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INTELLECTUALIZATION AS A KEY FACTOR OF SUSTAINABILITY IN UKRAINE

Abstract

The key vector in the development of modern post-industrial society, which is formed under the influence of informatization and computerization processes, is the intellectualization of all spheres of social life. This results from the dominance of intellectual activity, which takes precedence over the production of material goods and services. Consequently, there is a steady trend toward the intellectualization of production factors. This article explores the relevance and the need for the intellectualization of production and implementation of smart-specialization in the regions of Ukraine during post-war recovery as the only path toward realizing the country's sustainable development strategy.

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Problem Statement and Literature Review

The complexity and versatility of challenges associated with the intellectualization of the economy, along with its linkages to various economic processes at micro-, meso-macro- and mega-economic levels, have been reflected in the works of researchers from both foreign and national backgrounds. Scholars across diverse scientific directions and schools have demonstrated the significance of intelligence and knowledge for the social development of modern society. Among Ukrainian scientists who have delved into the issues of the «knowledge economy», notable authors include Geiets (2005), Melnyk (2015), Svitlychna (2015), and Stoianenko (2012), who have studied aspects related to the development of the knowledge economy. Iliashenko et al. (2017) conducted research on knowledge management and marketing, production and use of various types of scientific, professional, technical and technological knowledge. Zinchenko et al. (2019) examined the essence and development of the information economy. Rak (2009) explored the nature of the knowledge economy, factors and components of knowledge management, among other aspects. The notable interest of researchers in this problem determines its ongoing relevance.

Methodology and Theoretical Background

The authors utilized a comprehensive approach to evaluate the economies of leading nations and assess the innovative and educational potential of Ukraine. By employing a combination of quantitative and qualitative methods for comparison, an analysis of Ukraine's human potential was conducted as a necessary step toward reshaping its current model of economic development.

Research Results

Advancements in technology lead to a deepening division of labor and the accumulation of vast amounts of formalized knowledge. The development of knowledge requires an appropriate level of human abilities and skills, which play a fundamental role in the creation of consumer value. It is customary to call them «intellectual capital». The accumulation of intellectual capital is usually associated with the formation of «the post-industrial society» or the «knowledge economy», or «the innovative society», or «the digital economy», or any other type of society we are having today, whose main characteristics are the accumulation of wealth and the establishment of the corresponding societal structures through the utilization of human intelligence as a key economic resource. While it may seem evident that an individual, or rather their intelligence, by itself, represents the foundation of the economy and wealth creation, further in-depth analysis is necessary because the process of knowledge economy research reveals many contradictions and unusual conclusions.

Therefore, the expansion of the production boundaries of the economy under the conditions of high population growth and the corresponding growth in needs necessitates the search for alternative sources of growth. These include intellectualized factors of production and technology. The realization of their resource potential involves the creation of a paradigm of a qualitatively new stage in the development of human civilization, defined as the «knowledge economy», the systematization of various approaches to its content, the mechanisms of knowledge transformation into an implicit component of production factors (Kornukh, 2012). Revealing the categorical content of the processes of intellectualization of the economy and studying its system-forming characteristics represent a priority direction in the development of modern economic science.

Thus, the need to form a new scientific picture of the world, based on the recognition of intellectual resources as a key factor of progressive macroeconomic dynamics, as well as the need to study and generalize the developmental experiences of the countries where intellectualization processes have taken on a large-scale character, determined the choice of the research topic, its theoretical and practical significance.

Today only knowledge is the only resource that matters. Its production becomes a driving force for the development of the country and society, a marketable product that can be sold to make a profit. Such a scheme works only in those nations where the cult of knowledge appears, and citizens are ready to constantly learn and develop (Stoianenko, 2012). The artificial delineation of abstract stages in the technological progress made it possible to separate the logic of society's development and the study of the wealth accumulation process from purely social and political prerequisites, giving a new point of objectification linked to the structure of the production process, its division into primary (agricultural and mining industries), secondary (manufacturing) and tertiary (service or service) sectors of the economy. In the post-industrial society, the secondary sector is losing its leading role, because the level of technological development of production is increasing, while the main role is played by science as a field of obtaining, processing and using new knowledge that obeys certain principles. If the trends of polarization of countries at the level of use of intellectual resources are preserved and strengthened, there is a threat of the transformation of most states not only into technologically backward ones, but also into intellectually peripheral ones. In this regard, the pace and quality of the development of economic knowledge significantly depend on the results of the information and analytical departments of organizations, corporations, state and local authorities, which determine the strategic directions of development, monitor the quality of the use of existing and generation of new knowledge, identify and analyze key data indicators of the actual state of the knowledge economy, present management with reports on the most effective use of resources, including intellectual capital (Hrishnova, 2001).

