

# Activities of Digital Platforms on the Basis of Clusterization and Innovative Development Strategies in the Conditions of European Integration

NATALIIA KRAUS<sup>1</sup>, KATERYNA KRAUS<sup>2</sup>, ILONA BABUKH<sup>3</sup>, VIKTORIIA LISITSA<sup>4</sup>,  
OLHA NOVIKOVA<sup>5</sup>

<sup>1</sup>Department of Finance  
Borys Grinchenko Kyiv University,  
Kyiv, 18/2 Bulvarno-Kudriavska St.,  
UKRAINE

<sup>2</sup>Department of Management,  
Borys Grinchenko Kyiv University,  
Kyiv, 18/2 Bulvarno-Kudriavska St.,  
UKRAINE

<sup>3</sup>Department of Marketing, Innovation and Regional Development,  
Yuriy Fedkovych Chernivtsi National University,  
Chernivtsi, 2 Kocyubynskogo St.,  
UKRAINE

<sup>4</sup>Department of Entrepreneurship, Trade and Exchange Activity,  
Poltava University of Economics and Trade,  
Poltava, 3 Koval St.,  
UKRAINE

<sup>5</sup>Department of Personnel Management, Labor Economics and Economic Theory,  
Poltava University of Economics and Trade,  
Poltava, 3 Koval St.,  
UKRAINE

*Abstract:* - The purpose of the scientific research is to present the features of the work of digital platforms based on clustering as a foundation on which the gradual formation of smart production and industry is built and to find ways to implement the innovative development strategy of Ukraine in the war and post-war times through the prism of digitalization. The object of scientific research is the digitization of the work of platforms, and the expansion of digital capabilities of their work due to the clustering and network interaction of business entities of the Industry 4.0 ecosystem as one of the key reserves of innovative development in the conditions of European integration. Authors' opinion is: features of platform business models are presented, including: real-time, immediacy, spatiality, financial, and economic components; the features affecting the clustering processes of digital platforms are named, namely: mobility, Internet connectivity, artificial intelligence, gamification, ubiquitous computerization, ecosystemicity, networking. The peculiarities of digital transformation in the formation of enterprises of the Industry 4.0 ecosystem are revealed. The best global practices of digitization of production and industry and tools for improving the policy of innovation and digital development of the countries of the European Union are analyzed. Value/originality: having conducted a thorough analysis in parts of the acceleration of clustering of digital platforms, the authors proposed to apply in practice solutions such as the distribution of roles in accordance with real capabilities; gradual, integrative rapprochement; a single information field, regular communications; focus on quick wins; full integration with national initiatives. To speed up clustering based on digital platforms in Ukraine, it is proposed to include and profile already existing and verified Industry 4.0 Strategy projects. Conclusions. Clusters and participants of the ecosystem, which have export and internationalization experience, have been identified, which in the future could affect the quality of the implementation of Ukraine's innovative development strategy in the context of European integration.

*Key-Words:* - digital platforms, clustering, clusters, innovative development strategy, European integration, automation of business processes, regional projects, internationalization, reserves of economic growth.

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## 1 Introduction

The technological structure of Industry 4.0, which is emerging today for a decade ahead, is oriented from socio-economic perspective to Society 5.0 and the knowledge economy, is based on the digitization of the main factors of production, the strengthening of the role of big data in the generation of value chains and the formation of added value of products. It is expected that the consequence of infrastructural transformations of industry and institutional conditions of digitalization of the economy will be new forms of management of economic entities such as clusters, formed ecosystems, and new sharing business models of prosumerism, which ultimately ensure an increase in the quality of life of the population. In the conditions of the clear simultaneous start of Industry 4.0 factories and their rapid start, the fact that one should expect in the future for innovative companies to gradually pass through all phases of evolutionary cycles becomes obvious. Digital transformation is changing the process of doing business. Digital transformation creates new business opportunities and efficiencies that were previously bottlenecks in traditional ways of performing routine business tasks.

