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QUALIFICATION PAPER

**It is submitted for the Master's degree
Specialty 292 "International Economic Relations"
on the topic**

**" THE ECONOMIC DEVELOPMENT MODEL OF UKRAINE IN THE
CONTEXT OF STRENGTHENING INTEGRATION PROCESSES AND
INDUSTRY 4.0"**

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Master's level degree qualification paper contains the results of own research. The use of the ideas, results and texts of other authors has a link to the corresponding source

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SUMMARY

of Master's level degree qualification paper on the theme
“THE ECONOMIC DEVELOPMENT MODEL OF UKRAINE IN THE
CONTEXT OF STRENGTHENING INTEGRATION PROCESSES AND
INDUSTRY 4.0”

student Oksana Oleksandrivna Musiienko
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The main content of the master's level degree qualification paper is set out on 60 pages, including a list of used sources of 70 titles, which is placed on 9 pages. The work contains 14 tables, 2 figures, which are placed on 14 pages.

KEYWORDS: ECONOMIC DEVELOPMENT, UKRAINE, INTEGRATION PROCESSES, INDUSTRY 4.0, DIGITAL TRANSFORMATION, INNOVATION, SUSTAINABLE DEVELOPMENT, GLOBALIZATION, COMPETITIVENESS, ECONOMIC GROWTH, INDUSTRIAL REVOLUTION.

The purpose of the master's level degree qualification paper is to study the theoretical foundations and to develop practical recommendations for enhancing Ukraine's economic development model in the context of strengthening integration processes and adapting to the advancements of Industry 4.0

The object of the study is the economic development model of Ukraine within the framework of integration processes and the transition to Industry 4.0.

The subject of the study is the theoretical, methodological, and practical aspects of strengthening Ukraine's economic integration and industrial transformation in the context of Industry 4.0.

To achieve this goal and objectives, the study utilized a range of scientific research methods. Theoretical foundations of economic development were explored in the context of integration processes and Industry 4.0, focusing on the concept and essence of Industry 4.0, its impact on economic processes, and the influence of global integration trends on Ukraine's economy. The analysis of Ukraine's current economic state included an examination of its economic indicators, integration policy, and key challenges and opportunities arising from Industry 4.0 and integration processes. Building on these insights, an economic development model for Ukraine was proposed, tailored to the specifics of Industry 4.0, supported by a SWOT analysis to evaluate strengths, weaknesses, opportunities, and threats. Finally, prospects for implementing the model and potential adjustments were discussed to ensure alignment with Ukraine's strategic objectives in the global economy.

The information base of the master's level degree qualification paper is The information base of the master's level degree qualification paper consists of scientific literature, academic articles, and research papers on economic development,

integration processes, and Industry 4.0; statistical data from national and international organizations such as World Bank, IMF, and World Bank; official documents and reports on Ukraine's economic policies and integration strategies; legislative and regulatory acts related to Industry 4.0 and economic reforms. This comprehensive information base ensures the reliability and validity of the research findings and recommendations.

The main scientific results of the work are as follows:

1) The theoretical foundations of economic development in the context of integration processes and Industry 4.0 were clarified, with a focus on the concept, essence, and key features of Industry 4.0 and its impact on modern economic processes.

2) The influence of global integration processes on Ukraine's economy was analyzed, identifying critical challenges and opportunities for Ukraine's economic development.

3) A comprehensive analysis of Ukraine's current economic state was conducted, including the evaluation of economic indicators, integration policies, and the readiness of industrial sectors for Industry 4.0.

4) An economic development model for Ukraine was proposed, considering the specifics of Industry 4.0 and the strategic goals of Ukraine's integration into the global economy.

5) The proposed model was supported by a SWOT analysis, which identified key strengths, weaknesses, opportunities, and threats in Ukraine's economic development.

6) Practical recommendations for the implementation of the proposed economic development model were provided, along with potential adjustments to enhance Ukraine's economic competitiveness in the context of global technological and integration trends.

The obtained results can be used by the subsidiary of government bodies, research institutions, and business entities involved in Ukraine's economic development, industrial transformation, and integration processes. These results can serve as a basis for formulating policies and strategies aimed at enhancing Ukraine's competitiveness in the global economy, adapting to Industry 4.0 technologies, and fostering sustainable economic growth. Additionally, they can be applied by policymakers, economic planners, and industry leaders to optimize Ukraine's integration into international economic structures, improve industrial processes, and support innovation-driven development. The proposed economic development model and SWOT analysis can also assist in the decision-making process for adjusting Ukraine's economic priorities in the context of the ongoing technological revolution and global integration trends.

Year of Master's level qualification paper fulfillment is 2024

Year of Master's level paper defense is 2024

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Department of International Economic Relations

TASKS FOR MASTER'S LEVEL DEGREE QUALIFICATION PAPER

(specialty 292 " International Economic Relations ")

student 2 course, group МБ.М-31/1

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Oksana Oleksandrivna Musiienko

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1. The theme of the paper is «The economic development model of Ukraine in the context of strengthening integration processes and Industry 4.0» approved by the order of the university from 03 December 2024 № №1255-VI.
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4. The object of the study is the economic development model of Ukraine within the framework of integration processes and the transition to Industry 4.0.
5. The subject of the study is the theoretical, methodological, and practical aspects of strengthening Ukraine's economic integration and industrial transformation in the context of Industry 4.0.
6. The qualification paper is carried out on materials from the electronic sources.
7. Approximate master's level degree qualification paper plan, terms for submitting chapters to the research advisor and the content of tasks for the accomplished purpose is as follows:

Chapter 1 Theoretical foundations of economic development in the context of integration processes and Industry 4.0 till 10.11.2024.

Chapter 1 deals with the concept of Industry 4.0, its essence and impact on modern economic development, including trends in automation, digitalization and the introduction of innovative technologies. It analyzes how Industry 4.0 changes economic processes, contributing to increased efficiency. Special attention is paid to integration processes in the global economy and their impact on Ukraine.

Chapter 2 Analysis of the current state of economic development in Ukraine till 27.11.2024.

Chapter 2 deals with Ukraine's economic indicators at the present stage, emphasizing the country's integration policy in the context of economic development. It also examines the key challenges and opportunities for Ukraine's economy in light of Industry 4.0 and ongoing integration processes.

Chapter 3 Model of economic development of Ukraine in the context of Industry 4.0 till 06.12.2024.

Chapter 3 deals with on developing an economic model tailored to the specifics of Industry 4.0, incorporating a SWOT analysis of Ukraine's economic development within this framework and the broader context of integration processes. It explores the prospects for implementing the proposed model and identifies potential areas for adjustment to enhance its effectiveness.

8. Supervision on work:

Chapter	Full name and position of the advisor	Date	
		task issued by	task accepted by
1	Viktoriia Shcherbachenko, PhD, Senior Lecturer of the Department	1.11.2024	10.11.2024
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The tasks have been received: _____ Oksana Musiienko

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LIST OF ABBREVIATION

AI - Artificial intelligence

ASEAN - Association of South East Asian Nations

BSEC- Black Sea Economic Cooperation

CIS - Commonwealth of Independent State

CPS - Cyber-physical systems

DCFTA- Deep and Comprehensive Free Trade Area

IoT - Internet of Things

IT- Information Technology

EBRD- European Bank for Reconstruction and Development

EU- European Union

GDP - Gross Domestic Product

IMF - International Monetary Fund

MERCOSUR- Southern Common Market

NAFTA- North American Free Trade Agreement

RES- renewable energy sources

STEM- Science, Technology, Engineering and Mathematics

SWOT - Strengths, Weaknesses, Opportunities and Threats

SMEs- Small And Medium-Sized Businesses

TEN-T - Trans-European Transport Network

TRACECA- transport corridors such as "Europe - Caucasus - Asia

USMCA - U.S. – Mexico – Canada Agreement WTO- World Trade Organization

INTRODUCTION

In today's conditions of globalization and intensive technological development, the fourth industrial revolution, or Industry 4.0, attracts special attention. This new era of transformations is determined by the rapid development of digital technologies, artificial intelligence, automation, as well as changing approaches to the organization of economic processes.

The actuality of the topic: At the current stage of world development, the process of globalization and integration plays an important role, changing the state's approach to economic development. As part of the global economic space, Ukraine faces the problem of effective adaptation to new conditions caused by the development of industry 4.0, the fourth industrial revolution, based on digital technologies, automation, the Internet of Things, artificial intelligence and big data.

Level of the studied problem: Ukraine, as a state with a transition economy, faces a number of challenges related to the need to adapt to the new conditions of the world economic order. The successful integration of Ukraine into the world economic system requires the analysis of its economic indicators, the identification of key problems, as well as the use of opportunities provided by integration processes and Industry 4.0 [1]

The main goal: analyzes the economic development of Ukraine, taking into account the possibility of integration into global economic processes, adaptation of the principles of Industry 4.0 and the use of innovative technologies to increase the competitiveness of the national economy. Understanding the theoretical underpinnings of these trends is essential for understanding their implications on economic policy, competitiveness, and the socio-economic environment.

This section explores the concept and essence of Industry 4.0, highlighting its features and the ways it redefines economic development. Particular attention is given to its impact on productivity, labor markets, and global value chains.

Tasks of the qualification work: analysis the impact of integration processes aimed at integration with the European economic space, as well as the introduction of Industry 4.0 technologies into the Ukrainian economy is taken into account. the chapter examines the role of integration processes in the world economy, emphasizing their impact on countries such as Ukraine. Integration increases trade, investment and technological exchange, which can stimulate growth, but also creates challenges for developing economies. By analyzing the interactions between Industry 4.0 and integrated processes, this chapter provides a theoretical framework for understanding the opportunities and risks associated with these changes.

The subject of the study is the theoretical, methodological, and practical aspects of strengthening Ukraine's economic integration and industrial transformation in the context of Industry 4.0.

Methods of the research : the following research methods were used in the work. The theoretical part using the general scientific method. The analysis of theoretical aspects, basic concepts, specificity and form was carried out. Using this method, a basic analysis of challenges, opportunities and strategies of integration processes was investigated

Entering the 21st century, Ukraine's economic development is still an important issue, and Ukraine faces a complex situation of both challenges and opportunities. Ukraine is located at the crossroads of Europe and Eurasia, and its economy is shaped by abundant natural resources and constant efforts to meet global trends, such as digital transformation and integration into the world economy. [2]

The practical part of the work was investigated using a general scientific, analytical and statistical method. The general method was carried out by analyzing the specifics integration processes and Industry 4.0. Analysis of possibilities and problems of integration processes and Industry 4.0

At this juncture, Ukraine is experiencing a dynamic period marked by ambitious reforms aimed at fostering economic stability, improving governance, and enhancing competitiveness. Integration into international structures, particularly the European Union (EU), is a central component of Ukraine's strategy to modernize its economy and align with global standards. However, these efforts occur against a backdrop of significant external and internal challenges, including geopolitical tensions, structural weaknesses, and global economic shifts.

This analysis provides a comprehensive overview of Ukraine's economic performance, the role of integration policies in shaping its development path, and the key challenges and opportunities presented by the ongoing Fourth Industrial Revolution. By examining these factors, the study aims to offer insights into Ukraine's prospects for sustainable economic growth and its ability to adapt to a rapidly evolving global economy.

The scientific novelty of the study consists in the development of a theoretical and methodological basis for the formation of a model of economic development of Ukraine in the conditions of strengthening integration processes and the implementation of Industry 4.0. The model of the development of the economy of Ukraine in the context of Industry 4.0 provides for a significant transformation of the structure of the country's economy, taking into account the latest technologies. These technologies include manufacturing automation, artificial intelligence, the Internet of Things, big data and the use of robotics.

Information base: the main information base for this work was the Internet. The current stage of national development requires the development of a strategy for the effective integration of these innovations into economic processes and ensuring sustainable development. Taking into account the peculiarities of the national economy, Ukraine has the potential to modernize its industry, in particular information technologies, agro-industrial complex and engineering, which will contribute to increasing productivity and competitiveness in world markets. [3]

The practical significance of the results of the scientific work lies in the possibility of using the proposed model of economic development of Ukraine to

increase the efficiency of integration processes and the introduction of Industry 4.0 technologies. A SWOT analysis of Ukraine's economic development in the context of Industry 4.0 reveals both strengths and serious challenges. Among the strengths of the country, one can note a high potential in the fields of information technology and scientific research, as well as a high level of education in technical specialties, which contributes to the development of innovative projects. However, weaknesses include low investment in research, underdeveloped digital infrastructure, and political instability that constrains development.

However, the opportunities opening up for Ukraine thanks to the integration of Industry 4.0 technologies are significant. They include improving competitiveness in the international market, developing digital services and attracting investments. However, there are also serious threats, including cyber security issues, insufficient protection of digital infrastructure and uncertainty in the geopolitical situation, which can affect foreign economic relations.

The prospects for the implementation of Ukraine's economic development model in the context of Industry 4.0 depend on the successful adaptation of technologies and the creation of a favorable environment for innovation. An important condition is the development of a strategy at the state level, which will include the development of digital infrastructure, support for startups, as well as investments in research and development[4]

This work and all the results provided in:

- Revolutionizing Industry 4.0: Exploring the Potential of Distributed Infrastructure for Enhanced Efficiency and Resilience.
- Integration Processes In Ukraine And Their Influence On The Development Of International Business.

