transparency and traceability of inventory.

Secondly, for Ukraine, in the conditions of constant economic instability and the need to ensure effective management of limited resources, the digital transformation of inventory accounting is no less important. However, domestic practice has not yet reached the same level of integration of digital technologies into this process as in European countries. This creates certain difficulties and barriers for enterprises wishing to implement innovative technologies, and requires a deeper analysis of existing problems, opportunities and prospects for the development of this area.

Thus, the study of the digital transformation of inventory accounting in the context of European practice and Ukrainian realities is extremely relevant, since it allows not only to identify the main problems that hinder the effectiveness of this process in Ukraine, but also to formulate recommendations for the implementation of advanced European practices taking into account national characteristics and needs of enterprises. This will be an important step towards modernization and increasing the competitiveness of the Ukrainian economy in the global context.

Presentation of the main results of the study. During the study, it is important to pay attention to the research of domestic and foreign scientists studying this problem. Since digitalization is an important direction of development of modern business, numerous scientific works cover both theoretical and practical aspects of implementing

the latest technologies in the field of accounting and inventory management.

In order to better understand the current state of research, an analysis of the works of domestic and foreign scientists related to the digital transformation of inventory accounting was carried out. Table 1 below provides a comparative overview of the main studies in this area.

Table 1

Comparative analysis of scientific research in the field of digital transformation of inventory accounting

Authors	Researched questions
1	2
Andrusyak V. M., Khoroshilova I. O., Smirnova N. V. [4]	Studying the impact of digitalization on accounting and auditing in Ukraine, in particular: adaptation of enterprises to new technologies, changes in control processes, implementation of automated systems to increase the efficiency of auditing and accounting, analysis of the problems and benefits of digital transformations in accounting.
Svystun L. A., Nosenko D. O. [10]	Digitalization of inventory management processes at enterprises, including: automation of production inventory accounting, use of ERP systems for inventory management, improvement of real-time control and accounting processes, as well as the benefits of digital technologies in reducing storage and supply costs.
Shevchuk O., Muravsky V. [12]	Innovative technologies in accounting: implementation of the latest information systems for accounting automation, use of blockchain technologies for accounting transparency, implementation of machine learning systems to improve inventory forecasting processes, as well as integration of modern IT solutions into financial inventory control.
Semenova S. [11]	The role of digital technologies in accounting processes, features of the implementation of automated accounting systems in Europe, studying the experience of EU countries in automating financial forecasting, using analytical tools to optimize inventory management, and integrating Big Data technologies into accounting and control.

Continuation of Table 1

1	2
Kulyk V. A., Karpenko E. A. [7]	Process-oriented inventory management: research into the effectiveness of implementing automated accounting systems, integration of inventory management technologies with other enterprise functions (production, logistics, finance), the impact of automated systems on reducing costs and increasing accounting accuracy.
Desyatnik M. V., Korol S. Ya. [5]	Automation of accounting and inventory management in crisis situations, in particular in war conditions: the use of flexible and adaptive systems for inventory management, analysis of the problem of supply disruptions, implementation of reservation and distribution systems for goods, as well as the role of digital solutions in optimizing inventories in unstable conditions.
Aishwarya Lakshmi S., Keerthana R., Pradeep S., Dr. J. Krithika [1]	Digital transformation of supply chain management: research into the role of digital technologies (ERP, IoT, AI) in reducing inventory management costs, improving logistics and supply chain management, the role of data in optimizing costs and forecasting enterprise needs, and implementing the latest IT solutions in global supply chain management.
Bruhns H. R. [2]	The role of artificial intelligence in inventory management: research into implementing AI to forecast inventory needs, developing automated inventory systems, optimizing supply chains using AI, creating adaptive inventory systems that can anticipate market changes and quickly adapt processes.

Source: compiled based on [1; 2; 4; 5; 7; 10; 11; 12]

Analysis of scientific research indicates an active interest in the digitalization of inventory accounting both in Ukraine and abroad. Domestic researchers focus on the impact of digital technologies on accounting systems, analyzing the benefits and challenges of their implementation. Foreign works, in particular the experience of EU countries, provide valuable information on the use of ERP systems, big data analytics, artificial intelligence and blockchain in accounting processes. These studies emphasize the importance of integrating

modern technologies to improve the efficiency of inventory management and financial forecasting.

After considering scientific views and research, in particular on the implementation of digital technologies in inventory accounting, the importance of a detailed analysis of the problems faced by enterprises on the path of digital transformation in this area becomes obvious. Problems that arise during the transition to digital accounting systems require comprehensive research, as they directly affect the efficiency of inventory management and the financial results of enterprises.

Studying the problems of digital transformation of inventory accounting is an important stage in the process of modernization of accounting and management processes at enterprises, as it allows not only to identify existing barriers and challenges, but also to suggest ways to overcome them. Determining the main causes of these problems is critical for the successful implementation of new technologies and achieving maximum effect from their application in inventory accounting.