The process of global digital transformation leads to a transition to a new technological system, changing traditional markets and the main source of added value, which is formed due to more efficient economic processes provided by the use of the advantages of digital infrastructure and modern technologies. The world is changing at a rapid pace and these changes are primarily related to the processes of generation, transmission, storage, management, and analysis of information, which turns the latter into the most important production resource today. Countless flows of information structure the modern world, changing the consciousness of people and the forms of their life activities. Digital technologies, which today have become one of the most powerful driving forces of the world economy, are changing the paradigm of social development, reducing the dependence of economic growth on the natural resources available in the country, the number of working populations, fixed capital and other extensive factors characterized by the greatest entropy, i.e., chaotic

dispersion, [1].

The development of processes of digital transformation of the economy is associated with great expectations (economic growth, improvement of service quality, increased competitiveness) and challenges (reduction of jobs, increasing inequality, increasing threats to information security). Many countries have developed digital strategies and action plans, [2], aimed at realizing development opportunities using such digital technologies as artificial intelligence, analysis and storage of big data, and the Internet of Things, which are drivers of the digitalization of the economy. In these conditions, the task of developing high-quality work of digital platforms based on clustering and synergy of innovative development institutes in the course of digital transformation at the national, regional, and industry levels and creating the necessary tools, mechanisms, and measures for this becomes urgent.

## 2 Problem Formulation

### 2.1 Literature Review

The problem of the formation of the digital economy and the transformation of economic systems was reflected in the research of scientists such as In several scientific publications, modern researchers defend the fact that economic growth, according to the expectations of global business, will be associated with the complete automation of processes, increased labor productivity, the introduction fundamentally new business models and technologies of "Industry 4.0", namely: creation of conditions for the introduction of innovations, the attraction of investments in digital technologies and infrastructure based on cluster formations, which, moreover, become a necessity for the further innovative and digital development of countries. These results are presented in scientific papers and articles, [3], [4], [5], [6], [7], [8], [9], [10], [11], [12], [13], [14].

Among the Ukrainian researchers who are engaged in revealing the content of the work of digital platforms, eco-cluster management systems in the conditions of globalization, industrialization

in the times of digitalization of the economy can be named, [1], [15], [16], [17], [18], [19], [20], [21], [22], [23]. The analysis of the noted recent studies proved that the concept of digital transformation carries three main advantages relevant for any type of business: increasing the efficiency of the existing infrastructure based on clusters; emergence of qualitatively new business models; increasing revenue or reducing costs in existing business models. In particular, scientists, [20] proposed and highlighted three directions in which the use of new digital technologies in cluster systems is the most justified and effective, namely: customer search (firms can use digital information and social networks to attract their customers in new ways); operational processes (digital technologies make it possible to achieve great results in operational activities at all stages of the value chain); business models (digital transformation makes it possible to develop completely new forms of creating and obtaining value). Researchers note that the synergistic potential of digital technologies can collectively lead to transformational changes in public administration and make the public sector more efficient and valuable.

A group of scientists, at one time studied the issues of digitization of economies through the prism of the strategic decision-making process in the VUCA environment, which involves: strategic foresight (Why? – identification of drivers of change), strategic thinking (How? – intellectual rethinking) and strategic planning (What? – creation of effective plans to achieve the set goal), [18], [19]. What allowed scientists to conclude that the fourth industrial revolution, causing the rapid pace of technological change, forces digital humanity to adapt to life in the VUCA world, which reflects the instability, uncertainty, complexity, and ambiguity of general conditions and situations.

It is worth noting that since the beginning of independence, all adopted development strategies of Ukraine did not foresee the development of a vision – as a common vision of the future of our country, attractive to the majority of citizens. Instead, they mainly contained a list of tasks, main directions and stages of strategy implementation, a mechanism for its implementation, and expected benchmarks. One of these strategies, which was approved by the Cabinet of Ministers of Ukraine in 2013, is devoted to the development of the information society. The goal of the implementation of the latter is “the formation of favorable conditions for the development of the socio-economic, political and cultural development of the state with a market economy guided by European political and

economic values, improving the quality of life of citizens, creating ample opportunities for meeting the needs and free development of the individual, increasing the competitiveness of Ukraine, improvement of the public administration system with the help of information and communication technologies”, [24].