Chapter 1. THEORETICAL FOUNDATIONS OF ECONOMIC DEVELOPMENT IN THE CONTEXT OF INTEGRATION PROCESSES AND INDUSTRY 4.0

1.1. The concept, essence of Industry 4.0, and features of economic development in modern conditions

Industry 4.0 is the concept of a new industrial revolution that combines digital technologies with production processes to achieve maximum automation and integration into the economy. Industry 4.0 is the fourth industrial revolution characterized by the combination of advanced digital and physical technologies to transform industry, economy and society. The concept uses connectivity, data analysis, automation and new forms of human-machine interaction to create "smart" factories and networks.

This paradigm emerged at the beginning of the 21st century and focuses on smart manufacturing, the key components of which are the Internet of Things (IoT), Cyber-Physical Systems (CPS), Artificial Intelligence (AI), Big Data and Blockchain technology. The purpose of Industry 4.0 is to increase productivity, reduce costs, optimize production and logistics processes, and develop innovations at all levels of the economy.

Industry 4.0 is a concept whose main goal is to create so-called "smart factories" that have a high level of automation, digitization and interconnection between physical and virtual systems.

Industry 4.0 is a concept characterized by the deep integration of digital technologies into all aspects of production and business processes. It is a new stage of industrial development based on the use of CPS, AI, IoT, big data, cloud technologies and automation, which work together to create smart factories [5]

The relatively new phenomenon that we call Industry 4.0 is the result of several previous stages of the development of human civilization, each of which carries elements of industrial revolutions that have significantly changed society, economy and technology.

The first industrial revolution (end of the 18th - beginning of the 19th century). The history of industrial revolutions begins at the end of the 18th century with the first industrial revolution, which was closely related to the invention of the steam engine by James Watt.

This was made possible by the development of new energy sources such as steam, which greatly improved the mechanization of production in industries such as textiles, mining and metallurgy. For example, in Great Britain in the middle of the 18th century, mass production of textiles began, and at the end of the century, a steam engine appeared, which made it possible to replace manual labor with more efficient mechanical labor.

This period changed the world economic structure, entered the stage of industrialization and urbanization, contributed to the rapid development of cities and the improvement of production capacities. Mechanization has greatly increased the efficiency of production, but it has not yet touched the field of intelligent automated control.

The Second Industrial Revolution (late 19th - early 20th century) The second industrial revolution began at the end of the 19th century and was caused by the development of electricity and new technologies in the production of steel, chemicals and mechanical engineering. Thanks to the invention of the electric motor and electric lighting, production became more energy efficient and convenient. In this period, conveyors and mass production appeared, which became the basis for the widespread use of standard parts in production.

The most famous example of this phase is Henry Ford's development of assembly line manufacturing in the early 20th century, which made automobile production cheaper and made automobiles affordable for mass consumers.

Thanks to this, production became more standardized, and enterprises became large and centralized.

The third industrial revolution (mid-20th century) industrial revolution, which covered the period of the middle of the 20th century, was caused by the development of electronics and information technologies. The main innovations of this stage were the appearance of computers, automated control systems (ACS) and programmable logic controllers (PLCs), which allowed to significantly reduce the need for human labor in production. At this time, information technologies began to actively develop, which became important components for production processes.

With the advent of computer systems and automated production lines, it became possible to plan production processes faster and more accurately, as well as to control product quality at all stages of its production. However, at that time, manufacturing still remained relatively isolated from the global network and mostly focused on autonomous enterprises.

With the advent of computer systems and automated production lines, production processes can be planned faster and more accurately, and product quality can be controlled at all stages of production. However, production at that time was still relatively isolated from global networks and focused mainly on autonomous enterprises.

Industry 4.0 The fourth industrial revolution (beginning of the 21st century) The definition of the concept of Industry 4.0 became possible at the beginning of the 21st century, when the world was undergoing revolutionary changes due to the widespread introduction of new digital technologies. This concept was proposed at the Hannover Messe in Germany in 2011, when governments and scientists discussed future trends in manufacturing [6].

This allows for the creation of interconnected networks between production processes, machines and people. The system can adapt to changing conditions and make real-time adjustments based on the collected data.

One of the key aspects of Industry 4.0 is the ability to monitor and manage production processes via the Internet, which allows you to significantly reduce costs, increase the speed and accuracy of production, as well as increase safety in enterprises.

As for the key technologies of Industry 4.0, we can say that Industry 4.0 includes several key technologies that ensure its effectiveness:

- 1) The Internet of Things is a network of physical objects connected to the Internet that can interact with each other and with other systems.
- 2) Artificial intelligence the use of algorithms to automate processes, make decisions, and optimize production operations.

3) Big data analysis of large volumes of data, which allows obtaining accurate information for making management decisions.

4) Robotics automated machines and robots that perform functions previously performed by humans on production lines.

5) Cyber-physical systems systems that combine physical objects with digital technologies for continuous monitoring and control of processes.

6) 3D printing is a technology that allows you to produce parts and even finished products without using traditional production processes [7]

Industry 4.0 has a huge potential to transform global production, as well as the entire economy. It promises to increase efficiency, reduce costs, reduce production time and create new business models. However, this process is not without difficulties. Key obstacles include the need for significant investment in new technologies, changes in workforce skills, cyber security, and the potential economic and social impacts of automation.

Industry 4.0 is the transition to high-tech, fully automated and connected manufacturing that provides maximum productivity and flexibility at the lowest cost, but requires appropriate infrastructure, skilled personnel and significant investment.[8]

Industry 4.0 is driving economic development, but there are also challenges related to cybersecurity, maintaining privacy, and the need to retrain workers and adapt to social systems.

The essence of Industry 4.0 is the creation of "smart production" - automated, autonomous and interconnected production systems capable of making decisions independently based on real-time data analysis. Industry 4.0 transforms not only production processes, but also the entire ecosystem of interaction between companies, suppliers, customers and end consumers. In the modern economy, this means a significant acceleration of innovative development and a significant increase in the efficiency of enterprises.

Industry 4.0 is a driver of change, driving the next stage of economic development by increasing productivity, increasing supply chain sustainability and

promoting green practices. However, its benefits come with challenges that require investment in technology, policy and human capital. Embracing Industry 4.0 means changing the economy to become more sustainable, knowledge-based and responsive to the needs of an increasingly digital world.

Previous industrial revolutions mainly focused on the automation of manual labor (the first revolution), electrification and mass production (the second revolution), and computerization (the third revolution). However, unlike previous stages, the goal of Industry 4.0 is to create "intelligent manufacturing", where machines make independent decisions, communicate with each other and with people, and the production process is more flexible and personalized [9]

Thus, the main goal of Industry 4.0 is to increase production efficiency, flexibility and adaptability of production systems, as well as a significant reduction in costs and time due to automation and the use of intelligent solutions based on data and analytics.

Features of the development of the economy under the conditions of Industry 4.0 include the digitization of most processes and the gradual integration of innovative technologies into various sectors of the economy. New forms of production organization are emerging, such as flexible production systems that allow quick adaptation to changes in market conditions.

In addition, as a result of growing automation, the labor market is transforming - the requirements for the qualifications of employees are changing, and the demand for specialists who can work with modern digital technologies is increasing. This shift underscores the importance of continuous learning and adaptability, as workers must acquire new skills to thrive in an increasingly technology-driven economy.

1.2. Industry 4.0 and its impact on economic processes

Industry 4.0 is the concept of the fourth industrial revolution, which involves the widespread use of digital technologies, artificial intelligence, the Internet of Things, robotics and big data in production processes and business models.

These latest technologies are changing the nature of production and the way economic processes are organized. The main goal of Industry 4.0 is to create more flexible, intelligent and connected systems that allow you to optimize resources and increase productivity at all stages of production.

First of all, Industry 4.0 contributes to increasing the competitiveness of enterprises. Thanks to the automation and robotization of the production process, companies can reduce costs, improve product quality, and shorten production times. For example, IoT technology makes it possible to collect data from a variety of machines and sensors in real-time, enabling rapid response to breakdowns, forecasting of repair needs, and efficient inventory management.

Another important aspect of the impact of Industry 4.0 on the economy is the transformation of the labor market. The introduction of automation contributes to the substitution of some types of manual labor, which can lead to a decrease in the number of jobs in traditional fields. At the same time, there is a demand for highly qualified specialists in the fields of IT, engineering, robotics and data analytics. This trend is pushing countries to invest in the education and retraining of workers so that they can adapt to the demands of new labor markets [10]

Change in approaches to supply chain management. Digitization allows enterprises to quickly track deliveries, monitor the condition of products and respond to changes in demand. This is especially important in the context of globalization, when supply chains span different countries and regions. Thanks to blockchain technology, businesses can ensure transparency and security of information in supply chains, which reduces the risks of fraud and loss.

The implementation of Industry 4.0 also opens up opportunities to create new business models based on digital platforms. For example, the servitization model is becoming popular, when manufacturers instead of selling products offer services for their use (such as renting equipment with maintenance). This approach allows

enterprises to adapt to the individual needs of customers and creates additional sources of income, which has a positive effect on economic processes.

Industry 4.0, or the Fourth Industrial Revolution, significantly changes economic processes thanks to the introduction of the latest digital technologies, automation and intelligent systems. The core technologies of this revolution are the Internet of Things, artificial intelligence, big data, blockchain, 3D printing, robotics, and augmented and virtual reality. Their impact on the economy can be analyzed in the following aspects:

Industry 4.0 makes it possible to automate routine operations, which increases the speed of production processes and reduces production costs. The use of robots and automated lines makes it possible to reduce the human factor and minimize errors, which leads to higher product quality and reduces the amount of waste.

Thanks to the Internet of Things, enterprises get constant access to data about the use of resources, which allows them to optimize production processes. For example, sensors can analyze the condition of equipment in real time, which allows preventing breakdowns and reducing downtime. More efficient use of resources reduces the cost of production and increases company profits [11]

Big data and artificial intelligence make it possible to analyze the behavior of consumers and their needs, which contributes to the personalization of products and services. Such adaptation to market demands increases the competitiveness of enterprises and allows them to create individual offers for consumers, which increases the level of sales and customer loyalty. While automation is reducing some traditional jobs, it is also creating new occupations such as data analytics, cyber security, programming, operating robotic systems, and more. At the same time, the demand for qualified specialists in industries related to digital technologies is growing, which stimulates the labor market to retrain employees.

Digitization of production processes and the availability of network platforms allow companies to enter new markets at low costs. The online platform simplifies the process of entering international markets, lowers barriers to export and import, and accelerates the globalization of economic processes. Blockchain ensures the

transparency of the supply chain, as well as the security of financial transactions and data storage. This reduces the risk of fraud, increases trust between partners and facilitates verification. This is especially relevant for such industries as finance, logistics and health care.

Industry 4.0 will contribute to the emergence of new business models, such as platforms for the joint use of resources (sharing economy), rental of equipment in advance and intelligent products that are serviced or repaired independently. These models allow companies to create new sources of income and increase the value of their products for customers.

Industry 4.0 promotes ecological practices, optimizing resources, reducing energy consumption, waste and carbon dioxide emissions. It meets the requirements of modern society and environmental legislation, which is an important element of economic and social stability [12]

Industry 4.0 fundamentally changes economic processes, contributing to productivity growth, resource optimization, globalization, as well as the transition to new business models and increased environmental sustainability. These changes have a positive impact on the economy, but also require business and workforce adaptation to new digital technologies and challenges.

Thus, it changes approaches to the organization of production, business and the labor market, stimulating innovation and increasing the efficiency of economic processes. This revolution requires significant investment, but opens up new perspectives for businesses, governments and society in general, ensuring competitiveness and sustainable development in the digital age.

Industry 4.0, known as the Fourth Industrial Revolution, is based on the implementation of the latest technologies in production processes, management and business models. These technologies create new opportunities for enterprises, increasing productivity and competitiveness. The table below presents the main technologies of Industry 4.0, their brief description and key impact on the economy.

Industry 4.0 radically changes economic processes, transforming the labor market, production models and consumer expectations. Due to automation, routine

tasks are gradually being replaced by robots and intelligent systems, resulting in the reduction of jobs in traditional industries. Instead, the demand for highly qualified specialists in the fields of IT, data analysis, robotics and cyber security is growing. People need to learn new skills, and governments and businesses are investing heavily in retraining programs to meet the new demands [13]

Automation and digitization of processes also significantly increase productivity. Systems based on artificial intelligence minimize human errors, optimize resource consumption and speed up production. Thanks to the analysis of big data, companies can instantly react to changes in demand and adapt their strategies.

At the same time, thanks to the digital platform, it was integrated. Global supply chain and localization of production using automated systems allowed to reduce costs and delivery times. Changes in consumer habits also play an important role. Consumers expect fast production, high quality and personalized products. Using data, companies can better understand their customers' preferences and offer customized solutions that meet their expectations.

Competition between countries and companies in this new reality depends on the speed of implementation of Industry 4.0 technologies. Countries that adapt quickly to these changes reap benefits in the form of product innovation, economic growth and global leadership. At the same time, the development of new technologies helps to reduce inequality between countries, since even developing countries have the opportunity to create competitive products [14]

Thus, Industry 4.0 becomes the driving force of the global economy, creating new challenges and opportunities. It is changing our understanding of work, production and consumption, paving the way for a future that depends on society's ability to adapt to the digital age.