Considering the above, the study of the problems of digital transformation of inventory accounting is extremely relevant and requires in-depth analysis both for Ukrainian realities and for European experience, since it is these problems that can determine the further efficiency and sustainable development of production processes at enterprises (Table 2).

One of the main problems is the lack of full automation of inventory accounting processes, as well as the insufficient level of integration of accounting systems with other business functions (finance, production, logistics). Many enterprises use outdated or disparate software solutions, which complicates data exchange between different departments and, accordingly, reduces the efficiency of inventory management.

The increase in the volume of data generated by the digitalization of accounting creates new challenges for enterprises in processing and analyzing this data. Many companies face problems in correctly interpreting large volumes of information, which reduces the accuracy of forecasts and the efficiency of inventory management.

Table 2

Problems of digital transformation of production inventory accounting and their causes

Problems of digital transformation	Causes of occurrence
Insufficient level of automation and integration of systems	– high cost of implementing new technologies; – lack of qualified IT specialists; – uncertainty in choosing the optimal technological solutions.
Difficulty in processing and analyzing large amounts of data	– lack of powerful analytical tools for processing large amounts of data; – imperfection of existing forecasting algorithms; – lack of skills among employees to work with new tools.
Problems in data security and information protection	– imperfect information protection system in old IT systems; – lack of proper training of personnel on cybersecurity; – increased risk of cyberattacks due to insufficient use of modern protection tools.
Resistance to change from staff	– lack of motivation for change among employees; – insufficient qualification of personnel; – psychological unpreparedness for changes in work processes.
High costs of implementing new technologies	– high initial costs for software development and implementation; – additional investments for personnel training; – uncertainty in the return of investments at the first stages of transformation.

Source: compiled based on [3; 6]

Digital technologies create new threats to data security. Enterprises can be subject to hacker attacks, information leaks or data loss, which can lead to serious financial and reputational losses. Given the sensitivity of inventory accounting data, the issue of information protection is critically important [3].

An equally important problem is the resistance of personnel to the implementation of new digital technologies. Changes in accounting

processes require employees to acquire new knowledge and skills, as well as a willingness to adapt to new working conditions. This can cause stress and reduce efficiency during the transition to digitalization.

Digitalization requires significant financial investments in the development and implementation of new technologies, as well as in personnel training and system support. For small and medium-sized enterprises, this can be a serious financial According to the analysis of the problems of digital transformation of inventory accounting, it can be noted that the introduction of new technologies into this process faces several significant barriers. The main problem is the insufficient level of automation of accounting processes and low integration of systems between different business functions, which reduces the efficiency of inventory management.

The issue of processing and analyzing large volumes of data is also important, since many enterprises lack the necessary tools for their effective processing [6]. Particular attention should be paid to cybersecurity issues, since the increase in digital technologies increases the risks of data leaks and cyberattacks. In addition to technical aspects, an important problem is personnel resistance to change, which complicates the process of transition to new digital systems.

Finally, the high costs of implementing new technologies are another significant barrier for many enterprises, especially small and medium-sized ones. Thus, to effectively overcome these problems, it is necessary to develop strategies that include the comprehensive implementation of automated systems, employee training, and significant investments in cybersecurity and infrastructure. This will allow you to maximize the potential of digital technologies for effective inventory management.

Digital transformation is one of the main trends in the modern business environment, and its impact on accounting, in particular on inventory accounting, is extremely important. In European countries, modern technologies such as ERP systems, IoT, and AI have long been integrated into inventory management processes,

which allows you to significantly increase efficiency, reduce costs, and optimize supply chains. In Ukraine, although digitalization is developing, many enterprises still face problems integrating the latest technologies into their inventory management processes, in particular due to the high costs of implementing technologies, lack of qualified personnel, and lack of a sufficiently developed IT infrastructure. Below in Table. 3 presents a comparative analysis of European practice and Ukrainian realities in the digital transformation of inventory accounting [8].

Table 3

A comparative analysis of European practice and Ukrainian realities in the digital transformation of production inventory accounting

Parameter	European practice	Ukrainian practice
Inventory accounting automation	Using integrated ERP systems, IoT, AI for inventory management. Processes are automated, data is processed in real time.	Many enterprises use outdated software solutions, automation in the initial stages.
Integration with other functions	High integration with finance, production, logistics, which allows you to reduce costs and improve forecast accuracy.	Low integration between accounting systems and other business functions, which reduces the efficiency of inventory management.
Reducing costs and increasing efficiency	Using blockchain technologies, AI to optimize processes, reduce storage and transportation costs.	The use of technologies is only at some enterprises, but significant spread has not yet been observed.
Risks and barriers	High implementation costs, employee qualifications, cybersecurity. Investments in staff development and IT infrastructure.	High initial costs, lack of qualified IT specialists, staff resistance to change.

Source: compiled based on [8; 9]

As we can see, inventory automation in Europe is actively using integrated solutions, which allows to reduce costs and increase accounting accuracy. In Ukraine, this process is at an early stage, and many enterprises are still working with outdated software products.