Intellectual capital is a complex structure consisting of interconnected elements. These elements represent a static stock of resources used to achieve competitive advantage, on the one hand, and dynamic characteristics of the company that unfold in the environment of its operation in the process of intellectual capital management, on the other hand. The reason for such a dichotomy is the ambiguity in the definition of knowledge, which is a passive category, but it can be transformed or deepened in the process of organizational learning into an active or dynamic category. This implies that organizations accumulate experience, much like individuals who use it to construct an image of reality and to make decisions. At that, learning is inseparable from the functioning of the company's employees and other stakeholders.

Human capital is the stock of knowledge and skills of the organization's employees, as well as their attitude to work and other essential characteristics of their abilities, which are used by the company to create consumer value. Companies rent the capabilities of their employees for a certain period, make investments in their formation and development, and employees receive a contractual salary as a reward for their efforts. Specialized human capital is formed specifically within the framework of specializations and specialties for each field and contains the necessary elements of knowledge and skills that are necessary to support specialized professional competencies. Education is responsible for this.

A significant number of firms invest 1% to 2% of their total personnel expenditure fund in annual formal training.

In the era of globalization, the key to economic development lies in acquiring and applying productive knowledge, particularly in complex industries and products. Sustainable economic growth necessitates adept diversification of economies into areas demanding specialized expertise, including innovation-intensive sectors such as information and communication technology (ICT), pharmaceuticals, medical technology, and various high-tech engineering products. Harvard University's Economic Development Index (ECI) and the metric featured in the Global Innovation Index (GII) evaluate the competitiveness of economies based on the advanced and diversified nature of their exports, aligning with this foundational principle (see Table 1).

Table 1

Positions of leading economies in the 2023 Global Innovation Index and Economic Complexity Index

Region	Country	Region's rank in GII	Rank in ECI
South-East Asia, East Asia and Oceania	Japan	1	1
	Republic of Korea	2	4
	Singapore	3	5
Europe	Switzerland	1	2
	Germany	2	3
	Czech Republic	3	6
North America	United States	1	12
	Canada	2	43
Latin America and the Caribbean	Mexico	1	20
	Panama	2	40
	Costa Rica	3	48
North Africa and West Asia	Israel	1	21
	Turkey	2	41
	Saudi Arabia	3	42
Central and South Asia	India	1	46
	Kyrgyzstan	2	54
	Sri Lanka	3	71
Sub-Saharan Africa	Mauritius	1	65
	South Africa	2	69
	Uganda	3	86

Source: compiled by the authors based on WIPO (2023) and Growth Lab (n. d.).

The World Intellectual Property Organization (WIPO) released the annual Global Innovation Index 2022 report, comparing the innovative activities of 132 countries and economies worldwide (WIPO, 2022). In the 2022 report, Switzerland earned recognition as the most innovative country for the 12th time in a row, with the USA, Sweden, Great Britain, and the Netherlands following suit. The report highlights China's advancement to the 11th position among the top 10 innovative economies globally, and Turkey and India making their debut in the top 40. In the Global Innovation Index 2022, Ukraine holds the 57th spot, securing the 4th position among the 36 countries in the lower-middle-income economy group.

The growing awareness that knowledge-based capital (KBC) is the engine of economic growth is commonplace in today's global marketplace. KBC encompasses a wide range of intangible assets that reflect or express human ingenuity, including research, data, software, and design skills. The creation and application of knowledge are central to the ability of companies and organizations to thrive in a competitive global economy and to create well-paying jobs.