Table 1.1 The main technologies of Industry 4.0 and their impact on the economy

Technology	Description	Economic Impact
Internet of Things	Connection of devices to collect and exchange data	Optimization of production processes, reduced maintenance costs
Artificial Intelligence	Data analysis and decision-making based on algorithms	Personalization of products and services, increased productivity
Big Data	Processing and analysis of large volumes of information	Demand forecasting, customer behavior analysis, marketing efficiency improvement
Blockchain	Technology for storing data in distributed ledgers	Supply chain transparency, security of financial transactions
3D Printing	Creation of physical objects based on digital models	Reduction in production costs, product customization
Robotics	Use of automated systems to perform tasks	Reduction in manual labor, cost savings, quality improvement
Cloud Computing	Use of remote servers for data storage and processing	Lower infrastructure costs, access to powerful tools for SMEs
Augmented and Virtual Reality	Technologies for interacting with digital models in real or virtual space	Staff training, design, marketing activities

Industry 4.0 contributes to the creation of a new type of economy based on digitization, automation and intelligent systems. The use of technologies such as IoT, artificial intelligence, blockchain and robotics can significantly increase production efficiency, reduce costs, ensure transparency of business processes and open new opportunities for business development. At the same time, these changes require companies and their employees to adapt to new conditions, stimulate innovation, retrain staff and implement sustainable practices.

Industry 4.0 is an important concept at the current stage of economic development, which ensures the transformation of production and business processes due to the introduction of advanced digital technologies.

This opens up new opportunities for increasing production efficiency, optimizing resources, creating innovative business models and improving the quality of products and services. Thanks to automation, the use of artificial intelligence, the

Internet of Things, blockchain and other technologies, companies can reduce costs, minimize risks and develop more flexible and transparent management systems.

But Industry 4.0, along with its advantages, poses new challenges to society. In particular, automation is causing changes in the labor market, reducing the demand for traditional manual labor and at the same time creating the need to retrain personnel to work with new technologies. In addition, the implementation of such changes requires significant investments, infrastructure development and adaptation to the regulatory and legal environment [15]

In general, Industry 4.0 forms the basis for the digital economy, stimulates innovation and increases the competitiveness of enterprises. It not only changes approaches to the organization of production and management, but also contributes to sustainable development, environmentalization of processes and globalization of business. In order to fully utilize the potential of this industrial revolution, it is necessary to adapt educational systems, develop new competencies and promote the integration of digital technologies in all spheres of the economy.

1.3. Integration processes in the global economy and their impact on Ukraine

Integration processes in the world economy are one of the key factors determining the modern development of international relations and the formation of the global economic space. In the conditions of growing interdependence of countries, globalization of trade, capital, technology and labor force, integration acts as a driving force that opens up new opportunities for the development of national economies.

For Ukraine, as a state with an open economy, these processes have both positive and negative aspects that affect economic policy, competitiveness in the world market, the level of participation in the international division of labor, and general social and economic development. In this context, the analysis of the integration process and its impact on It is very important for Ukraine to determine

how to adapt to global economic challenges and use opportunities for sustainable growth.

The integration process in the world economy is an important element in the development of globalization and promotes close cooperation between countries in the fields of trade, investment, technology, and human resources. These processes have a significant impact on all aspects of economic life, in particular on macroeconomic stability, the structure of the economy and the country's competitiveness.

Integration processes in the world economy have become a key component of modern global development. They include the deepening of economic, social and cultural ties between countries, which contributes to the improvement of production efficiency, the expansion of sales markets, and the spread of innovations and technologies. Ukraine, as part of the global economic system, is actively involved in these processes.

This includes participation in international trade, attraction of foreign investments, cooperation with international organizations, as well as European integration. However, integration also creates challenges, such as increased competition, the need to adapt to international standards and manage the risks of global instability. The given table makes it possible to systematize the main integration processes and assess their impact on Ukraine [16]

Table 1.2 Integration processes in the world economy and their impact on Ukraine [17]

Integration Process	Process Description	Examples of Impact on Ukraine
Globalization	The growth of interconnections between countries through trade, investments, information technologies, and migration.	<ul style="list-style-type: none"> - Expansion of access to external markets for Ukrainian goods. - Increased competition for domestic producers. - Spread of technologies and innovations.
Eurointegration	The process of aligning Ukraine with European Union standards, including the adaptation of legislation and economic standards.	<ul style="list-style-type: none"> - Signing of the Association Agreement with the EU. - DCFTA with the EU. - Increased exports to the EU but stricter product quality requirements.
Regional Economic Unions	Formation of intergovernmental organizations to promote economic cooperation (e.g., EU, CIS, NAFTA).	<ul style="list-style-type: none"> - Withdrawal from the CIS led to a decrease in trade with CIS countries. - Integration into the European market strengthens Ukraine's position in regional trade agreements.
International Trade	Increased volumes of imports and exports between countries due to free trade agreements.	<ul style="list-style-type: none"> - Active expansion of agricultural exports to EU countries. - Balancing imports and exports remains a challenge.
Investment Integration	Expansion of foreign investment flows between countries due to market openness and guarantees for investor protection.	<ul style="list-style-type: none"> - Growth of foreign investments in Ukraine's agriculture, IT sector, and energy. - High risks for investors due to political and economic instability.
Digitalization of the Economy	The spread of digital technologies that facilitate global trade, finance, and production.	<ul style="list-style-type: none"> - Development of Ukraine's IT sector and outsourcing. - Creation of digital

		- Creation of digital platforms for exports.
Labor Migration	Increased international mobility of workers between countries.	- Significant outflow of labor force to EU countries. - Remittances from labor migrants contribute to supporting the economy.
Integration into International Organizations	Participation in the WTO, IMF, World Bank, and other organizations to support reforms and attract resources.	- Financial support from the IMF for economic stabilization. - Commitment to implementing structural reforms.

The process of integration of the global economy opens up important opportunities for the development of Ukraine, especially for entering foreign markets, attracting investments and introducing modern technologies. At the same time, it is necessary to actively adapt the national economy to new challenges, such as increased competition, the need to improve the quality of manufactured products and stabilize the economic situation.

In order to maximize the benefits of integration, Ukraine needs to continue structural reforms, develop export potential and ensure the stability of the investment climate. Thus, the effective use of the opportunities of global economic integration will become the basis for sustainable economic growth in Ukraine in the future.

The integration process is an important component of the modern globalized economy and has a significant impact on the development of both individual countries and regions. Its distinctive features are economic interdependence, the formation of regional economic zones, the harmonization of trade liberalization and economic policy, as well as the development of general infrastructure.

Integration contributes to the strengthening of economic ties between countries, which is manifested by an increase in the volume of trade in goods and services, the growth of foreign investments and international capital flows. Interdependence stimulates the specialization of national economies, which allows

countries to concentrate resources on the production of competitive products. For example, thanks to the single market, EU countries actively exchange goods and services, which allow reducing production costs and improving product quality.

However, growing interdependence also poses challenges. Economic crises in one country can quickly spread to others, as was the case during the 2008 global financial crisis. Therefore, an important condition is the creation of risk management mechanisms within the framework of integration processes.

In the modern world, regional economic blocs play a leading role in ensuring economic integration. Examples of such associations as the European Union, USMCA, ASEAN or MERCOSUR demonstrate the success of removing trade barriers, coordinating policies and stimulating economic growth [18]

The European Union is the most developed example of integration, which has moved from a free trade zone to a Single Economic and Monetary Union. This will allow EU member states to use a single currency, coordinate policies in various areas, and jointly respond to global challenges. Other blocs, such as ASEAN, are focused on liberalizing trade and attracting investment, while maintaining greater autonomy among member states.

One of the most important features of the integration process is the reduction of barriers to trade and financial transactions. Simplification of import and export procedures, cancellation of tariffs and provision of free movement of capital stimulate economic exchanges between countries. For example, free trade agreements reduce the cost of tariffs and make goods cheaper for consumers.

However, liberalization does not always bring only benefits. The opening of markets can lead to increased competition and negatively affect sectors of the economy that are not ready for integration. Therefore, it is necessary to carry out reforms aimed at increasing the competitiveness of producers in the country.

For successful integration, countries often harmonize macroeconomic, social and regulatory policies. This allows you to avoid conflicts caused by economic asymmetry and ensures the stability of relations. WEC Harmonization covers even such complex areas as environmental policy, labor standards, and tax policy. Such

steps create a basis for economic interaction, but at the same time require a concession of sovereignty, which in part provokes resistance from individual states and societies.[19]

The key element of the integration process is the joint development of infrastructure. Energy corridors, international transport networks, communication systems and digital platforms contribute to strengthening economic relations and increasing the efficiency of trade. For example, EU efforts to expand the TEN-T transport network are improving. logistical connections between member states and neighboring regions.

For Ukraine, integration with the European Union is a strategic task that opens up new opportunities for modernization of the economy. The Union, by agreement between Ukraine and the EU, has created a platform for deepened economic cooperation, however, Ukraine must make significant efforts to adapt standards.

Integration is also connected with such issues as the need to modernize the infrastructure, reform the management system and fight against corruption. However, the experience of other countries shows that these efforts bring long-term benefits in the form of economic growth, improving the welfare of citizens and strengthening their positions in the international arena.

Integration processes are an important tool for ensuring economic development and strengthening international relations. They create conditions for growth, but require adaptation to new conditions, weighted decisions and close cooperation between countries. Ukraine has a unique opportunity to use this process for its own modernization and economic stability on the way to EU integration.

Chapter 2. ANALYSIS OF THE CURRENT STATE OF ECONOMIC DEVELOPMENT IN UKRAINE

2.1. Ukraine's economic indicators at the present stage

At the current stage, the economy of Ukraine is developing under the conditions of numerous challenges associated with internal crises and external threats. The hostilities, which have been ongoing since 2014 and entered the phase of full-scale aggression in February 2022, have caused significant damage to key sectors of the economy. However, even in such difficult circumstances, the Ukrainian economy shows certain signs of adaptation and gradual recovery

Gross domestic product is the main indicator of the country's economic development. It reflects the total value of all goods and services produced in the economy for a certain period and are an important indicator for assessing the level of population welfare and economic activity.

In 2022, Ukraine's GDP shrank by 29.1%, which was the biggest drop since independence. This unprecedented decline was driven by large-scale negative factors: the physical destruction of businesses and infrastructure by hostilities that destroyed industrial facilities, roads, bridges and energy systems, paralyzing key sectors of the economy; the loss of territories that were temporarily under occupation, where a significant part of the industrial potential remained; mass migration of the population, due to which millions of citizens were forced to leave their homes, which caused a reduction in labor resources and domestic consumer demand; and the reduction of exports due to the blockade of sea ports and the destruction of logistics chains, which significantly limited the possibilities of foreign trade, especially in the agricultural sector and metallurgy [20]

Despite these challenges, in 2023 the economy of Ukraine began to show signs of stabilization. According to the estimates of the National Bank of Ukraine, real GDP growth amounted to about 2.8%.

This was facilitated by such factors as the restoration of the agricultural sector, which provided large foreign exchange earnings and jobs in rural areas, an increase in international aid, which contributed to the restoration of humanitarian projects and infrastructure and stimulated economic activity, as well as the development of

small and medium-sized businesses with the help of programs supported by the Government, such as grants, preferential loans and tax credits benefits that allowed them to develop business even in difficult situations.

Inflation in Ukraine has remained high in recent years due to the influence of both external and internal factors. In 2022, it exceeded 25% due to rising energy prices, logistical problems and increased defense spending. Inflation fell to 15% in 2023, helped by the stabilization of the exchange rate thanks to the tight monetary policy of the National Bank, the recovery of food exports, and international financial assistance that ensured currency stability. However, inflationary pressure continues to persist due to high dependence on imports, rising energy prices and the need to finance the budget deficit through emissions [21]

Ukraine's foreign trade is largely based on the agricultural sector and metallurgy. In 2022, the volume of exports decreased sharply due to the blockade of sea ports and the destruction of the logistics infrastructure. In 2023, a partial transition to alternative routes took place, in particular through the European Union under the "Paths of Solidarity" program. The main export items remain grain crops, sunflower oil, corn, as well as metallurgical products, although their volumes have decreased due to the destruction of enterprises in the east of the country. The share of exports is also maintained by the chemical industry and engineering.

Imports continue to grow, especially in the energy, equipment and consumer goods segments, which creates a negative foreign trade balance. However, international aid partially covers this deficit, ensuring the country's financial stability.

Military operations significantly increased Ukraine's budget deficit. In 2023, it reached more than 20% of GDP, which required active involvement of external financial resources. Ukraine's total public debt exceeded 80% of GDP, but thanks to the restructuring of debt obligations and the freezing of payments on part of the external debt, the government was able to avoid default. Grants and loans from international organizations such as the EU, the IMF, and the World Bank, domestic borrowing through the issuance of military bonds, and tax revenues have been the

main sources of covering the deficit, although the latter have declined due to business losses and a decrease in the number of taxpayers [22]

Unemployment remains high due to the destruction of enterprises, migration of the population, and the occupation of some districts. In 2023, the unemployment rate will reach approximately 18%. This situation is especially important in those districts that have suffered the most as a result of hostilities. The average salary nominally increased to 16-18 thousand hryvnias, but its real purchasing power remains low due to inflation. The government actively supports the population with social support programs and targeted financial assistance to internally displaced persons.

Due to the high risk, the amount of investments in 2023 remained at a low level. However, international donors and partners allocated large sums of money for the restoration of infrastructure and residential facilities in the affected areas. The key areas of investment are the development of infrastructure, such as roads, bridges and distribution centers, renewable energy sources, which gradually replace dependence on traditional sources energy, digitization of the economy and further development of the IT industry. Demonstrate sustainability.