The integration of inventory accounting with other business functions is an important component of success in Europe, where such integrated systems allow to reduce errors and improve enterprise management. In Ukraine, enterprises face problems of integration of various functions, which reduces the efficiency of management processes.

Technologies for reducing costs and increasing efficiency, in particular blockchain and artificial intelligence, are actively implemented in European countries and provide significant savings and transparency in supply chains. In Ukraine, these technologies have not yet been widely used, although interest in them is growing.

The risks and barriers to digital technology adoption are similar in both regions, but in Ukraine these problems are more pronounced due to the lack of qualified personnel and the high costs of initial technology implementation [9].

Thus, while Europe is already using digital technologies for inventory management at a fairly high level, Ukraine still needs to overcome a significant number of barriers to successful transformation in this area. Investing in IT infrastructure, developing personnel, and overcoming psychological resistance to change are important steps for Ukraine on the path to digitalizing inventory accounting.

As the analysis shows, the introduction of digital technologies in inventory accounting provides significant benefits, such as reducing costs, increasing accounting accuracy, optimizing logistics processes, and integrating with other business functions. However, the key factor determining the speed and scale of digital transformation is investment in technology and infrastructure.

Investing in digitalization of inventory accounting is a strategic decision with long-term consequences. It requires significant initial investments in software, hardware, personnel training and adaptation of business processes. At the same time, in European countries such investments have already proven their effectiveness, allowing businesses not only to reduce costs, but also to increase competitiveness.

In view of this, it is important to consider in more detail the investment aspect of digitalization – what investments are needed, what sources of financing can be attracted, how the effectiveness of such investments is assessed and what financial risks should be taken into account. Researching these issues will allow assessing the real capabilities of Ukrainian enterprises to implement modern technologies and develop optimal approaches to their financing.

Ukrainian companies are gradually implementing digital solutions for inventory accounting. For example, Kormotech, a leading manufacturer of animal feed, successfully implemented the INTUIFLOW system, which led to an increase in production and sales by 40 % while maintaining overall inventory levels and reducing finished goods inventories by 45 %.

Another example is YUKO, a lubricants manufacturer, which, after implementing INTUIFLOW in its distribution, achieved a halving of inventory and a 60 % increase in sales in the first four months.

Pharmaceutical company Farmak invested 9 million euros in implementing a new drug production site equipped with advanced digital solutions that ensure maximum sterility and increase labor productivity.

In Europe, the digitalization of inventory accounting is part of broader initiatives to implement Industry 4.0. A study of Portuguese companies showed that they face problems such as a lack of vertical and horizontal integration of information systems, poor data quality and insufficient use of MES (manufacturing execution systems).

At the same time, large European companies are actively investing in digital technologies for inventory management. For example, companies using the SAP S/4HANA system can automate warehouse and inventory management processes, which increases supply chain efficiency.

Investing in digitalization of inventory accounting is necessary to increase the efficiency and competitiveness of enterprises. Ukrainian companies that have implemented modern digital solutions have achieved significant improvements in inventory management

and sales growth. European experience emphasizes the importance of integrating information systems and using advanced technologies to optimize inventory management processes. However, for successful digitalization, it is necessary to take into account factors such as technical infrastructure, personnel training, and integration of new systems into existing business processes [6].

For the successful implementation of digital technologies, Ukrainian enterprises should take into account the experience of European companies that have already achieved a high level of automation. Important aspects of this process are process optimization, personnel training, cybersecurity, and strategic investments.

Below is Table 4, which contains the main practical recommendations for digitalization of inventory accounting in the context of Ukrainian realities and European experience.

Table 4

Practical recommendations for Ukraine on digitalization of inventory accounting

Destination	Ukraine	Europe	Recommendations for Ukraine
1	2	3	4
Accounting automation	Partial implementation of ERP systems, use of IT-Enterprise, MASTER, but many processes remain manual	Wide use of SAP, Oracle, Microsoft Dynamics, warehouse automation using WMS, RFID	Implementation of complex ERP systems, integration with warehouse and logistics modules
Staff training	Low level of digital literacy, lack of mandatory accounting automation programs	High level of specialist training, continuous professional development	Development of corporate training programs, implementation of online courses, cooperation with universities

Continuation of Table 4

1	2	3	4
Investments in digital transformation	Limited funding, dependence on government support programs	High level of investment in innovation, active support from the state and the EU	Introduction of tax breaks for businesses, creation of state grants for digitalization
Cybersecurity	High risks of cyberattacks, low level of data protection	Strict legal regulation, multi-level protection, certified security systems	Development of national cybersecurity standards, employee training, information security audit
Strategic planning	Lack of long-term digitalization strategies	Clear plans and roadmaps for implementing digital solutions	Development of state and corporate digital transformation strategies

Source: compiled based on [6]

The proposed recommendations are aimed at overcoming key barriers in the digitalization of inventory accounting of Ukrainian enterprises. Optimization of automation processes, staff training and investments in cybersecurity will contribute to increasing the efficiency of inventory management. The implementation of modern domestic software solutions will ensure that accounting processes comply with international standards and improve the competitiveness of Ukrainian companies.