Knowledge-based capital enables countries and companies to enhance their comparative advantage and position themselves in higher value-added industries, activities, and segments of the global market. Indeed, in global value chains, most of the value of a good or service is usually created in either upstream activities, which include product design, research and development, and production of core components, or in downstream activities, such as marketing and branding. For example, in 2020, the manufacturing of iPods involved 14,000 workers in the United States and 27,000 workers outside the United States. However, U. S. workers – those in engineering, software, and marketing – earned $753, nearly double the earnings of foreign workers, who earned $318 million.

With aging populations and dwindling natural resources, the growth of advanced economies increasingly hinges on increases in knowledge-based productivity. Knowledge-based capital, unlike labour, natural resources, and physical capital, remains unaffected by scarcity. In numerous OECD countries, business investment in KBC has outpaced investment in physical capital like machinery, equipment, and buildings. Notably, in the United Kingdom and the United States, investment in KBC now surpasses investment in physical capital, exhibiting a strong correlation with productivity growth. China and Brazil are actively working to develop KBC, aiming to enhance productivity and secure higher-value segments in global production chains.

The transformative impact of KBC extends to entire industries. For instance, in the automotive industry, approximately 90% of new car features, such as innovative ignition systems, advanced fuel injection systems, and surveillance cameras, incorporate a significant software component. About 40% of all development costs associated with new model launches are attributed to electronics and software. Notably, the top 10 automotive companies have established advanced research centers in Silicon Valley. Research indicates that countries pri-

oritizing investments in KBC are better equipped to reallocate resources to innovative companies, the primary drivers of employment growth in OECD economies. Relative to GDP, the United States and Sweden invest about twice as much in KBC as Italy and Spain, and their patent firms attract four times as much capital. The digital transformation of business life, along with significant changes in employee education, has been underway for a considerable time. However, the Covid-19 pandemic and the resulting restrictions accelerated these changes, compelling companies to quickly reorganize their business processes. It is logical that these events have changed the priorities set by global and Ukrainian business leaders and revealed many new problems for the future of business. In addition, the war disrupted global production and trade in goods in many industries. The war is estimated to have affected more than 600,000 companies worldwide and could slow global economic growth by 0.8% by the end of 2023 compared to 2022. In addition to impacting the production capacity of individual countries, the war has also disrupted global supply chains, creating the preconditions for rising global inflation. Manufacturers in various sectors of the global economy, especially in Ukraine, were forced to cease operations due to the war.

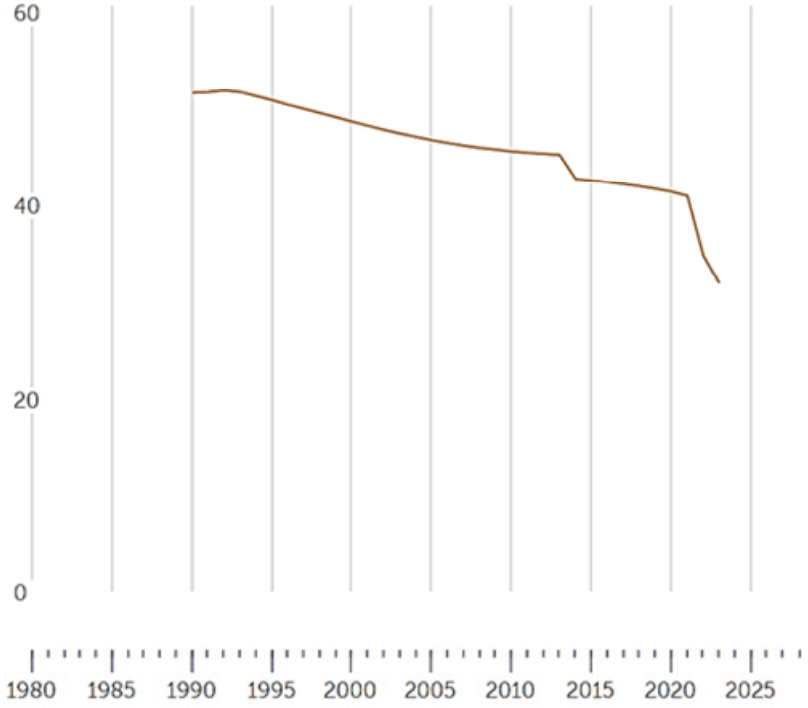
For example, Volkswagen suspended operations in Russia, and auto parts manufacturer Sumitomo moved production from Ukraine to Romania and Morocco. The blockade of the Black Sea ports of Ukraine and the delays of cargo ships have disrupted maritime cargo chains. Consequently, the global supply of raw materials to car manufacturers around the world faced interruptions. The war in Ukraine had the most significant impact on the commodity markets in the last 50 years, particularly affecting countries that had long relied on Ukraine and Russia as primary exporters.