As a result, the current state of Ukraine's economy is characterized by complex challenges, but the gradual recovery and prospects of integration with the European market, international support for further economic growth, structural reforms and further adaptation of the economy to new conditions play an important role [23]

Table 2.1 shows the key macroeconomic indicators of Ukraine for the period 2022–2024, including actual data, estimates and forecasts. These indicators illustrate the dynamics of the country's economy in the face of deep challenges related to military actions, economic instability and recovery measures. Analysis of changes in GDP, inflation, unemployment, public debt, foreign trade and budget deficit allows to assess the state of the economy, outline risks and prospects for development in the post-crisis period.

Table 2.1 Main macroeconomic indicators of Ukraine, 2022–2024
(prediction) [24]

Indicator	2022	2023 (Estimate)	2024 (Forecast)
GDP (Change, %)	-29.1%	+2.8%	+3–4%
Inflation (Annual, %)	25.1%	15%	11–12%
Unemployment Rate (%)	21%	18%	16%
Public Debt (% of GDP)	84%	82%	78%
Exports (USD billion)	44.1	55.0	65.0
Imports (USD billion)	55.0	65.0	70.0
Budget Deficit (% of GDP)	20%	20%	15%

The analysis of the main macroeconomic indicators of Ukraine in 2022–2024 shows a gradual recovery of the economy after a significant decline in 2022. The projected GDP growth and stabilization of inflation testify to the effectiveness of economic policy measures and support from international partners. A reduction in unemployment, a reduction in the share of public debt in GDP, and an increase in export volumes create the basis for further development. However, high budget deficits and foreign trade imbalances remain challenges that require systemic solutions to ensure sustainable economic growth.

The export structure is a key indicator of the country's economic activity, which reflects the development trends of economic sectors and their competitiveness on international markets.

Table 2.2 Export structure of Ukraine, 2022–2023 (in percent) [25]

Product Category	2022 (%)	2023 (%)	Change (%)
Agricultural Products	42%	48%	+6%
Metallurgical Products	18%	14%	-4%
Chemical Industry	10%	12%	+2%
Machinery Manufacturing	8%	10%	+2%
Other Products	22%	16%	-6%

Analysis of the structure of Ukraine's exports in 2022–2023 shows that the most significant positive changes occurred in the field of agricultural products, the share of which increased by 6%. An increase in the share of the chemical industry and mechanical engineering by 2% in each category is also noted. In contrast, the share of metallurgical products decreased by 4%, and the share of other products decreased by 6%, which may indicate certain difficulties in these industries. The data obtained emphasize the need to diversify the economy and support priority industries to ensure the stability of export activities.

Ukraine is in a difficult phase of economic development caused by internal crises and external threats arising from military operations and related destruction. In 2022, the economy experienced an unprecedented 29.1% contraction in GDP, caused by the physical loss of infrastructure, reduced labor, falling consumer demand, and disruption of foreign trade. However, in 2023, the stabilization of the economic situation was predicted: GDP growth by 2.8%, inflation falling to 15% and a gradual recovery of exports.

Among the main achievements are the development of agriculture, the growth of the role of small and medium-sized businesses thanks to state support, as well as active international aid that contributed to the implementation of humanitarian and infrastructure projects. The reduction of the unemployment rate to 18% and the reduction of the public debt to 82% of GDP also indicate positive changes [26]

However, significant challenges remain, including a high budget deficit (20% of GDP in 2023), imbalances in foreign trade, export restrictions due to logistical difficulties, and infrastructure destruction. Some industries, such as metallurgy, are experiencing a serious reduction in their share in the structure of exports, which indicates the need to support them and diversify the economy.

Thus, the recovery of Ukraine's economy continues, and its success depends on the effectiveness of structural reforms, integration into European markets, and the continuation of international financial support. Increasing exports, reducing inflation and public debt create the basis for sustainable economic development, but the realization of these prospects requires systemic solutions to overcome existing challenges.

2.2. Ukraine's integration policy in the context of economic development

Ukraine's integration policy is an important element of its economic development, as it determines foreign economic priorities, creates conditions for attracting investments, expanding sales markets, and modernizing the economy. Ukraine implements its integration policy in several key directions, the main one of which is European integration.

The integration policy of Ukraine is one of the key directions of the state's development in the conditions of globalization and European integration aspirations. It covers a wide range of aspects, such as economic cooperation, modernization of infrastructure, development of leading sectors of the economy and improvement of socio-political processes [27]

Progress in these areas determines the level of Ukraine's readiness for full integration with the European community, while highlighting challenges that require immediate solutions. Table 1 illustrates the main achievements and challenges of Ukraine's integration policy, demonstrating its multi-vector nature.

Table 2.3. The main achievements and challenges of Ukraine's integration policy

Aspect	Achievements	Challenges
Economic Integration	Association Agreement with the EU and DCFTA, growth in exports to the EU	Adaptation of legislation to EU standards, improving product quality
Growth Sectors	Development of the agro-industrial complex, IT industry, metallurgy	Competition in European markets
Infrastructure and Investments	Attraction of foreign investors, partial modernization of transport and energy infrastructure	Need for substantial infrastructure renewal, improving the investment climate
Socio-Political Context	Strengthening ties with EU countries	Combating corruption, ensuring transparency in governance processes

Analysis of the achievements and challenges of Ukraine's integration policy shows significant progress in strategic directions, such as economic integration, development of key sectors, and strengthening of ties with EU countries. [28]

However, significant potential remains unrealized due to the need to overcome structural problems, modernize infrastructure, improve product quality, and strengthen governance transparency. The further success of the integration policy depends on Ukraine's ability to effectively overcome these challenges, which is an important step on the way to achieving stable and sustainable development.

European integration is a strategic priority of Ukraine, aimed at ensuring economic development and integration of the world market. The EU Treaty and the Russian Federation of Trade Unions have opened access to the European market, which accounts for more than 40% of Ukrainian exports. The main advantages of European integration are expanding trade, attracting investments, implementing European standards in production, technology and management. This will contribute to the modernization of the economy, increasing competitiveness and integration into European energy and digital systems.

At the same time, European integration stimulated the implementation of major reforms in Ukraine, especially in the fields of energy, management, anti-corruption policy and environmental protection. Development of transport infrastructure, modernization of agriculture and integration into the single airspace are also important stages of this process. On the way to European integration, Ukraine faces such problems as the adaptation of legislation to EU standards, competition on the European market, and the need for significant investments in infrastructure.

Despite these difficulties, European integration remains an important factor in the economic growth of Ukraine. It contributes to the attraction of foreign capital, the development of human potential with the help of EU educational programs, as well as the strengthening of economic relations with the member states of the Union. A strategic course on European integration will ensure modernization of the economy, improvement of citizens' well-being and sustainable development of the country.

Ukraine's integration policy is one of the most important factors in its economic development. In the process of integration with international markets, organizations and economic unions, the state seeks to achieve greater stability, investment attractiveness and economic growth.

After signing the Association Agreement with the EU in 2014, Ukraine strengthened its integration into the European market. This contributes to the expansion of the sales market for Ukrainian manufacturers who have gained access to the single EU market. Harmonization of product quality standards will increase the competitiveness of Ukrainian goods and attract investments, create favorable conditions for the development of the economy, for more transparent rules of stability.

Ukraine is actively expanding the network of economic agreements, in particular, free trade zones with the EU, Canada and other countries, which allows reducing tariff barriers and stimulating trade. The agreement with the International Monetary Fund promotes macroeconomic stability, although it often requires the

implementation of tough reforms. At the same time, integration into world markets is accompanied by challenges, such as competition from more developed economies and the need to adapt domestic business to new conditions.

Integration policy significantly affects key sectors of the economy. Agriculture became one of the main drivers of growth, thanks to which Ukraine strengthened its position as a leading exporter of grain and oil to the EU. Industry and technology are given an incentive to modernize, although this requires significant investment. Integration also has a positive effect on transport and logistics, contributing to the development of seaports, railways and other infrastructure [30]

International organizations such as the WTO and the European Bank, the EBRD, play an important role in this process. They provide financial and technical support for the development of long-term economic strategies. bureaucracy, geopolitical tension, special military aggression from Russia.

However, the positive results of the integration policy are obvious. GDP growth is due to its integration into the international economic chain, investors' confidence in the Ukrainian economy is growing, and the implementation of European standards, thanks to the quality integration of goods and services, allows Ukraine to gradually modernize its economy and increase its competitiveness at the world level. However, in order to maintain the maximum benefit, it is necessary to continue structural reforms, increase the transparency of the economy and ensure macroeconomic stability.

Ukraine's integration policy plays an important role in ensuring economic development, as it is aimed at building strong relations with the EU, international organizations and regional partners. This includes both cooperation at the state level and the activation of regional initiatives that contribute to the economic growth of the region and ensure the balanced development of all regions of the country.

The main direction of Ukraine's integration policy is European integration. The Association Agreement with the EU, signed in 2014, became the basis for

adapting legislation to European standards, opening markets for Ukrainian goods and deepening the Free Trade Area.

This created opportunities for simplifying export and import procedures and attracting investment in infrastructure and industry. In addition, Ukraine is actively integrating with the countries of the Black Sea and Baltic regions in areas such as energy, transport and trade. For example, the development of transport corridors such as "Europe - Caucasus - Asia" (TRACECA) contributes to the logistics potential of Ukraine, and cooperation within the framework of the Black Sea Economic Cooperation (BSEC) expands opportunities for regional projects [31]

Another important aspect of integration policy is cross-border cooperation. Such EU programs as financial projects of Interreg in border regions, such as Lviv, Zakarpattia and Chernivtsi regions. The creation of a European region, similar to the Carpathian region, allows us to jointly solve environmental, social and transport problems. At the same time, integration with Poland, Lithuania, Latvia and Estonia opens up new opportunities in the field of digital transformation, agriculture and energy independence, especially within the framework of the European Green Deal.

Regional initiatives in Ukraine aimed at strengthening the regional economy. In particular, industrial parks are actively being created to attract investments. For example, the Bilotserkiv Industrial Park develops light industry and logistics, and new projects in the eastern and southern regions contribute to the restoration of infrastructure after military operations. Localization of production encourages foreign companies to open enterprises in the western regions, especially in the fields of mechanical engineering, food industry and information technologies.

Another direction is the development of agro-industrial complexes. The agricultural support program will allow the regions of the South and Center to implement modern technologies throughout the agricultural sector and expand the export of agricultural products to the EU. In parallel, the tourist potential of such regions as the Carpathians, Poltava and Odesa regions is developing, stimulating the economy by attracting foreign tourists. In addition, the digitalization of the local

economy facilitates the access of small and medium-sized enterprises to export bases.

Despite active development, integration policy faces challenges. Among them are the adaptation of infrastructure to European standards, insufficient level of investment attractiveness in some regions and the threat to security due to military operations. However, prospects include further attraction of investments, integration into the EU common digital market and implementation of "green" projects for sustainable development of regions.

Thus, Ukraine's integration policy is a powerful tool for economic growth. Thanks to active regional initiatives, it is possible to ensure a balance between national and local interests, which contributes to the sustainable development of the entire country [32]

Ukraine's integration policy plays a key role in ensuring the country's sustainable economic development. Since the declaration of independence, Ukraine has been actively seeking its place in the global economic space, striving to integrate into the European and world economies. The signing of the Association Agreement with the European Union and the launch of a DCFTA was a significant step in this direction. However, the implementation of the integration policy faces a number of challenges.

One of the main challenges is the need to adapt Ukrainian legislation to EU norms and standards. This process requires significant financial and human resources, as well as effective coordination between various authorities. Particular difficulties arise in areas such as energy, agricultural policy and environmental protection, where international standards significantly exceed existing Ukrainian ones.

Economic challenges include the need to modernize production, increase the competitiveness of Ukrainian goods and services, and expand access to international markets. For example, Ukrainian exports to the EU are growing, but the structure of exports remains predominantly raw materials, which limits added value and profits.

It is important to diversify the economy and develop high-tech industries, which could become the basis for long-term growth.

Geopolitical instability also complicates integration processes. The war with Russia significantly affects the economy, disrupts trade relations and infrastructure, creating additional barriers to international integration. In such conditions, Ukraine is forced to seek new markets and expand trade partnerships with countries in Asia, America, and the Middle East [33]

Social aspects of integration policy also remain a problem. The implementation of reforms, especially anti-corruption, judicial and administrative, is often hindered by the inertia of the system and lack of understanding on the part of the population. Ensuring the appropriate level of public awareness and its involvement in the decision-making process is of crucial importance for successful integration.

Despite these difficulties, Ukraine's integration policy has significant potential for stimulating economic development. European integration opens up access to investments, the latest technologies and best management practices. To achieve success, it is necessary to continue structural reforms, strengthen the rule of law and ensure transparency in all areas of governance.

Thus, the integration policy of Ukraine is a strategic direction that can provide the country with economic growth and improve the quality of life of the population. Overcoming existing problems requires coordinated actions of the government, business and civil society, but the results of these efforts will be important for the future of the country.

Ukraine's integration policy plays an important role in shaping the state's modern economic model. Taking into account its geopolitical position and economic ambitions, the successful implementation of the policy aimed at the integration of Ukraine with the European Union, actively reflected in the deepening of economic, political and cultural ties, can become a catalyst for the sustainable economic development of the country.

Ukraine has already made significant steps towards European integration. The Association Agreement with the EU, which includes a DCFTA, has created new opportunities for the export of Ukrainian products, attracting investment and modernizing the economy. Successes in the agro-industrial sector, IT industry, and metallurgy demonstrate Ukraine's potential as a global player [34]

Ukraine faces numerous challenges on its path to integration into the European Union. The most important ones include adapting Ukrainian legislation to EU standards, modernizing outdated infrastructure, creating a favorable investment climate, combating corruption, and improving governance. In addition, competition in European markets requires Ukrainian businesses to improve product quality, production efficiency, and logistics processes.