Conclusions. Thus, based on the research conducted, we note that the digitalization of inventory accounting is an important stage in the development of modern accounting, which ensures increased efficiency of resource management, transparency and accuracy of accounting processes. Analysis of European experience shows that the successful implementation of digital technologies

in this area contributes to cost optimization, reducing fraud risks and improving managerial decision-making. At the same time, Ukraine faces a number of challenges, including regulatory and legal restrictions, insufficient technical support and low digital literacy of personnel. For further effective implementation of digital solutions in inventory accounting in Ukraine, it is necessary to improve the legislative framework, invest in modern technologies, and improve the qualifications of accounting personnel. Only a comprehensive approach to digital transformation will allow Ukrainian business to integrate into global economic processes and increase its competitiveness.

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1.4. DIGITALISATION OF THE UKRAINIAN ECONOMY IN THE CONTEXT OF EUROPEAN INTEGRATION

Introduction. In today's world, digitalisation is a defining trend in the development of national economies, transforming traditional business models and creating new opportunities for competitiveness. The relevance of the study is driven by the need for a deep understanding of the current state of digitalisation of the Ukrainian economy in the context of European integration processes. The purpose of this article is to analyse the current state of digitalisation of the Ukrainian economy in the context of its European integration aspirations based on international indices and compare it with the EU's digital transformation goals. The results of the study will help identify the strengths and weaknesses of digital transformation in Ukraine and formulate recommendations to accelerate its European integration in the digital sphere.

The main material of the research. The term "digital economy" was first used in the scientific discourse in 1995, which was directly related to the rapid development of economic relations based on digital information and communication technologies [1]. Over time, this

concept has gained considerable importance and has become firmly established in modern scientific usage.

To date, there is certain diversity in the scientific environment in the interpretation of the essence of the 'digital economy'. In particular, G. Karcheva defines the digital economy as an innovative and dynamic economic paradigm, the key characteristics of which are the active introduction of innovations and information and communication technologies in all types of economic activity and spheres of public life without exception [2]. This approach, in her opinion, contributes to the growth of efficiency and competitiveness of both individual enterprises and the national economy as a whole, as well as to improving the living standards of the population. On the other hand, S. Koliadenko interprets it as a system based on the creation of electronic goods and services by high-tech business units and their further distribution through e-commerce mechanisms [3]. In addition, the digital economy is seen as a complex set of relations arising in the processes of production, distribution, exchange and consumption based on online technologies and focused on meeting the needs for life's goods [4]. This leads to the formation of fundamentally new ways and methods of doing business and requires the development and implementation of effective state regulation tools.

Analysing the above definitions, it can be stated that a common element in different approaches to understanding the digital economy is the emphasis on the key role of information and communication technologies as the basis for new forms of economic interaction and value creation.

Based on this, we can identify a number of characteristic features of the digital economy, including the intensive use of digital technologies in all sectors of the economy, the growing importance of e-commerce and online, the production and consumption of digital content and services, the formation of new business models, databases, and the increasing level of automation and digitalisation of production processes.

In Ukraine, the first signs of a digital economy can be traced back to the early 2000s with the growth of Internet penetration and the development of the first forms of e-commerce. The gradual expansion of the use

of information technology in the banking sector, telecommunications, and other industries has been a sign of the preconditions for deeper digitalisation of the economy in the years to come.

The intensification of Ukraine's European integration course has given a significant impetus to the digitalisation process. The European Union defines far-reaching goals in the field of digital transformation for such key elements as skills, infrastructure, business, and government in the framework programme Digital Compass 2030: The European Way to the Digital Decade [5].

In the context of skills development, the strategic goal is to ensure that at least 80 % of all adults have basic digital skills and that the EU has 20 million employed ICT professionals with a greater gender balance in this area.

In terms of infrastructure, the key objective is to create a secure, productive and resilient digital infrastructure, including gigabit connectivity for all EU households, 5G coverage of all settlements, doubling the EU's share of global production of advanced and sustainable semiconductors, deploying 10,000 (ten thousand) climate-neutral, highly secure edge nodes and developing the first quantum accelerated computer.

In the area of business development, the priority remains to accelerate the digital transformation of businesses, with the aim of ensuring that 75 % of EU companies use cloud computing services, big data and artificial intelligence; more than 90 % of SMEs reach at least a basic level of digital intensity; and the number of EU "unicorns" is doubled.

As for the government, the ambitious goal is to digitise public services to ensure 100 % online delivery of key public services, 100 % citizen access to their electronic health records, and 80 % citizen use of a digital identification solution.