In January-March 2022, a major price surge of 154.5% was recorded for mineral fertilizers, marking the highest increase among all raw materials. Also, a price increase of 74.7% was observed for coal. A total of 4.8 million jobs have been lost in Ukraine since February. It is estimated that more than 7 million jobs could be lost if the war continues (Maksymov, 2022).

According to KPMG's CEO Outlook 2022 report (KPMG, 2022), human capital risk has surged from the eleventh to number one position globally this year. The risks of disruption of supply chains and a return to territorialism hold the second and third positions, respectively. Contrary to the global trend, the risk of personnel shortage in Ukraine this year has dropped from the first position, where it consistently ranked in recent years, to the fourth place. This shift is primarily attributed to the increasing significance of the remote work tradition, initiated during the pandemic, which has gained importance in connection with the migration processes due to the ongoing war in Ukraine.

Figure 1

Population of Ukraine in April 2023, million



Source: IMF Data Mapper (2023a).

At the same time, global business leaders are contemplating that the transformation of business due to all the aforementioned processes will radically change both the ways of working with human capital and the necessary employee skills. There is huge acceleration in centralized digitization even today. Businesses require people who can implement digital technologies in companies, collaborate digitally with each other, customers and suppliers, and create added value. According to a survey conducted by KPMG, 42% of Ukrainian managers and 69% of CEOs worldwide plan to reduce office space and transition some employees to remote work after the epidemic is over.

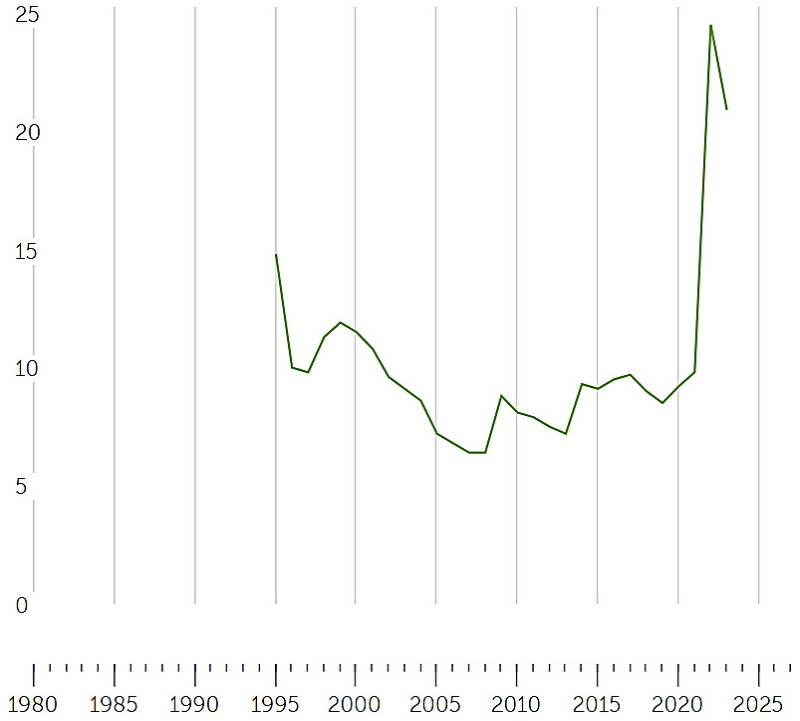
At the very least, this shift is expected to become the new norm, prompting a review of qualification requirements for staff. Some skills and occupations may

become obsolete, losing their significance and becoming a thing of the past. On the other hand, telecommuting has broadened the potential of the workforce, leading companies to actively change their hiring strategies and planned work formats.

The leaders of Ukrainian companies assign the highest rank to the regulatory risk. In our opinion, this fact indicates a growing loss of trust in the state, attributed to inconsistent regulatory policies. For example, continuous monitoring of previously adopted decisions in the field of renewable energy has led to a decrease in investor interest in this sector.