The prospects of Ukraine's economic development in the context of European integration depend on the successful implementation of reforms in such key areas as the economy, energy, justice and social policy. One of the promising directions of integration policy is expanding access to Ukrainian products, in particular, with high added value, to the European market by reducing trade barriers and harmonizing standards.

Diversification of the economy is also important because it allows the development of new sectors such as "green" energy, engineering, biotechnologies and information technologies, which are the driving force of economic growth.

An important emphasis was placed on attracting foreign investments, which will stimulate the creation of new jobs and contribute to the growth of the country's competitiveness. To do this, it is necessary to simplify the conditions of doing business, ensure the transparency of the rules and improve the infrastructure.

Innovation and digitalization are another important success factor. Cooperation with European partners in the field of research and technology contributes to the modernization of many sectors of the economy and the creation of modern products and services.

Finally, the development of human capital remains an important aspect of European integration. New opportunities for training, internships, professional

development and mobility of Ukrainian citizens within the framework of cooperation with the EU will ensure the growth of competencies and increase the country's competitiveness at the global level [35]

Ukraine's integration policy plays a key role in its economic development and strengthening its positions in the international arena. Taking into account modern challenges and the strategic goal of integration with the European Union, Ukraine is focusing its efforts on implementing promising areas capable of ensuring stable economic growth, strengthening competitiveness and social progress. The table presents the main areas of Ukraine's integration policy, their brief description and expected results.

Table 2.4. Prospective directions of Ukraine's integration policy[36]

Direction	Brief Description	Expected Effect
Deepening Trade	Expanding access to EU markets through reducing customs barriers and harmonizing standards	Growth in exports, stimulation of high-value-added production
Economic Diversification	Developing new sectors: green energy, mechanical engineering, biotechnology	Reducing dependence on traditional industries, creating new jobs
Foreign Investments	Improving the investment climate, simplifying business conditions	Attracting financial resources, accelerating production modernization
Innovation and Digitalization	Collaborating with the EU in technology, innovation, and research	Implementing modern technologies, enhancing the competitiveness of the Ukrainian economy
Human Capital Development	Expanding opportunities for education and professional growth	Increasing workforce qualifications, ensuring competitiveness in the global labor market

The proposed areas of Ukraine's integration policy are aimed at achieving a comprehensive economic and social effect. They include stimulating exports and attracting investments, as well as diversifying the economy, introducing innovations and developing human capital.

The successful implementation of these measures will contribute not only to the country's economic recovery, but also to Ukraine's integration into the European space as a reliable partner with a developed, modern and competitive economy.

Strategic priorities for a successful future of integration involve focusing on several key areas that will contribute to achieving the goals set. It is important to continue structural reforms in the economy, justice and anti-corruption activities, as this is the basis for creating an effective and transparent governance system. These measures are aimed at ensuring stability, public trust in state institutions and increasing the country's investment attractiveness.

Particular attention should be paid to the development of transport and energy infrastructure, which will ensure integration with European markets. This includes the modernization of transport corridors, increasing the efficiency of logistics systems, building energy networks and introducing innovative technologies. Such development will contribute to the effective exchange of resources, strengthen ties with European partners and ensure the country's energy security [37]

One of the main directions is the support of small and medium-sized enterprises, which are the driving force of the economy and the basis of job creation. Ensuring access to financing, simplifying regulatory procedures, and creating conditions for business development are key aspects of this strategy. The development of small and medium-sized businesses contributes to the stability of the economy and its diversification.

Equally important is the creation of favorable conditions for sustainable development, especially environmentally friendly production. The implementation of the principles of sustainable development in all spheres of life will minimize the impact on the environment, meet modern international standards and create a basis for long-term growth.

Ukraine is actively implementing a policy aimed at integration into the European and world economic space, which requires the implementation of a number of specific measures. These measures are very important for overcoming modern challenges and achieving positive changes that will not only bring the

country closer to the European Community, but also contribute to increasing its competitiveness in the world.

For a successful future of integration, it is necessary to focus on several strategic priorities:

- 1) Continuing structural reforms in the economy, justice and anti-corruption activities.
- 2) Developing transport and energy infrastructure for integration with European markets.
- 3) Supporting small and medium-sized businesses as the basis of the economy.
- 4) Creating favorable conditions for sustainable development and environmentally friendly production [38]

Ukraine is actively working on integration into the European and global economic space, which requires the implementation of clearly defined strategic priorities. This table shows the key areas that are of decisive importance for achieving this goal. Each of them includes specific necessary actions aimed at overcoming existing problems and contributing to the expected positive result. The successful implementation of these priorities will not only bring Ukraine closer to European integration, but will also increase its competitiveness at the international level.

Ukraine is actively working on integration into the European and global economic space, which requires the implementation of clearly defined strategic priorities. This table shows the key directions that are of decisive importance for achieving this goal.

Each of them includes specific necessary actions aimed at overcoming existing problems and contributing to the expected positive result. The successful implementation of these priorities will not only bring Ukraine closer to European integration, but also increase its competitiveness at the international level.

Table 2.5 Strategic priorities for Ukraine's integration[39]

Priority	Necessary Actions	Expected Outcome
Economic and Judicial Reforms	Ensuring transparency in legal processes, improving mechanisms for anti-corruption policies	Increased investor trust, creation of stable conditions for business
Infrastructure Development	Investing in modernization of transport and energy infrastructure	Integration with European markets, improvement of logistics capabilities
Support for Small and Medium-Sized Businesses (SMEs)	Providing financial support, creating development incentive programs	Strengthening the role of SMEs in the economy, increasing employment
Environmental Safety and Sustainable Development	Implementing environmental production standards, supporting green energy	Reduction of environmental impact, enhancement of Ukraine's international image

The implementation of the strategic priorities listed in the table is an important step to ensure the sustainable development of Ukraine and its integration into the global economic space.

Economic reforms, modernization of infrastructure, support for small and medium-sized businesses, and the implementation of environmental standards formed a solid basis for increasing investor confidence, increasing employment and improving the quality of life of citizens. A comprehensive approach to the implementation of these measures contributes to the achievement of strategic goals and strengthens the position of Ukraine in the international arena.

Ukraine's integration policy is not only an important tool for economic development, but also a path to a stable future for the country. Successful integration into the European space can ensure long-term growth of Ukraine, increase its competitiveness and create new opportunities for its citizens. Effective implementation of this opportunity depends on political will, economic stability and active participation of society in the reform process.

2.3. Key challenges and opportunities for Ukraine's economy in the context of Industry 4.0 and integration

Industry 4.0 (the Fourth Industrial Revolution) opens up significant prospects for Ukraine, but also poses a number of challenges. This is due to technological transformation, changes in global supply chains, as well as integration processes within the framework of cooperation with the European Union and other international partners.

Investments in Industry 4.0 technologies in Ukraine in recent years have shown gradual growth, which is due to increased interest in the digitalization and automation of processes in Industry 4.0, which is based on the digitalization of production, the use of the Internet of Things, artificial intelligence, big data and automation, opens up unique opportunities for Ukraine to modernize the economy and increase its competitiveness.[40]

At the same time, this process is accompanied by a number of challenges that need to be overcome for successful integration into the global economy. These challenges include infrastructure problems, personnel shortages, financial constraints, uneven development, and regulatory barriers.

Table 2.6 Main aspects of challenges for Ukraine in the context of Industry 4.0[41]

Category of Challenges	Characteristics
Infrastructure Issues	- Outdated production facilities
	- Weak IT infrastructure (low high-speed internet coverage)
	- Insufficient level of energy security
Workforce Shortages	- Lack of innovation clusters
	- Brain drain: skilled professionals emigrating abroad
	- Mismatch between educational programs and Industry 4.0 needs
	- Weak workforce retraining programs
	- Low popularity of technical professions among youth

Financial Constraints	- Limited access to financing due to high interest rates
	- Low investment levels caused by political and economic risks
	- High cost of imported equipment and technologies
Uneven Development	- Regional disparities between major cities and rural areas
	- Sectoral differences: progress in IT but slow development in agriculture and energy
	- Socio-economic inequality in access to resources
Regulatory Barriers	- Outdated legislation not aligned with modern technologies
	- Bureaucratic hurdles in implementing innovations
	- Lack of transparency in regulatory policies
	- Absence of tax and financial incentives for innovative companies

A significant part of Ukrainian companies continues to work on the basis of outdated technologies, which reduce their efficiency and productivity. This is due to limited access to modern equipment and technologies, the high cost of modernization and weak incentives from government programs. Moreover, the lack of effective maintenance and support of modern technologies increases this problem.

Industry 4.0 requires developed infrastructure, including broadband Internet, secure servers, cloud computing, and access to modern data exchange systems. However, most regions of Ukraine, especially rural ones, have limited access to these resources. Insufficient investments in the development of digital infrastructure and an even distribution of available resources slow down the country's integration into the global digital economy.

In Ukraine, research often remains at the level of scientific publications without practical implementation. The lack of mechanisms for the commercialization of scientific development and limited financial support for innovative startups lead to "brain drain" - talented scientists look for opportunities abroad. In addition, the insufficient participation of private companies in the financing of scientific research creates additional obstacles for innovation. [42]

Ukraine's education system does not meet the modern challenges of Industry 4.0. The lack of retraining programs aimed at digital and innovative specialties and the slow update of educational standards lead to a shortage of specialists in areas such as artificial intelligence, data analysis, cybersecurity and robotics. In parallel, increased migration of qualified personnel abroad is deepening the crisis on the labor market.

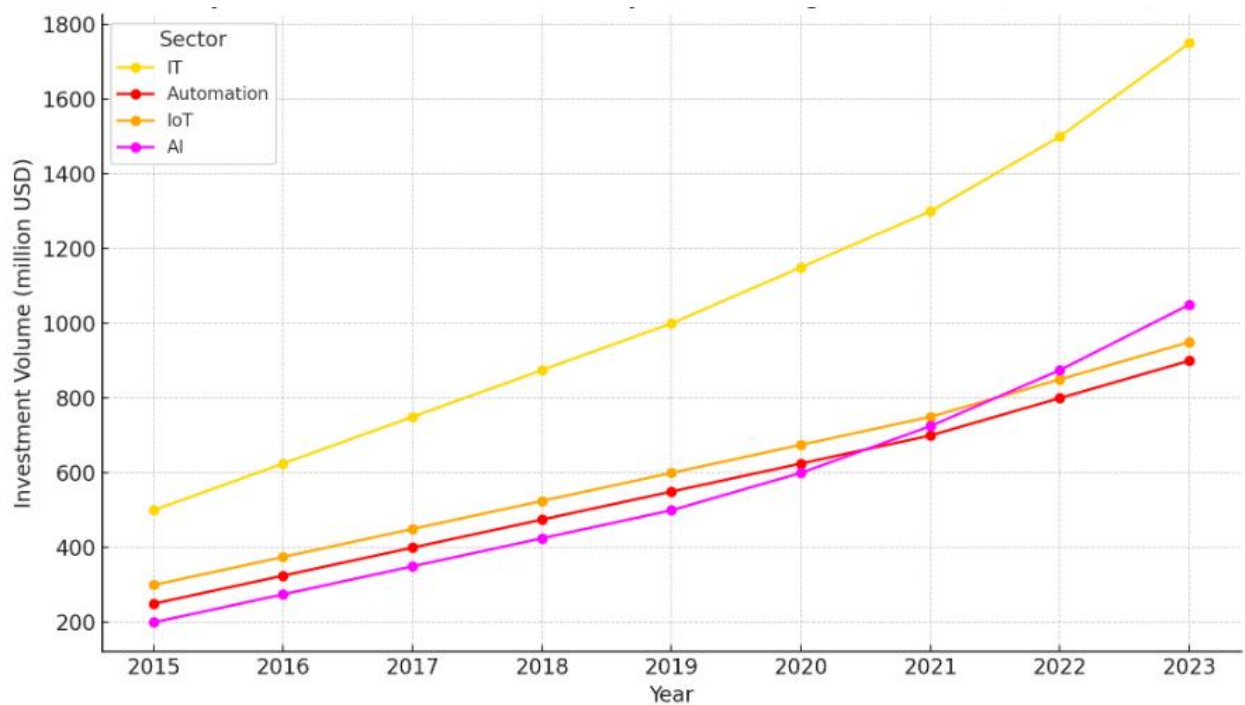
Most small and medium-sized enterprises (SMEs) do not have access to the resources necessary for the transition to digitalization and automation. High loan rates, low trust in the banking system, and the lack of state support in the form of grants, tax breaks, and modernization limit the financial capabilities of enterprises.

The legislative field of Ukraine remains backward in the field of digitization and innovation. Weakly developed laws regulating the work of startups, commercialization of intellectual property, cyber security and e-commerce create uncertainty for investors. Slow administrative procedures, bureaucracy, and corruption also discourage potential investors.

Industry 4.0 offers active participation in international supply chains, access to global data exchange platforms, and participation in international standardization processes. However, the low competitiveness of Ukrainian products, the slow implementation of international quality standards, and the lack of a systematic export promotion policy hinder the integration of Ukraine into the global economic process. Industry 4.0 requires a stable energy supply, but this still remains a problem for Ukraine due to outdated energy infrastructure, high tariffs for renewable energy sources. This creates additional obstacles for increasing energy efficiency and implementing innovative projects [43]

The growth of private capital attraction is one of the key trends: large industrial enterprises, in particular in metallurgy, energy and agricultural sectors, are increasing spending on automation and optimization of production. Ukrainian IT companies play an important role, becoming key partners for the development of Industry 4.0 solutions and attracting foreign investments.