For Ukraine, alignment with the goals and principles of the "Digital Compass 2030…" – programme is extremely important for its European integration aspirations and the modernisation of its economy and society. An overview of Ukraine's participation in key European programmes aimed at supporting digital transformation is presented in Table 1.

Table 1

Ukraine's participation in European digitalisation programmes

Programme name	Source of funding	Main goals and directions
EU4Digital Programme	European Union	Supporting the development of the digital economy and society in the Eastern Partnership countries (including Ukraine). Improving online services, enhancing cybersecurity, developing digital infrastructure, facilitating digital trade and harmonising digital markets with the EU.
Digital Europe Programme	European Union	Providing access to funding for projects in the areas of high-performance computing (€2.2 billion), artificial intelligence, data and cloud services (€2.1 billion), digital skills (€580 million), and the use of digital technologies in the economy and society (€1.1 billion).
EGAP Programme (E-Governance for Government Accountability and Participation)	Eastern Europe Foundation Innovabridge Foundation in partnership with the Ministry of Digital Transformation	Promoting the digitalisation of regions and the development of e-government.

Source: [6; 7; 8]

Thus, Ukraine is using a variety of tools to stimulate the development of its digital economy and to bring it closer to EU standards in this important area.

In this context, an analysis of the current state of the digital economy in Ukraine is of particular relevance. A detailed understanding of the current situation is a prerequisite for developing effective strategies and policies aimed at accelerating the

country's digital transformation and its integration into the European digital space.

The Digital Economy and Society Index (DESI) is a valuable tool for assessing the progress of EU member states in the digital sphere, but Ukraine, not being a member of the EU, is not officially assessed by this methodology [9]. At the same time, to gain a broader understanding of the current state of digital transformation in Ukraine, it is advisable to turn to other international metrics. One such authoritative tool is the Global Innovation Index (GII). The GII assesses the innovation capabilities and outcomes of countries around the world using about 80 indicators grouped into blocks of innovation resources and outcomes.

In 2024, Ukraine was ranked 60th among 133 countries, showing a decline from 55th place in 2023 [10]. The dynamics of Ukraine's position in the Global Innovation Index (GII) in the period from 2020 to 2024 are set out in Table 2.

Table 2

Dynamics of Ukraine's position in the Global Innovation Index (GII)

Year	Place in the GII	Innovation costs	Innovation results
2020	45th	71th	37th
2021	49th	76th	37th
2022	57th	75th	48th
2023	55th	78th	42th
2024	60th	78th	54th

Source: [10]

Thus, there is a downward trend in Ukraine's overall ranking, from 45th in 2020 to 60th in 2024. The Innovation Expenditures indicator shows relative stability with a slight increase in 2023–2024, but remains at a rather low level. At the same time, Innovative Outputs fluctuated, but generally showed an increase until 2024. For a deeper understanding of the current situation, it is advisable to consider key indicators that characterise various aspects of Ukraine's digital economy: the state of the institutional and business environment, the

level of human capital and research, and the level of infrastructure development.

An assessment of the institutional and business environment based on the Global Innovation Index (GII) for 2024 is presented in Table 3.

Table 3

Assessment of the institutional and business environment based on the Global Innovation Index (GII) for 2024

№	Category	Indicator	Score / Value	Place
1	**Institutions**		**30.8**	**107**
1.1	**Institutional environment**		**28.8**	**117**
1.1.1		Operational stability for business	26.7	123
1.1.2		Government effectiveness	31.0	99
1.2	**Regulatory environment**		**25.3**	**106**
1.2.1		Quality of regulation	33.1	90
1.2.2		Rule of law	17.5	115
1.3	**Business environment**		**38.2**	**84**
1.3.1		Policy stability for doing business	46.0	72
1.3.2		Business policy and culture	30.3	54

Source: [10]

The data indicate that there are significant challenges in the institutional and regulatory environment that may hinder innovation. The business environment has some strength, but also requires further strengthening, especially in terms of support for entrepreneurship. These findings highlight the need for reforms aimed at improving stability, public administration, regulatory quality and the rule of law to create a more favourable climate for innovation and economic growth.

Another important aspect for analysing Ukraine's digital economy is the assessment of human capital. The assessment of human capital and research based on the Global Innovation Index (GII) for 2024 is presented in Table 4.

Table 4

Assessment of human capital and research based on the Global Innovation Index (GII) for 2024

№	Category	Indicator	Score / Value	Place
2	**Human capital and research**		34.3	54
2.1	**Education**		**58.9**	**43**
2.1.1		Expenditure on education, % of GDP	5.9	16
2.1.2		Public funding per pupil (secondary school), % of GDP/per capita	28.5	10
2.1.3		Expected duration of schooling, years	13.3	76
2.1.4		PISA results in reading, mathematics and science	439.5	43
2.1.5		Pupil-teacher ratio (secondary school)	8.3	18
2.2	**Higher Education**		**37.2**	**49**
2.2.1		Gross tertiary enrolment, %	70.7	44
2.2.2		Graduates in science and engineering, %	25.7	40
2.2.3		Inward mobility of higher education students, %	4.9	50
2.3	**Research and development (R&D)**		**7.0**	**69**
2.3.1		Researchers (FTE) per million population	580.8	66
2.3.2		Gross expenditure on R&D, % of GDP	0.3	70
2.3.3		Global corporate investors in R&D (top 3), US$ millions	0.0	41
2.3.4		QS University Rankings (top 3)*	16.9	56

Source: [10]

Overall, Ukraine has some strength in education, particularly in terms of public funding per pupil (secondary school), but the data suggests that the research and development sector needs to be significantly strengthened to stimulate innovation and the development of the digital economy.