Figure 2

Unemployment rate in Ukraine as of April 2023, %



Source: IMF Data Mapper (2023b).

However, this assessment of Ukrainian business leaders indicates that the procedures for addressing regulatory issues in Ukraine are still in their infancy, limiting businesses' ability to manage this type of risk. In other words, Ukrainian businesses have not yet developed sufficient «flexibility» to cope with changes in the regulatory environment, unlike their European counterparts. In Europe, businesses are used to being 100% compliant and understand that this requires financial resources, for example, to support various compliance services. This is not the case in our country, where many companies still believe that creating such structural divisions only complicates business operations.

Another significant risk is labor migration, a consequence of the forced displacement of persons due to the military aggression of the Russian Federation. This primarily impacts vulnerable categories of citizens (children, the elderly, people with chronic diseases, pregnant women). However, it should not be forgotten that to some extent it is also about the loss of human and, in particular, intellectual capital. Human capital is a renewable resource that can be accumulated. Theodore Schultz, who studied investment in human capital and knowledge, posited that «investment involves the allocation of resources to obtain future income and satisfaction» (Schultz, 1961).

The changes associated with knowledge-based capital present significant opportunities for productivity enhancement. However, these changes coincide with a period of substantial structural transformation triggered by the crisis and may exacerbate unemployment and inequality, at least over the short term. The growth of KBC may involve technologies displacing human labor, particularly in low-skilled and routine tasks, leading to winner-take-all scenarios for a select few. To foster long-term growth and future job creation, governments must establish a policy framework supporting business investments in KBC.

Information technology (IT) industry stands as a cornerstone of the Ukrainian economy, experiencing rapid year-on-year growth. Over the past six years, the share of IT services exports in GDP has increased from 1.8% to 3.5%, while the share of total services exports has surged from 13.4% to 37.8%. Notably, IT services now account for nearly 40% of all Ukraine's services exports to foreign markets. Ukraine's IT industry employs 2% of all workers, contributing 3.5% to Ukraine's GDP.

Ukraine's IT industry is for the most part export-oriented. The volume of IT services exports has been growing at an average annual rate of 26.8% over the past six years, reaching $6.9 billion in 2021. The United States is the largest importer of Ukrainian IT services.

According to Tech Ecosystem, as of the beginning of December 2022, there were 2,400 companies operating in the market. Of them, 23.5% were IT service providers, while 76.5% were product development companies.

Technologies are increasingly spreading across various industries, enabling the automation of production processes, boosting productivity, reducing costs, and enhancing overall business efficiency. The study revealed that 21.7% of enterprises hire IT specialists full-time, while an additional 14.6% of enterprises engage freelance workers to handle information and communication technology functions.

Ukrainian industry has undergone active transformation since 2014 with the advent of the Industry 4.0 movement, encompassing fully automated production and real-time management of all processes (National Academy of Sciences of Ukraine, State University «Institute of Economics and Forecasting at NASU», 2022). Industry 4.0 relies on the revolutionary technologies, such as:

1. Artificial Intelligence (AI): Artificial intelligence plays a central role in creating automation solutions for industry. AI enables increased flexibility and accuracy in production processes, adjustment of management processes, and more.

2. Internet of Things (IoT): IoT refers to computer networks connecting physical objects equipped with detector units, sensors, and installed software. It facilitates information processing, remote process management and production automation.

3. Big Data: Big Data technological solutions enable the collection, analysis, and forecasting of data related to production volumes, costs, logistics, customer services, and other production processes in real time.

From 2018 to 2021, the average share of innovative industrial enterprises exhibited notable growth: by 10.7% in the mining industry, 13.1% in the processing industry, 11.5% in electricity and gas supply, and 8.9% in water supply. Across industries as a whole, the observed average growth rate was 12.9%.

The full-scale war became a powerful catalyst to the development of military technology in Ukraine. These companies cater to the diverse needs of Ukrainian defenders, ranging from drones to tactical medicine. The growth of the military-tech sector in Ukraine has been quite rapid: Since 2014, the market has expanded by a factor of 3 to 7, depending on the specific direction (Levchuk & Kuzmych, 2017). This rapid development enables significant reductions in the time required for project implementation. While in 2014, projects mostly took 1.5 to 2 years, the advancements in this sector have now brought this timeline down to 2 to 3 months.