The chart shows the dynamics of investments in Industry 4.0 technologies in Ukraine for the period 2015–2023. This period is characterized by a significant increase in interest in digital technologies, in particular in such sectors as information technology, automation, Internet of Things and artificial intelligence. Thanks to foreign investments, cooperation programs with international companies, as well as state initiatives, Ukraine has begun to actively introduce these technologies into various sectors of the economy. The growth of financing in these sectors has contributed to the development of new startups, modernization of production, and improved competitiveness in the global market.



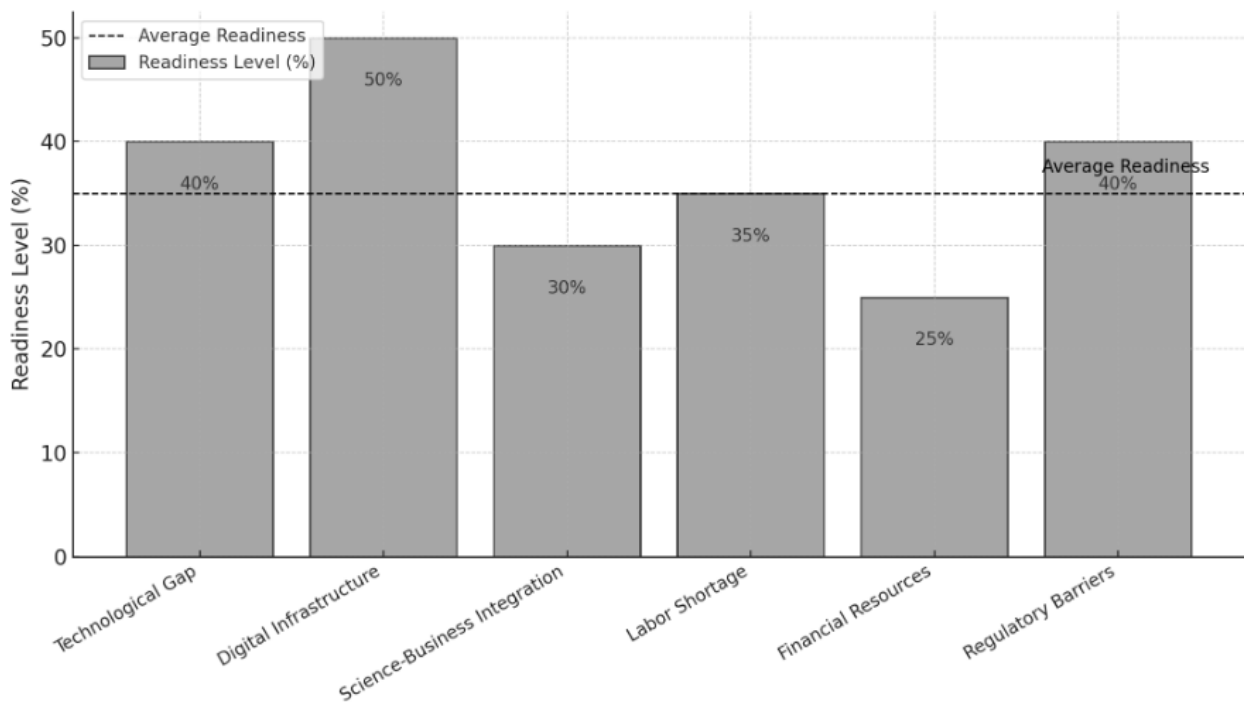
Picture 2.1 Dynamics of Investments in Industry 4.0 Technologies in Ukraine 2015-2023 [44]

In general, the graph shows a significant increase in investments in Ukrainian Industry 4.0 technologies, especially in the IT sector, automation, the Internet of Things, artificial intelligence. It reflects the relevance of global trends and the digitization of the economy. However, despite the positive dynamics, the country

faces certain problems, such as the lack of financing of scientific research and the need for further integration of technologies in industry

To support the sustainable development of Industry 4.0, it is necessary to ensure closer cooperation between governments, enterprises and scientific institutes. Industry 4.0 offers the introduction of advanced technologies, automation, digitalization and innovation as a new stage in the development of the world economy. For Ukraine, the transition to this model is of strategic importance, as it contributes to increasing competitiveness, the development of exports and integration into the world the economy

However, the country faces a number of challenges that slow down this process. The graph reflects Ukraine's level of readiness for the implementation of Industry 4.0 in key aspects such as digital infrastructure, financial resources, science and business integration, technological development, human resources, and regulatory framework. It also demonstrates the dynamics of changes in these areas, indicating areas that require priority intervention and reform [45]



Picture 2.2 Ukraine`s Readiness for Industry 4.0 be Key Challenges [46]

This chart shows an assessment of Ukraine's level of readiness for the implementation of Industry 4.0 according to six key challenges, each of which is evaluated in percentages. The vertical axis shows the level of readiness (0-100%), and the horizontal axis lists the main challenges.

1) Technological backwardness (40%) enterprises in Ukraine still use outdated technologies, which limits their competitiveness. In recent years, there have been no significant changes in this direction (a stable indicator).

2) Digital infrastructure (50%) is the strongest area, showing positive dynamics (+10%) thanks to initiatives to expand access to the Internet, particularly in rural areas, and the implementation of digital public services such as "Diya".

3) Integration of science and business (30%) the level of cooperation between scientific institutions and business remains low. A small increase (+5%) indicates gradual but insufficient shifts.

4) Personnel shortage (35%), high outflow of qualified personnel abroad and insufficient adaptation of the educational system to the needs of Industry 4.0 leave the problem almost unchanged (the indicator is stable).

5) Financial resources (25%) the lowest level of readiness. Limited access to financing and high credit rates hold back innovative transformations in the country. There is no dynamics.

6) Regulatory barriers (40%) slight progress is observed in the digitalization of public services, but the slow implementation of innovative legislation does not allow to significantly improving the situation.

Ukraine shows progress in the development of digital infrastructure, but in other areas, such as financing, integration of science and business, and human resources, there is a significant lag. The graph also illustrates the need for a strategic approach to solving these problems.

Industry 4.0, based on the integration of digital technologies into production processes, opens up significant prospects for Ukraine. In the conditions of global digital transformation, the country has the opportunity to use its potential to

modernize the economy, integrate into international markets, and achieve the goals of sustainable development.

At the same time, the realization of these opportunities is associated with a number of challenges that require complex solutions and a strategic approach. Industry 4.0 can become the driving force of changes, and also defines the main opportunities, challenges and examples of successful solutions for Ukraine.

Table 2.7 Potential of Industry 4.0 for Ukraine [47]

Sector	Opportunities	Challenges	Examples and Solutions
Economy	<ul style="list-style-type: none"> - Modernization of production - Increased competitiveness - Growth in exports of high value-added products 	<ul style="list-style-type: none"> - High implementation costs - Insufficient access to investments 	<ul style="list-style-type: none"> - IT clusters in Kyiv, Lviv, Kharkiv - Partnerships with foreign companies
Global Chains	<ul style="list-style-type: none"> - Integration into global markets - Compliance with international quality standards - Development of logistics systems 	<ul style="list-style-type: none"> - High competition in global markets - Low technological readiness in some sectors 	<ul style="list-style-type: none"> - Warehouse and transport automation - Cooperation with the EU within free trade agreements
Regional Development	<ul style="list-style-type: none"> - Creation of technoparks - Development of innovation hubs - Engaging youth in the digital economy 	<ul style="list-style-type: none"> - Uneven distribution of resources across regions - Insufficient infrastructure in rural areas 	<ul style="list-style-type: none"> - Establishment of technoparks in smaller cities - Decentralization programs
Green Economy	<ul style="list-style-type: none"> - Energy efficiency - Transition to renewable energy sources (RES) - Circular economy 	<ul style="list-style-type: none"> - High dependence on traditional energy sources - Need for modernization of outdated infrastructure 	<ul style="list-style-type: none"> - Development of wind and solar energy - Implementation of smart energy systems

Sustainable Development	<ul style="list-style-type: none"> - Reduction of emissions - Environmental production standards - Corporate social responsibility 	<ul style="list-style-type: none"> - Low environmental awareness among the population - Slow adaptation to European environmental requirements 	<ul style="list-style-type: none"> - Projects under the European Green Deal - Training programs on environmental responsibility
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The modern world is experiencing the fourth industrial revolution, which is changing established economic models, production processes, and methods of interaction between countries. Industry 4.0, based on digital technologies, automation and innovation, opens up unique opportunities for developing economies, especially for Ukraine. This will not only provide tools for industrial modernization, but will also create conditions for deeper integration in the world market, stimulate regional development and promote sustainable and environmentally safe growth.

In the conditions of global challenges and the transition to a "green" economy, Ukraine has the opportunity to use its scientific and technical potential and advantageous geographical location to build an innovative economy. The realization of this opportunity requires a strategic approach, coordination of the efforts of the state, business and science, as well as the implementation of systemic reforms [48]

Industry 4.0 is an important driving force of technological and economic development in modern countries, especially in Ukraine. It includes the integration of automation, digital technologies, artificial intelligence and the Internet of Things in all aspects of production and management. For Ukraine, this is not only an opportunity to modernize the economy, but also a challenge associated with the need to adapt infrastructure, education, investment environment and management. The table presents the main challenges and opportunities facing the Ukrainian economy in the transition to Industry 4.0, as well as real examples of enterprises that are already integrating these technologies.

Table 2.8 Challenges, opportunities and strategies for Ukraine in the context of Industry 4.0 [49]

Category	Key Challenges / Opportunities	Examples
Digitization of Enterprises	Insufficient adoption of digital technologies	Only 25% of companies in the industry use IoT or big data analytics.
Investment in Innovation	Lack of capital for production modernization	The machine-building company "Turboatom" faces automation issues due to insufficient investment.
Workforce Development	Education does not meet Industry 4.0 standards	Companies like "Interpipe" must provide additional training for engineers to work with new technologies.
Infrastructure Constraints	Underdeveloped 5G networks and digital infrastructure	IT clusters in Kharkiv and Lviv experience resource shortages in remote regions.
Innovation Exports	Development of IoT, AI, and automation for global markets	Ajax Systems exports security systems to over 130 countries.
Integration with the EU	Collaboration with European accelerators and companies	Ukrainian startups collaborate with Techstars, attracting international investments.
Industrial Modernization	Increased productivity through automation	ArcelorMittal Kryvyi Rih integrates AI for quality control.
Cluster and Hub Development	Creation of environments for startup growth	UNIT.City – a technopark in Kyiv for IT and high-tech enterprises.
Agrotechnology	Implementation of precision farming and automation of farming processes	MHP uses AI and IoT to optimize agricultural processes.

Industry 4.0 opens unique prospects for Ukraine - from the development of technological startups to the modernization and integration of industries in the European technological space. However, insufficient digitalization, lack of personnel and limited infrastructure require a complex solution.

It is important for governments, companies, and educational institutions to act synchronously: develop innovative ecosystems, create favorable conditions for investors, and train a new generation of specialists.

Only under such circumstances will Ukraine be able to realize the potential of digital transformation and strengthen its position on the world economic stage. The realization of the potential of Industry 4.0 in Ukraine depends on the ability to overcome existing challenges, such as the high cost of implementing technologies, uneven regional development, and dependence on traditional resources [50].

Successful examples, such as the development of IT clusters, the introduction of green energy and international cooperation, show that Ukraine is competitive on the world stage. Systematic support, infrastructure development and investments in education and science at the state level will help use the advantages of Industry 4.0 for the sustainable economic and social development of the country.

3.1. Development of an economic development model considering the specifics of Industry 4.0

The development of Ukraine's economy in the context of Industry 4.0 involves the use of the latest technologies based on automation, digitalization, the use of big data, the Internet of Things (IoT), artificial intelligence (AI), cloud technologies and other innovations. The development of an innovation ecosystem is a key element of economic progress and digital transformation.

Table 3.1 "Key areas of innovative development and their impact"

Direction	Key Initiatives	Expected Outcomes
Innovative Foundation	- creation of innovation hubs and tech parks; - <u>development of digital infrastructure</u> (high-speed internet, data centers).	- development of startups; - <u>access to technology</u> in all regions.
Investment in Human Capital	- training in new skills (IT, analytics, automation); - <u>educational reform</u> with a focus on STEM.	- increased economic competitiveness; - creation of a skilled workforce; - adaptation to digital realities.
Support for Business and Entrepreneurship	- tax incentives for innovative enterprises; - <u>grants</u> and state support for digital projects.	- innovative thinking among the youth; - growth of small and medium-sized businesses; - <u>support for startups</u> at early stages.
Development of Partnerships	- engagement of international corporations; - <u>collaboration between government, business, and academia.</u>	- creation of new jobs; - technology transfer; - integration of local professionals into global projects; - effectiveness of joint projects.
Environmental	- principles of circular economy;	- waste minimization;

Sustainability	- use of green technologies.	- renewable energy sources; - increased energy efficiency in production.
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The innovation base provides basic conditions for the development of startups and the implementation of digital technologies, especially through technoparks and high-quality infrastructure. This will create a favorable environment for entrepreneurs and will help attract investors in the technological industry.

Investments in human capital are aimed at training specialists capable of meeting the requirements of the future market. Improving the education system and retraining the workforce will contribute to society's adaptation to digital transformation, in particular, due to the introduction of STEM education and the development of digital skills.