This is critical for stimulating innovation, which, in turn, is a prerequisite for strengthening national socio-economic sustainability and ensuring the country's competitiveness in the context of global digitalisation of the economy. An analysis of the current state of innovation shows that Ukraine lags far behind in terms of the number of start-ups, which are key drivers of innovation. In particular, there are only 33 start-ups per million people in Ukraine, which is significantly lower compared to 500 in the European Union [11; 12].

Given the identified needs to stimulate innovation and the overall context of global digitalisation of the economy, the state of infrastructure development is an equally important aspect for a comprehensive analysis. The quality and accessibility of digital infrastructure, including broadband, mobile communications, and cybersecurity, is the fundamental basis for deploying digital services, supporting businesses, and ensuring effective interaction in the digital economy. An assessment of the level of infrastructure development in Ukraine based on the Global Innovation Index (GII) for 2024 is presented in Table 5.

In the area of information and communications technology (ICT), Ukraine scores relatively well (75.6, 56th place), particularly in terms of access to ICT. Online government services are rated quite high (79.5, 34th place), and e-participation is at an average level (59.3, 57th place). However, general infrastructure is rated much lower (13.8, 117th). Electricity production per capita is relatively high, but logistics efficiency and gross fixed capital formation are low.

Conclusions. Summarising the analysis based on the Global Innovation Index (GII) for 2024, the following conclusions can be drawn about the current state of Ukraine's digital economy. The country's overall position in the ranking demonstrates a negative trend, indicating the need to intensify efforts to stimulate innovative development.

Table 5

Assessment of the level of infrastructure development in Ukraine based on the Global Innovation Index (GII) for 2024

№	Category	Indicator	Score / Value	Place
3	**Infrastructure**		**35.5**	**82**
3.1	**Information and communication technologies (ICT)**		**75.6**	**56**
3.1.1		Access to ICT	87.9	74
3.1.2		Use of ICT	–	–
3.1.3		Online government services	79.5	34
3.1.4		E-participation	59.3	57
3.2	**General infrastructure**		**13.8**	**117**
3.2.1		Electricity generation, GWh/million population	3 605.8	60
3.2.2		Logistics efficiency	27.3	76
3.2.3		Gross fixed capital formation, % of GDP	14.1	125
3.3	**Environmental sustainability**		**17.3**	**81**
3.3.1		GDP per unit of energy consumption	5.5	115
3.3.2		Use of low-carbon energy, %	31.3	32
3.3.3		ISO 14001 environmental certificate/US$ billions of GDP at PPPU Low-carbon energy use, %	0.8	81

Source: [10]

An assessment of the institutional and regulatory environment has identified significant challenges that could hinder innovation and economic growth. The operational stability of businesses, government efficiency, and the rule of law need to be improved. At the same time,

the business environment has certain strengths, but requires further support, especially in terms of entrepreneurship development.

In terms of human capital and research, Ukraine performs relatively well in education, particularly in terms of funding and pupil-teacher ratios. However, the research and development sector is a weak link and needs to be significantly strengthened to ensure sustainable innovation development.

In terms of infrastructure, Ukraine has made some progress in information and communications technology and the development of online government services. However, the overall state of the infrastructure, especially in terms of logistics and investment, remains insufficient.

In general, to accelerate digital transformation and strengthen Ukraine's competitiveness, comprehensive reforms are needed to improve the institutional and regulatory environment, intensify research and development, develop human capital, and modernise infrastructure. Successful integration into the European digital space requires systematic efforts and a strategic approach to the development of the digital economy.

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1.5. IMPACT OF GLOBAL CHALLENGES, INCLUDING THE COVID-19 PANDEMIC, ON BUSINESS PROCESS TRANSFORMATION

Introduction. The modern economy is undergoing constant changes under the influence of globalization processes, technological progress and crisis phenomena, among which the COVID-19 pandemic has become one of the most powerful challenges of recent decades.