The military-tech sector in Ukraine is actively advancing in several key directions:

1. Robotics: Particularly in the production and deployment of drones – including those used for aerial reconnaissance and transmission of information, as well as kamikaze drones – Ukraine has proven to be highly successful.

2. Software for the military: The Ukrainian military utilizes proprietary software, including products such as «Nettle», «Delta», «Griselda», «Armor», «Milchat», and others. These software developments focus on automating the collection of information and its real-time analysis and processing.

3. Augmented Reality/Virtual Reality: Technologies of Augmented Reality underpin various weaponry and equipment simulators. These technologies offer cost-effective and less damaging options for military training and skill improvement.

In 2022, the anticipated volume of exports was expected to reach $8.4 billion under the baseline scenario and $8.0 billion under the conservative one. However, the full-fledged invasion prompted adjustments to industry development, and these predictions did not materialize.

The Ukrainian economy faced severe challenges during the war, with damaged and destroyed infrastructure, constant shelling, occupation of regions, and labor migration having the greatest impact. Among export-oriented industries, only the IT sector managed to increase its exports compared to the previous year, while others suffered significant losses. As the invasion unfolded, companies had to make urgent decisions to preserve their businesses. The IT sector is one of the few sectors in the Ukrainian economy that not only retained but increased the volumes of services exports.

At this stage, the strategies for regional development in Ukraine are distinctive in that they are formulated and implemented reactively in response to emerging problems. When such an approach dominates the formulation and execution of management decisions, the behavior of the managed system becomes passive, leading to delayed reactions compared to dynamics of the region's development. Moreover, the strategic management of regions' development is transitioning from «top-down» decision-making approaches, which largely overlook mixed and integrated methods that take into account the unique local characteristics of each region and often view regions as isolated systems, neglecting interregional interconnections and relations with higher hierarchical levels. Instead, there is a shift to locally-oriented, multi-level, and innovative approaches tailored to suit different types of regions.

The imperative for a change in the strategic management approach to development of regions in our country has long been recognized. Today, this imperative is not only driven by the necessity for post-war recovery in regional economies but is also underscored by the imperative for the country's economic integration into the EU market and its inclusion in global value-added chains, which requires that the domestic economic system aligns with the trends seen in European countries. The formulation and implementation of an innovative multivector policy for regions must be undertaken for maximum effect provided that strict standards are maintained at all levels of management and appropriate resources are available, which proves challenging in developing countries (Geiets

et al., 2022). This limitation impedes the full realization of innovative potential within a narrow segment and the positioning of the country as a niche in the global market due to fierce competition and relative openness of the economy. Another challenge is the disconnect between the current methodology for identifying priorities in scientific, technical, and innovative activity and the actual state and assessment of the potential of the production sector of the economy, which is emphasized by leading domestic scientists.

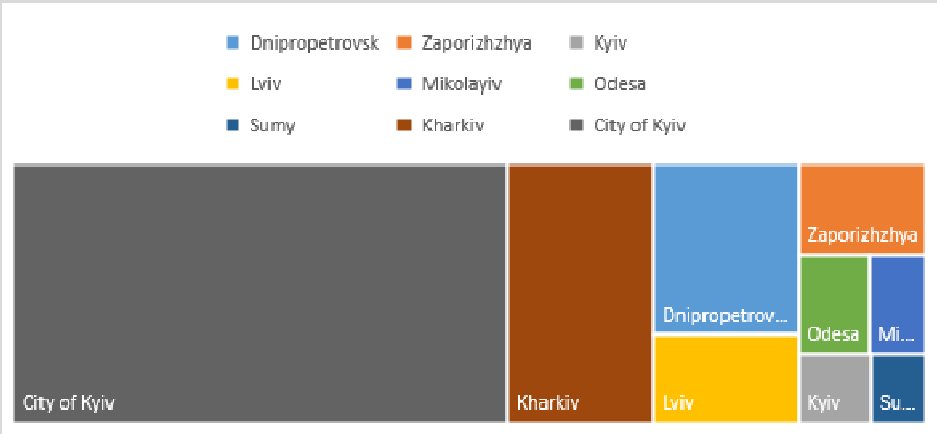
These contradictions can be resolved by implementing the concept of «Smart Specialization», which applies a vertically-oriented approach to selecting the priority industries for government support and the technologies of providing this support at the state level. The strategy of «Smart Specialization» is both a theoretical concept and a policy aimed at fostering innovative regional development to catalyze economic growth by effectively tapping into the region's potential. Essentially, smart specialization relies on a collaborative approach involving representatives from the business sector, government, scientific and technical institutions, and the public. Notably, this policy encourages and incentivizes entrepreneurs, scientists, and developers to enhance collaboration with enterprises, uncovering the primary areas of specialization within the region. Clusters play a pivotal role as the primary building blocks in the development of such specialization. Earlier regional innovation strategies, despite maintaining a continued focus on the development and growth of one's own innovation potential, had significant shortcomings, including the following:

- The isolated nature of the regional innovation system and lack of an international and cross-border perspective.
- The lack of effective interactions among the entities within the regional economy, in particular, the lack of connections between the research and innovation system, the management system, and the entrepreneurial sector;
- Misalignment between the research priorities and the actual orientation of industrial production;
- Low effectiveness of adopting legislative and regulatory acts and program documents in the field of innovations due to a failure to consider guidelines for entrepreneurship development and a lack of expert discussion;
- The gap between the economic sectors' real level of development and the unused research and development potential;
- The lack of a detailed analysis of the resources and assets available in the region;The formulation of the region's innovative development strategy without consideration for local characteristics.Smart specialization entails the development of an innovative strategy aimed at ensuring the competitiveness of a region in the context of smart, sustainable and inclusive devel-

opment. The regional strategy for smart specialization represents an integrated local program focused on harnessing and expanding the region's potential by aligning the vectors of science and education development with the socio-economic development conditions unique to the region itself.

Figure 3

Number of R&D personnel by region in 2020



Source: Ukrainian Cluster Alliance (n.d.).

As depicted in Figure 3, prior to the onset of the full-scale war in Ukraine, the regions with the highest innovation potential – measured by the number of people employed in research and development – included the Kyiv, Kharkiv, Lviv, and Zaporizhia regions, as well as the city of Kyiv itself. To coordinate regional efforts towards clustering, a specialized governing body, Ukrainian Cluster Alliance (UCA), was established. This alliance serves as a nationwide coalition, bringing together enterprises, business associations, clusters, and cluster organizations across various industries. Its primary objective is to enhance competitiveness by implementing cluster cooperation principles, fostering industrial, digital, and green automation innovations, and facilitating effective collaboration with the government. UCA holds a prominent position as the leading and largest formal association within Ukraine's economic cluster movement, currently encompassing 48 clusters and cluster-type associations. The alliance was established on March 24, 2022, on the basis of the «Clusters4Ukraine» initiative, which originated within the framework of the Clusters Committee of the Platform for Industrial and Hi-Tech

Sectors «Industry4Ukraine». The management structure of the Industry4Ukraine platform includes 4 committees: Smart Specialization and Innovation, Digitalization of SMEs, Sustainable Industry (Green Economy), and Cluster Development.

The smart specialization of regions involves the process of clustering. These processes share common stakeholders, including business, science, government, and community. They also exhibit common features, such as a focus on innovative development, an emphasis on increasing regional competitiveness, and a dedication to expanding the participation of regions in global value chains (GVCs). The intensive development of clusters is one of the key criteria for the successful smart specialization of regions and territorial communities.

As of now, Ukraine has developed and adopted regional development strategies (RDS) based on the smart specialization approach. Before the onset of the war, numerous clusters were operating successfully. Table 2 highlights the largest clusters in terms of size.

As the Russian Federation initiated a full-scale war against Ukraine, the Clusters Committee called upon clusters to unite and mobilize, aiming to fortify the economic front and support the Armed Forces of Ukraine. The Clusters4Ukraine initiative received active support from several clusters and cluster organizations in Ukraine, including the Engineering-Automation-Machinery Cluster from Kharkiv, the Ukrainian Association of Furniture Makers, the Ukrainian Automobile Cluster, the Khmelnytskyi and Lviv Sewing Clusters, the Agro-Tourism Cluster «Dniester 1362», the Agro-Food Cluster Initiative from Poltava Oblast, and many others. Hundreds of enterprises from the above-mentioned clusters joined forces in Ukrainian Cluster Alliance under wartime conditions.