Support for business and entrepreneurial activity is aimed at creating economic incentives for innovative companies. Reducing tax pressure, state financing and subsidies contribute to the growth of entrepreneurial activity, which is the engine of economic development. The development of partnership relations allows to jointly achieve the set goals, combining the efforts of the state, business and scientific institutes. The involvement of international companies and the transfer of technologies create conditions for the integration of global markets[51].

Environmental sustainability is an important component of modern development, since the introduction of "green" technologies and the principles of closed-loop economics contribute to the preservation of natural resources and the minimization of the negative impact on the environment.

In general, the implementation of these areas will contribute to the formation of a competitive economy based on innovation, cooperation and environmental responsibility. The key goal of the economic model in the context of Industry 4.0 is to build an innovation-oriented economy based on the principles of innovation, sustainable development and inclusiveness. Innovation involves the introduction of

modern technologies into all sectors of the economy, the creation of conditions for the widespread use of digital solutions and automation.

Sustainable development is guaranteed by economic growth in accordance with the principles of environmental responsibility and conservation of natural resources. Inclusiveness consists in the balanced development of the region, the creation of new jobs and the promotion of social unity. The model of economic development contains several key elements[52].

The first element is digitization of the economy, including the implementation of IOT technologies, automation, artificial intelligence and big data analytics in industry, agriculture, transport, energy and the service sector.

The second element is the development of the innovation ecosystem, which includes support for startups, creation of innovation clusters, development of research infrastructure (technology park, innovation center) and promotion of public-private partnerships for the integration of the latest technologies. into production

The third element is the stimulation of investments, especially by providing tax benefits to technological companies and the launch of state programs for financing Industry 4.0 projects.

The fourth element is the development of programs for the retraining of workers in traditional industries, the introduction of digital technologies in the educational reform process, which involves the spread of STEM fields.

The fifth element is the development of digital infrastructure, which includes providing access to the National Broadband Internet, building modern data centers, implementing 5G networks, and creating reliable cyber security systems.

Together, these components form a comprehensive model of economic development capable of adapting to the challenges of Industry 4.0 and ensuring sustainable and innovative growth of Ukraine [53]

3.2. SWOT analysis of Ukraine's economic development in the context of Industry 4.0 and integration processes.

Ukraine is at the stage of transformational development, which combines the introduction of modern Industry 4.0 technologies and active integration into the world economy. Industry 4.0 creates unique opportunities for an economic boom based on digitization, automation, the use of artificial intelligence, the Internet and other innovative solutions. At the same time, the process of European integration and cooperation with international organizations ensures access to advanced markets, financial resources and technologies.

Industry 4.0 is revolutionizing the world economy based on the introduction of digital technologies, automation, the Internet of Things, artificial intelligence, and big data analysis. Ukraine is also trying to adapt its economy to new realities, using the opportunities of Industry 4.0 and integrating it with global economic processes. This path is associated with both serious prospects and serious challenges.

First of all, Ukraine has a significant potential for the development of Industry 4.0 due to the presence of a strong IT department, known throughout the world for its high level of outsourcing services and software creation. Another important factor is a strong foundation of technical education:

Every year, Ukrainian universities graduate many specialists in the fields of engineering, cyber security, robotics, and automation. Innovation clusters are also being formed all over the country, for example, subdivisions of technoparks. The cities of Kyiv, Lviv, IT clusters, technoparks, Kharkiv, and Odesa contribute to the development of startups and the implementation of innovative technologies. But there are serious problems that prevent the large-scale implementation of Industry 4.0 in Ukraine [54]

Firstly, infrastructure issues are still relevant. The vast majority of production facilities use outdated technologies, which requires the modernization of transport and energy infrastructure.

Secondly, the main obstacles are financial constraints: the low level of state funding of research and development and limited access to venture capital, as well as regulatory obstacles, such as the lack of a clear National Strategy for the implementation of industry 4.0, difficulties in doing business due to tax and administrative bureaucracy. 1. Another problem is the insufficient digital literacy of part of the population, which slows down the implementation new technologies, everyday activities of companies.

Despite these difficulties, the process of Ukraine's integration into the global economy creates conditions for synergy with European partners in the context of Industry 4.0. The Union Agreement with the EU will allow Ukrainian companies to achieve their goals through access to European markets, adaptation to EU standards in the field of digital technologies, and much more. Participation in international programs such as Horizon Europe and Digital Europe. This opens up new opportunities for the future. Thanks to cooperation with international organizations, Ukraine can use the experience of developed countries to implement technological innovations and receive technical assistance.

Some branches of the economy have already demonstrated progress in the context of Industry 4.0. The agricultural sector is actively implementing precision farming technologies that use unmanned aerial vehicles and big data analysis to optimize yields. In the energy sector, the development of renewable energy sources and the introduction of intelligent networks to increase the efficiency of energy resource management are encouraged [55]

In medicine, telemedicine is becoming increasingly popular, electronic health records are being introduced and artificial intelligence is being used for diagnostics and treatment. Industry is also gradually moving to the use of additive manufacturing (3D printing) and robotics.

In order to further stimulate the development of Industry 4.0 in Ukraine, it is necessary to take a number of measures. State policy should be aimed at developing and implementing national strategies for the development of Industry 4.0, supporting innovative projects, and creating funds to stimulate investments in digitization.

Important support for education: improvement of educational programs in the fields of STEM (science, technology, engineering, mathematics) and development of research infrastructure. Cooperation between business and government is aimed at supporting small businesses in the process of automation and digital transformation. The development of international relations, including the creation of joint research centers, will help Ukraine integrate into the global innovation ecosystem.

At the same time, the economic development of Ukraine faces many challenges: unstable geopolitical conditions, low level of technological innovations, macroeconomic vulnerability and digital inequality between regions. Assessment of strengths and weaknesses, opportunities and threats (SWOT analysis) will allow you to better understand which areas of development should be prioritized to achieve sustainable economic growth. [56]

In this context, a SWOT analysis will help identify key factors affecting the economy and find optimal ways to use them to integrate Ukraine into the global technological space.

Table 3.2 SWOT analysis of the economic development of Ukraine in the context of Industry 4.0 and integration processes [57]

Strengths	Weaknesses
Significant agro-industrial potential and high-quality products.	Insufficient funding for innovation and R&D projects.
Leading position in the global IT industry (outsourcing, startups).	Low level of digital literacy among the population, especially in rural areas.
Advantageous geographical location for transport and logistics infrastructure.	Weak integration of universities, research centers, and businesses.
Natural resources (lithium, manganese, titanium) promising for "green" technologies.	Unstable legislative framework and high levels of bureaucracy.

Association Agreement with the EU providing trade preferences.	Underdeveloped infrastructure, particularly in digital and smart technologies.
Dynamic development of creative industries.	Limited access for SMEs to financial resources.
Gradual development of industrial parks and technology clusters.	Energy dependency on traditional energy sources.
Educated youth with potential in STEM fields.	Underdeveloped logistics infrastructure for integration into global supply chains.
Opportunities	Threats
Adaptation of Industry 4.0 (digitalization, automation, smart technologies).	Escalation of military conflicts and political instability.
Utilization of international support programs (Horizon Europe, Digital Europe).	Brain drain to countries offering better working conditions.
Development of renewable energy (solar, wind, hydrogen).	Global economic crises reducing investment opportunities.
Expansion of exports of high-tech products and services.	Increasing competition from other countries in high-tech sectors.
Development of smart cities and regional innovation centers.	Risk of growing digital inequality between regions.
Improved collaboration with international institutions to attract investments.	Underutilization of natural resources due to slow production modernization.
Creation of innovative platforms for cooperation between business, science, and government.	Environmental degradation due to inefficient production methods.
Attraction of private investors for digital infrastructure development.	Financial market instability affecting foreign capital attraction.
Formation of new markets in IoT, AI, electric vehicles, and renewable energy.	Stalling reforms in judiciary, anti-corruption efforts, and business deregulation.

Ukraine's economic development in the context of Industry 4.0 and integration processes opens up broad prospects for increasing the country's competitiveness on the global stage. SWOT analysis shows that Ukraine has significant potential in areas such as digital technologies, agro-industrial complex, innovative industries and human capital. However, there are significant obstacles, including the low level of implementation of new technologies, corruption, instability of the legislative

framework and geopolitical risks. So we can made the SWOT matrix SO-ST, WO-WT

Table 3.3. The matrix result of SWOT- analysis

Category	Strategies
SO Strategies (Strengths + Opportunities)	<ul style="list-style-type: none"> - Utilize the global leading position in IT to accelerate Industry 4.0 and smart technologies adoption; - combine creative industries and STEM talent to expand exports of high-tech products and services; - exploit EU Association Agreement for renewable energy technologies and high-quality agro-industrial products; - partner with EU programs (Horizon Europe) to integrate universities and businesses for green technology innovation; - <u>develop</u> industrial parks and technology clusters for IoT, AI, and smart city solutions.
ST Strategies (Strengths + Threats)	<ul style="list-style-type: none"> - Expand agro-industrial and IT exports to reduce dependency on unstable political climates; - enhance transport and logistics infrastructure to withstand global economic shocks; - utilize natural resources for renewable energy solutions to reduce energy dependency and environmental risks; - offer competitive opportunities in creative/STEM industries to retain educated youth; - <u>focus</u> on creative industries and industrial parks to bypass bureaucratic hurdles.
WO Strategies (Weaknesses + Opportunities)	<ul style="list-style-type: none"> - Use international programs (Digital Europe) to address funding gaps in innovation and R&D; - implement nationwide programs to increase digital skills, particularly in rural areas; - foster innovation platforms linking academia, research, and businesses, leveraging EU trade preferences; - attract private investment to upgrade infrastructure for global supply chain integration; - <u>develop</u> mechanisms for better SME access to financial resources for growth in high-tech sectors.

WT Strategies (Weaknesses + Threats)	<ul style="list-style-type: none"> - Prioritize reforms in legislation, judiciary, and anti-corruption for a stable business environment; - develop community-based renewable energy to reduce reliance on traditional energy sources; - invest in digital infrastructure in underserved regions to prevent disparities; - encourage efficient production practices to minimize environmental degradation. <p>Partner with international institutions to reduce dependency on unstable financial markets.</p>
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Analysis of the presented strategy within the framework of the SWOT matrix allows us to formulate a comprehensive approach to development. SO strategies are aimed at using strengths, such as leadership in the IT sector, creative industries, access to resources and partnership with the EU, to adapt Industry 4.0, develop innovation clusters and expand exports of high-tech products. This creates a basis for Ukraine's integration into the global economy with competitive advantages.

ST strategies focus on reducing risks associated with political and economic instability through export diversification, improving transport and energy infrastructure, as well as creating conditions for retaining talented youth. They help reduce the impact of external threats on economic sustainability.

WO strategies focus on overcoming weaknesses through international support, in particular financing of innovations, increasing digital literacy and integrating science, business and education. Infrastructure development and support for small and medium-sized businesses will remove barriers to their participation in modern markets.

WT strategies address weaknesses, minimizing threats through stabilizing the regulatory environment, reforming the judicial system, developing digital and energy infrastructure, and implementing effective environmental practices.

This strategy provides a comprehensive approach to the development of Ukraine as an innovative, environmentally sustainable, and competitive state

capable of integrating into the global economy and successfully overcoming external challenges.

For successful economic development, it is necessary to focus efforts on stimulating innovation, developing digital infrastructure, supporting education and science, attracting investment in high-tech industries. It is also important to accelerate Ukraine's integration into global supply chains and use the opportunities provided by international programs and cooperation with the EU [58]

Thus, strategic development based on a combination of strengths and opportunities will help overcome existing weaknesses and minimize threats. This will allow Ukraine to confidently move towards the status of a modern economy capable of adapting to the challenges of Industry 4.0 and becoming a full participant in the global digital ecosystem

3.3. Prospects for implementing the model and potential adjustments

The model of economic development of Ukraine in the context of Industry 4.0 involves the adaptation of the economy to modern digital challenges and technologies, such as automation, robotics, the Internet of Things, artificial intelligence, big data, blockchains, 3D printing. Industry 4.0 has formed a new model of production, consumption, management of resources and services, which can become a powerful driver of economic development of Ukraine.

Ukraine has significant potential for the implementation and development of the "Industry 4.0" model, which is based on the integration of innovative solutions in various areas of digital technologies, automation and economics. This opens up new opportunities for modernization of industries, expansion of technology exports, improvement of energy efficiency and integration into global supply chains.

The Ukrainian IT department with a high level of professionalism can become a driving force in the export of solutions for Industry 4.0. Thanks to the development

of software, cloud technologies and IoT solutions, this country can take a competitive position in the world market. The experience of a successful outsourcing company can be used to transition to creating your own food business, which will strengthen the economy and increase the potential for innovation [59].

Traditional industries of the economy can integrate Industry 4.0 technologies to automate processes, increase productivity, and reduce costs. In particular, predictive maintenance allows you to predict in advance the need for equipment maintenance, minimizing the risk of downtime. The introduction of robotics, automated production lines and technological process management systems will create conditions for increasing the competitiveness of Ukrainian industry.

In agriculture, the use of Industry 4.0 technologies contributes to the implementation of precision agriculture, based on monitoring with the help of drones, sensors and data analysis. Optimizing basin irrigation and applying Internet of Things solutions, you can reduce water and resource consumption by increasing yields. This makes the agro-industrial complex more efficient and environmentally sustainable.

Technologies of Industry 4.0 open new horizons for increasing energy efficiency. Intelligent networks and energy flow management systems help to optimize energy consumption, and the introduction of renewable energy sources reduces dependence on traditional fuel resources. 1. One of the promising areas of development is also the production of batteries and technologies for reducing energy consumption.