This period was a test for many businesses that were forced to adapt their business models, accelerate the adoption of digital technologies, and rethink approaches to business process management. Therefore, the issues of enterprise digitalization were studied by: Zub P., Kalach G. [1], Kononenko J. A., Karnaukhova G. V., Balyuk O. V. [2], Korobka S. V. [3], Lisova R. M. [4], Fedulova L. I. [5], Cherep A. V., Dashko I. M., Ohrenych Yu. O. [6], Cherep A., Cherep O., Ohrenych Yu., Kurchenko M. [7], Cherep O. H., Dashko I. M., Bekhter L. A., Pidlisnyi R. O. [8], Cherep O. H., Oleinikova L. H., Bekhter L. A., Veremieienko O. O. [9], Cherep A. V., Ohrenych Yu. O., Oleinikova L. H., Veremieienko O. O. [10]. But it is advisable to study the processes of digital transformation in the context of globalization.

Summary of the main results of the study. An example of an effective digital transformation is the activities of the Ukrainian logistics operator Nova Poshta LLC, which, even in the face of the pandemic, has demonstrated the ability to adapt flexibly and develop rapidly. Thanks to the introduction of digital services, automation of logistics operations, and effective monitoring of internal processes, the company has maintained its competitiveness and strengthened its market position [11].

In modern management, the term "business process" is considered to be a set of interrelated actions or tasks performed to create value for the end user. However, for a full understanding of this phenomenon, a general definition is not enough – it is important to analyze the deep essence of business processes as a key component of the enterprise's functioning.

The essence of a business process is that it is a structured, holistic and repeatable activity that has a clearly defined input (resources, information), a sequence of logically related actions and a result – a specific product or service that creates value for an internal or external customer. In this context, a business process is not an isolated function or task, but an end-to-end system that integrates various business units into a single coordinated model of action [12].

The key characteristics of business processes include:

– focus on results that satisfy customer requirements;
– sequence and logic of operations;

– repeatability – processes are carried out regularly and can be documented;

– formalization – processes can be described, modeled and optimized;

– cross-functionality – covering several structural units of the enterprise;

– potential for improvement through monitoring and digital technologies [13].

Thus, the essence of a business process is revealed in its ability to ensure consistency, efficiency and controllability of the enterprise's activities, orienting it towards achieving strategic and operational goals.

Business Process Management (BPM) involves a comprehensive methodology within which processes are not only identified, but also actively monitored, analyzed, optimized and automated [14].

In this context, monitoring of business processes is a critical element of the management system – it identifies deviations, risks, bottlenecks and provides management with objective data for decision-making. Monitoring allows you to assess the effectiveness of processes, timely identify imbalances between planned and actual indicators, and quickly respond to changes in the environment.

The main approaches to monitoring business processes include:

– operational monitoring focused on tracking current kpi in real time;

– tactical monitoring, which allows to analyze intermediate results and dynamics of changes;

– strategic monitoring, which ensures that business processes are in line with the company's long-term goals [15].

On the technological side, monitoring can be implemented through integration with ERP systems (e.g., SAP, Microsoft Dynamics), BPM systems, Business Intelligence (BI) tools, and digital dashboards that provide real-time visualization and analytics. Business process monitoring is especially relevant in the context of global challenges, such as the COVID-19 pandemic. During this period, companies faced the need to quickly adapt operational schemes, transfer some processes

to remote mode, and ensure the stability of supply and service chains. Only effective digital monitoring made it possible to maintain control, reduce risks and ensure business continuity [16].

Business management has always been a complex system that requires a precise balance between strategic vision and flexibility in decision-making. However, with the development of digital technologies, these approaches have undergone significant changes. Digitalization is no longer just a tool for automating routine operations. It has become an all-encompassing management paradigm that shapes new models of business organization, transforms the interaction between departments, and changes the very logic of enterprise management.

In the 21st century, digital technologies have become key to increasing the competitiveness of companies. Previously, innovation was perceived as an additional advantage, but today it is a matter of survival. This was especially evident during the COVID-19 pandemic, which exacerbated the need for rapid response, flexible planning, remote control, and rapid information exchange. Businesses that had the proper digital infrastructure were able to maintain their efficiency, while others found themselves facing the need to accelerate the implementation of digital solutions in a crisis mode [17].

Modern management in the digital era is increasingly based on the principles of transparency, integration, and analytics. Whereas earlier decision-making was based mainly on a manager's intuition or limited information, today the emphasis is shifting to objective data collected in real time. This is changing not only the tools used by the management apparatus, but also the very concept of management: linear vertical structures are gradually being replaced by flexible, decentralized models in which each unit can respond quickly to changes in the environment, having access to complete information.

An example of a successful implementation of digital management transformation is Zara, which actively implemented a fast fashion model based on digital demand analysis even before the pandemic. The system of collecting data from retail stores and online channels allowed the company to make management decisions based on real

consumer demand. This allows Zara to respond to changing trends in a matter of days, which is made possible by the digital integration of logistics, production, and marketing. Another striking example is Siemens, which has digitized its internal control system for production processes by integrating IoT solutions into production lines. This made it possible not only to monitor the condition of the equipment but also to automatically predict potential failures, planning maintenance before a breakdown occurs. Thus, enterprise management has become more predictable and adaptive, and decision-making has become fast and data-driven [18].