By the end of 2022, UCA is poised to become a self-sufficient organization that embodies the cluster movement of Ukraine and demonstrates the advantages of developing clusters under the umbrella of a cluster association. At the same time, UCA represents the next stage in the development of the Industry4Ukraine platform, which clearly demonstrates the potential of business associations and all other stakeholders in the modern industrial development of Ukraine. This is also the result of the implementation of the long-term strategy «Industry4Ukraine» to create developed, high-tech industries deeply integrated into European and global value chains. Despite the war, UCA is actively working. For example, the Podillya Fashion Clusters, the Kyiv Hi-Tech Cluster and the Prykarpattia Eco-Energy Cluster run the Burshtyn+ program, which has already found support from partners in Slovakia, Poland, and Germany. Separately, it is worth noting the start of joint projects with Slovak and Polish partners – Ukrainian clusters will be submitted to the Interreg Next program. In this field of activity, the leadership of the Ukrainian Academy of Sciences has also started exchanges and some coordination with the Ukrainian Institute for International Politics, which is in charge of the Interreg Next program in Ukraine.

Table 2

The largest cluster organizations registered in Ukraine as of 2020

No.	Name	Region	Areas of activity
1.	Kherson Agro-Cluster	Kherson	Agro-industrial sector
2.	«Ea.F.Tech+»	Dnipro	Aerospace engineering and production of defence technologies and heavy equipment
3.	Ukrainian Aerospace Cluster	Dnipro	Production of rocket and space equipment and defence technologies
4.	Dnipro Space Cluster	Dnipro	IT technologies
5.	Kharkiv IT Cluster	Kharkiv	IT technologies
6.	Agro Food Cluster	Kharkiv	Production and processing of agricultural products
7.	Sumy IT Cluster	Sumy	IT technologies
8.	Konotop IT Cluster	Konotop	IT technologies
9.	Chernihiv IT cluster	Chernihiv	IT technologies
10	Innovation Cluster «RInnoHUB»	Mykolaiv	Development of the startup ecosystem + innovative entrepreneurship
11	Precarpathian Eco-Energy Cluster	Ivano-Frankivsk	Alternative energy and environmental protection
12	Publishing and printing cluster	Lviv	Polygraphy, publishing house

Source: Ukrainian Cluster Alliance (n.d.).

Sustainable Value Added Chains (VACs) and innovative ecosystems play a pivotal role in effectively responding to external shocks. Ukraine is facing three big challenges in this realm: (a) the development of strong internal chains; (b) their integration into European industrial ecosystems; (c) the strengthening and intensive development of innovative ecosystems at the level of industries and regions.

Conclusions

The ongoing large-scale Russian-Ukrainian war, the resultant destruction of Ukraine's economic structure, and the challenging period of socio-economic post-war recovery pose significant risks for the return of a substantial portion of the population to Ukraine. Simultaneously, the decline in the number of young people heightens the threat of a deterioration in the quality of Ukraine's demographic potential in the medium and long term.

Regarding human capital, as Ukraine undergoes reconstruction, its migration policy should be guided by three principles. Firstly, there should be a focus on stimulating the outflow of unskilled and low-skilled labor, thereby alleviating pressure on the domestic labor market and reducing public expenses through remittances from migrants. In the realm of critical infrastructure, industries, and digital assets, the recovery and development process should adhere to key principles such as managed (coordinated) and safe decentralization, modularity, autonomy, and network interaction of individual assets and resources. The shift towards non-financial indicators, specifically Environmental, Social, and Governance (ESG) criteria, should serve as the foundation for new management accounting and enterprise management. This embodies the fundamental principle of Industry 5.0, which has become essential for Ukrainian enterprises aiming for successful integration into the Value-Added Chain (VAC) and the export of products to the EU. The war extends the application of this principle, emphasizing the importance of avoiding trade or support for aggressor countries.

In addition to this structure, regional executive authorities and local self-governments play a decisive role, particularly in the context of smart specialization, which forms the bedrock of contemporary regional economic strategies.

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