The development of financial technologies in combination with tools for automating financial transactions, blockchain and virtual services will contribute to the growth of e-commerce and the simplification of business processes. Innovations in this field create prerequisites for quick access to capital, more efficient financial management and attraction of new clients.

Thanks to active digitalization and high quality standards, Ukraine has the opportunity to integrate into the global supply chain. This is especially relevant in the technological sector, where digital solutions and process automation are key

advantages. This will allow Ukrainian companies to become an important player in the world market and strengthen the economic position of the country [60]

Thanks to the implementation of the latest technologies in such industries as the agricultural sector and energy, there is a significant potential for the development of the Ukrainian economy. In the agricultural sector, the use of intelligent agriculture, unmanned aerial vehicles and analytical platforms will increase production efficiency, reduce costs increase yield. But for successful implementation, coordination of the regulatory and legal framework, encouragement of farmers to use technologies in rural areas, and development of digital infrastructure are required.

In the energy sector, the transition to intelligent networks for the use of renewable energy sources will contribute to energy independence and reducing the impact on the environment. At the same time, it is necessary to solve the problem of modernization of outdated energy infrastructure, attraction of investments and introduction of transparent tariffs. The strategic direction of the global state is to stimulate the local production of renewable energy components that contribute to economic growth. The IT industry demonstrates dynamic development due to the active use of cloud computing and the support of the startup ecosystem. An important adjustment is the expansion of access to international markets and the creation of conditions for tax benefits to support the competitiveness of the industry.

Ukraine has the opportunity to become an important player in the global network thanks to the development of outsourcing services, the use of qualified personnel and the competitiveness of its products. But this requires strengthening the stability of the economy: simplifying customs procedures, harmonizing standards with international standards, improvement of transport infrastructure [61]

In addition, an important direction is the stimulation of innovations in the production sector, which will allow Ukraine to move from the role of a supplier of raw materials to a producer of high-tech products. A transparent and predictable regulatory policy is needed to attract foreign investors. Special attention should be paid to the creation of innovation clusters that combine science, business and

production. Investors are interested in projects with a clear market entry strategy and state support in the form of tax incentives or simplified business conditions. An additional correction can be the active promotion of Ukraine as a center of technological development, in particular in the IT sector, agro-innovations and green energy.

The training of specialists for Industry 4.0 is the foundation for the success of these areas. Updating educational programs with a focus on practical training, development of STEM education, as well as stimulating the participation of young people in scientific research will ensure the competitiveness of the workforce. It is also important to increase the funding of science and stimulate the cooperation of universities with business for the implementation of research in the real sector of the economy.

Ukraine has significant potential for breakthroughs in key industries and integration into global economic processes. However, the realization of these opportunities requires the coordinated efforts of the government, business and international partners. The main challenges remain the imperfect regulatory environment, limited access to financing and insufficient level of infrastructure. Adjustments aimed at eliminating these barriers can make Ukraine an innovation hub in Central and Eastern Europe.

The implementation of a complex model of development in the conditions of the modern economy faces a number of challenges, each of which requires a targeted approach and systemic corrections. Uneven regional development is one of the key barriers. A significant gap between large cities and rural regions limits the country's overall progress. To address this imbalance, it is important to invest in transport and digital infrastructure, especially in rural areas. This includes expanding access to high-speed Internet, creating technology parks in the regions and encouraging local businesses to use the latest technologies [62]

The high level of capital investment required for the development of new technologies can be a serious deterrent. Access to financing should be ensured with the help of state grants, preferential lending, as well as the involvement of

international financial institutions, such as the World Bank or the European Investment Bank. It is also important to create public-private partnerships for joint financing of innovative projects.

Low technical awareness of small and medium-sized enterprises (SMEs) significantly limits their growth opportunities. The development of specialized educational programs, consulting services and subsidies for the introduction of technologies contributes to increasing the competitiveness of small and medium-sized enterprises. In addition, it is worth creating a platform for the exchange of experience between companies that have already successfully implemented the latest technologies and those that are just starting this path.

Institutional barriers are also important obstacles to innovative development. Complex bureaucracy, outdated legal framework and weak protection of intellectual property discourage investors and slow down entrepreneurial activity. Implementation of reforms aimed at simplifying licensing procedures, creating transparent business conditions and effective protection of intellectual property will be an important step on the way to stimulating innovation [63]

The shortage of personnel in fields related to new technologies (artificial intelligence, robotics, data analysis) is another key problem. To overcome this, it is necessary to activate public-private educational initiatives, implement retraining programs, and expand cooperation between universities and companies for the development of human resources that meet the real needs of the market. Ukraine has great potential for the implementation of innovative models, but for this it is necessary to overcome a number of difficulties. The main factor for success will be a systematic approach to solving problems, coordination of the efforts of the government, business and international partners, and a focus on long-term results.

The implementation of the proposed changes will significantly accelerate economic development, create a competitive economy, increase the quality of life of citizens development of all regions. Industry 4.0 opens up significant opportunities for economic development for Ukraine thanks to the introduction of digital technologies, automation of processes and integration into global markets. However,

the realization of this potential depends on overcoming a number of barriers that prevent the effective use of modern innovations.

Table 3.4 "Comparative analysis of the potential and barriers to the implementation of Industry 4.0 in Ukraine"[64]

Aspect	Potential	Barriers
IT Sector	High level of expertise, growth of FinTech, active startup ecosystem, outsourcing experience	Lack of product-based businesses, limited access to international markets, brain drain
Agricultural Sector	Precision farming, smart farming, implementation of drones and IoT, growth of agritech startups	Insufficient digital infrastructure, low level of technological awareness among farmers
Industry	Predictive maintenance, robotics, automated production lines, localization of technology manufacturing	Obsolete production base, low investment in modernization, high cost of equipment
Energy	Renewable energy sources (solar, wind), smart grids, energy efficiency, growth of the "green" energy market	Infrastructure modernization, lack of investment incentives, regulatory barriers
Investment Level	Preferential loans, grants, support from international financial organizations, public-private partnership	Limited access to financing, high risks for investors
Transport Infrastructure	Integration of logistics technologies (IoT, blockchain), supply chain optimization	Low level of infrastructure development, high dependence on outdated logistics systems
Education and Workforce	STEM education, technical universities, growth of retraining programs	Insufficient funding for education, outdated training programs
Financial System	Development of FinTech, digitalization of payments, blockchain implementation	Economic instability, weak investor protection

The table provides a comprehensive view of the potential and barriers to the implementation of Industry 4.0 in Ukraine, covering key industries and aspects of economic development. The IT sector shows significant progress and opportunities for exporting digital solutions, but faces challenges such as labor attrition and lack of product business. The agricultural sector has prospects for the introduction of

precision agriculture and smart farming technologies, which can make agriculture more efficient and ecological. However, limited digital infrastructure in rural areas slows down these processes. In the industrial and energy sectors, new technologies, such as preventive maintenance, robotics and intelligent networks, can provide significant modernization, but this requires significant investments and the solution of old infrastructural problems.

Transport infrastructure and financial systems can benefit from the introduction of the most modern technologies, such as IoT and blockchain, contributing to the optimization of logistics and digitization of business. However, weak infrastructure and economic instability are still the main obstacles. Special attention should be paid to education and retraining of personnel for Industry 4.0. The development of STEM education and retraining programs will become the basis for the formation of human resources necessary for the implementation of innovative changes. The analysis shows that in order to fully unlock the potential of Industry 4.0 in Ukraine, it is necessary to reform the education system, improve the regulatory and legal framework, stimulate investments and overcome a number of barriers due to the development of digital infrastructure. This will turn key problems into opportunities for sustainable economic growth [65].

The analysis shows that Ukraine has a significant potential for the integration of Industry 4.0, but the realization of this potential requires a systematic approach to the elimination of barriers. Among the main problems are the lack of digital and production infrastructure, limited access to financing and a shortage of human resources in the technological sector. At the same time, the development of the IT sector, agricultural innovations, energy and financial technologies can become the basis for sustainable economic growth.

CONCLUSION

Industry 4.0 has changed the main principles of economic development in the modern world thanks to the introduction of advanced technologies such as

automation, the Internet of Things (IoT), artificial intelligence, big data and other innovative solutions. This is a driving force that determines new directions and opportunities for the development of business and the economy as a whole. Implementation of these technologies will allow us to increase production efficiency, reduce costs, optimize supply chains, and create new products and services.

Economic development within the framework of Industry 4.0 is characterized by significant changes in all sectors, from labor productivity to increasing competitiveness in international markets. In addition, governments and enterprises must adapt to new economic realities, develop human capital and ensure cyber security. The implementation of Industry 4.0 contributes to the creation of new jobs, but at the same time requires training programs for adaptation to new technological conditions and changes in the qualifications of employees.

The process of integration into the world economy is an important factor in the economic growth and development of the country. Taking part in the global integration process, Ukraine has the opportunity to adapt to new challenges and take advantage of technological innovations. Aletse also creates many problems for Ukraine, such as the need to modernize production equipment, increase its competitiveness world market and integration into the international economy and trade structure.

An important aspect for Ukraine is the creation of conditions for the development of its own high-tech sector, as well as the main engine of economic development in the context of Industry 4.0, taking into account global trends and integration processes, Ukraine will continue to work on ensuring technical and institutional readiness for active participation in the world economy. The economy, as a result of the development of Industry 4.0 and the process of integration of the world economy, has a significant impact on the economic development as at the global level, as well as at the level of individual countries, especially Ukraine. Adaptation to these changes is the key to successful future economic transformation and development [67]

Ukraine is at an important stage of its economic development, overcoming difficulties and taking advantage of new opportunities. Analysis of the current state of economic indicators shows a double dynamic: persistent structural weakness and external vulnerability, despite significant progress in such areas as digital transformation and export diversification. Inflationary pressure, budget imbalances and dependence on foreign markets emphasize the fragility of the economic system, but are balanced by promising trends in key industries and technological innovations.

The country's integration policy plays an important role in shaping its economic trajectory. Raising Ukraine's level to European Union standards, implementing EU union agreements, active participation in international trade, accelerating reforms and opening access to wider markets. However, the full realization of these advantages requires a certain strengthening of institutions, reduction of corruption and effective implementation of the political framework [68].

In the context of the development of Industry 4.0, Ukraine faces both significant challenges and opportunities for transformation. Challenges include inadequate infrastructure, a lack of skills in the labor market and limited investment in research and development. But the opportunities are huge - the development of a particularly strong IT department, increasing the productivity of agriculture with the help of intelligent technologies and the implementation of ecological solutions. Integration into the global chain of value creation and the introduction of advanced production technologies will help Ukraine establish itself as a competitive player in the world economy.

Overall, the economic situation in Ukraine is characterized by complex challenges, but an intensive and strategic approach to integration, innovation and institutional reforms opens the way to sustainable development. By implementing industry 4.0 and developing closer economic relations with international partners,

Ukraine has the potential to transition from backward development to economic prosperity.

The economic development of Ukraine in the context of Industry 4.0 is a complex but promising process that requires the integration of modern technologies, the adaptation of existing economic mechanisms and consideration of global trends.

When developing models of economic development, the unique features of Ukraine should be taken into account, such as resource potential, the level of digital literacy, the state of the industrial base and innovative infrastructure. The main directions of this model are digitalization of production processes, support of innovation clusters, stimulation of small and medium-sized enterprises to introduce new technologies, development of educational programs for training qualified personnel [69].

The SWOT analysis shows that Ukraine's strengths are a developed agricultural sector, a rich raw material base and scientific potential, but its weaknesses are digitization, obsolete opportunities are the use of Industry 4.0 initiatives for integration into the European and world markets, attraction of international investments and modernization of key industries. Among the threats, it is worth noting the risks of global competition, political instability and technological backwardness due to insufficient financing of technological innovations.

The implementation of this model requires significant investments and a strategic vision from governments and companies, in particular, the development of digital infrastructure, the creation of favorable conditions for venture capital, the expansion of international cooperation and integration into global value chains. When the global economic environment changes, the models must remain flexible in order to adapt to new conditions. The strategic approach to the implementation of the principles of Industry 4.0 provides Ukraine with opportunities for sustainable economic growth and effective integration into the modern global economic space.

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SUMMARY

Musiienko O.O. The economic development model of Ukraine in the context of strengthening integration processes and Industry 4.0 – Masters-level Qualification Thesis. Sumy State University, Sumy, 2024.

The master's thesis focuses on the is to study the theoretical foundations and to develop practical recommendations for enhancing Ukraine's economic

development model in the context of strengthening integration processes and adapting to the advancements of Industry 4.0

Keywords: economic development, Ukraine, integration processes. Industry 4.0, digital transformation, innovation, sustainable development, globalization, competitiveness, economic growth, industrial revolution.

АНОТАЦІЯ

Мусієнко О.О. Модель економічного розвитку України в умовах посилення інтеграційних процесів та Індустрії 4.0 – Кваліфікаційна магістерська робота. Сумський державний університет, Суми, 2024 р.

У роботі досліджено зосереджена на вивченні теоретичних засад та розробці практичних рекомендацій щодо вдосконалення моделі економічного розвитку України в контексті посилення інтеграційних процесів та адаптації до досягнень Індустрії 4.0

Ключові слова: економічний розвиток, Україна, інтеграційні процеси. Індустрія 4.0, цифрова трансформація, інновації, сталий розвиток, глобалізація, конкурентоспроможність, економічне зростання, промислова революція.