At the same time, digitalization is changing the requirements for management. A manager must be not only a strategist, but also an analyst who can work with large amounts of data, understands the principles of cybersecurity, knows how to coordinate digital teams, and is familiar with modern software. This requires new approaches to the formation of management teams and staff training.

However, despite its many benefits, digitalization of management remains a complex process, often accompanied by employee resistance, difficulties in integrating new systems, and the need for significant investment. Many companies trying to go digital face the problem of incompatibility between the old organizational culture and new technological approaches. Without an appropriate change in mindset, digitalization risks remaining just a technical modernization without any real management effect [19].

Thus, digitalization in management is not only about technology, but also about changing the principles, values, and logic of interaction within the enterprise. It requires a systematic approach, strategic vision and readiness for deep transformations. In a world where global challenges are becoming more and more frequent, digital thinking is becoming the basis for business sustainability and flexibility.

The COVID-19 pandemic has become not only a global health and social crisis, but also a powerful catalyst for economic transformation. Businesses around the world found themselves in a situation where their usual business models had lost their effectiveness, and classic management and operational processes needed to be immediately

restructured. This global challenge has dramatically accelerated the digitalization of business processes, forcing companies to change their internal structures, customer engagement strategies, supply chains, and approaches to human resources management. One of the key transformations was the shift to a remote work format, which required a review of internal management processes. Many companies that previously did not see the need for remote work had to adapt quickly. Twitter, for example, was one of the first to announce that it would allow its employees to work from home indefinitely, even after the pandemic ended. This meant not only technical restructuring – ensuring data security, organizing online communications – but also changing management approaches to control, performance evaluation, and maintaining corporate culture.

Another vector of change has been the rapid development of e-commerce. According to the UNCTAD, in 2020, the share of e-commerce in global retail turnover increased from 14 % to 17 % in just one year. This has forced thousands of companies to rethink logistics, warehouse management, customer service, and marketing. Businesses such as Amazon and Alibaba not only withstood the pandemic but also strengthened their positions thanks to pre-existing digital infrastructures. At the same time, less prepared companies were forced to urgently launch online stores, implement CRM systems and look for new distribution channels [20].

The pandemic has also brought the topic of flexible supply chains to the forefront. Due to restrictions on the movement of goods, border closures, and disruptions in logistics routes, companies such as Apple have reconsidered their dependence on suppliers in certain regions and started diversifying their chains. This has led to in-depth analysis and digital process modeling, which has allowed for better risk forecasting, inventory management, and increased resilience to external shocks.

The healthcare sector, in particular pharmaceutical companies, has demonstrated another facet of transformation – the integration of digital tools into R&D. For example, Pfizer and BioNTech developed a vaccine against COVID-19 using artificial intelligence to analyze genetic data and speed up clinical trials. This indicates

a shift from traditional to flexible digital models of innovation, where speed and accuracy are becoming critical competitive advantages.

In addition, the pandemic has caused a transformation of approaches to customer experience. Brands have started to actively use chatbots, automated support services, and customer query analytics to replace physical interaction with digital channels. For example, Starbucks introduced mobile applications for contactless ordering before the pandemic, but in 2020 the company significantly expanded this system, adapting its business processes to new realities. What was once an innovation has become a necessity. The psychological aspect of business transformation deserves special attention. The pandemic has exacerbated the issue of employee adaptation to new conditions, the growth of digital fatigue, and the need for mental support for staff. Many companies have begun to implement digital employee wellness platforms, offering consultations with psychologists, interactive trainings on maintaining productivity in isolation, creating virtual teams, and more. This once again proved that digital transformation is not only about technology, but also about people in the new digital ecosystem.

Conclusions. The study made it possible to draw a number of conclusions about the nature, transformation and current mechanisms for monitoring business processes in the context of digitalization, which has been especially intensified by global challenges, in particular the COVID-19 pandemic.

An in-depth theoretical analysis of the concepts of “business process” and “digitalization”, their interrelation and role in modern strategic management of an enterprise was carried out. It is found that business processes are the basis for the functioning of an organization, and their monitoring ensures control over efficiency, timely identification of problems and implementation of improvements. Digitalization, in turn, is not just a tool for automation, but a component of a deep transformation of management approaches, which allows for adaptability, transparency and flexibility of business. The COVID-19 pandemic has revealed vulnerabilities in traditional management systems and stimulated a global review of methods for

organizing business processes – with an emphasis on remote models, online infrastructure and real-time analytics.

As a result, the COVID-19 pandemic turned out to be a kind of "crash test" for all elements of business processes – from human resources management to logistics and innovation. Those companies that had already started digital transformation earlier gained an advantage, while others were forced to make changes in the conditions of the crisis. Global challenges have not just accelerated digitalization – they have fundamentally changed the idea of an effective business process. Today, companies can no longer afford to ignore the need for digital solutions – it has become the basis for long-term viability and adaptability in the new reality.

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