The sustainable development strategy, [25], approved by the Decree of the President of Ukraine, includes 62 reforms, of which 8 reforms and 2 programs are prioritized. The reforms aim to achieve European standards of living and a worthy place for Ukraine in the world, which formally can be considered a strategic vision of the country’s development. To realize the goal, it is planned to direct efforts along such vectors as development (ensuring the sustainable development of the state and carrying out structural reforms), security (ensuring guarantees of the security of the state, business, and citizens, protection of investments and private property), responsibility (ensuring guarantees that every citizen will have access to high-quality education, the health care system and other services in the public and private sectors), pride (ensuring mutual respect and tolerance in society, pride in one’s state, its history, culture, etc.), [26].

At the same time, the strategy, [25], is built on traditional drivers of development and does not include measures to actively promote the digital transformation of the economy. Instead, the Cabinet of Ministers of Ukraine approved the concept of development of the digital economy and society of Ukraine for 2018–2020 and approved the plan of measures for its implementation. “This concept provides for the implementation of measures to implement appropriate incentives for the digitalization of the economy, public and social spheres, awareness of existing challenges and tools for the development of digital infrastructures, the acquisition of digital competencies by citizens, and also defines critical areas and projects of digitalization, stimulation of the internal market of production, use, and consumption digital technologies. The path to the digital economy is through the internal market of production, use, and consumption of information, communication, and digital technologies”, [27]. The basis of this concept is developed by the world leaders of the “digital” market – Cisco, IBM, Intel, Oracle, Deloitte, SAP, Ericsson, MasterCard, Vodafone, Kyivstar, Lifecell, International Data Corporation, domestic consultants and experts and the NGO “HiTech Office”, - the document, [25], which defines the key policies, areas, initiatives, and projects of

“digitalization” of Ukraine for the next 3 years. The result of the analytical work carried out by Ukrainian experts with the support of the UN Development Program in Ukraine and the Global Environmental Fund as part of the project “Integration of the provisions of the Rio Conventions into the national policy of Ukraine” was the Project of the Sustainable Development Strategy of Ukraine until 2030 and the National Action Plan until 2020 for the implementation strategies.

The strategy of sustainable development of Ukraine until 2030 is oriented towards the vectors defined in the sustainable development strategy, [25], but unlike the latter, it reflects a completely logical construction of the strategic vision of the future of Ukraine. The goal of the sustainable development strategy is to “ensure a high level and quality of life for the population of Ukraine, create favorable conditions for the activities of current and future generations, and stop the degradation of natural ecosystems by implementing a new model of economic growth based on the principles of sustainable development. Achieving this goal corresponds to the worldview values and cultural traditions of the Ukrainian people and Ukraine’s international obligations”, [28]. At the same time, this document lacks a strategic vision for the implementation of the specified goal, which is an important element of the desired picture of the future.

Another strategy for the development of Ukraine for the next decade, which was called “Ukraine 2030E – a country with a developed digital economy”, was developed by the Ukrainian Institute for the Future. The formulated vision of this strategy reflects Ukraine as a “European leader in the field of innovation and new technologies. It identifies digitalization as a key driver of the growth of the Ukrainian economy and the well-being of citizens”. The key expectations of digitization are: “optimization of business processes; creation of new products and services thanks to the Internet of Things technology, virtual reality, cloud services, artificial intelligence; cost reduction (savings on people due to automation and robotics); completely new business solutions (new models of insurance, P2P systems, alternative services to banking services, mobile applications for training, an individual approach to the online buyer, personal advertising, etc.)”. By the year 3030, “companies will work at the intersection of industries and segments, will become platforms and platforms that will offer their customers not just a product, but a solution to any problem, experience, value,

emotions, and impressions”, [29].

## 2.2 Purpose of the Article

The purpose of the publication is to present the features of the work of digital platforms based on clustering and networking as the foundation on which the gradual formation of Industry 4.0 and Industry 5.0 is built and the search for reserves of economic growth in the conditions of digitalization of industry and production, which has every chance of becoming a decisive step in the implementation of the strategy of innovative development of Ukraine in the conditions of European integration.

## 2.3 Tasks of the Article

The purpose of the publication is to present the characteristic features of the work of digital platforms based on clustering, innovativeness, and networking as a basis for improving the interaction between all participants and economic agents of innovation-digital ecosystems and developing mechanisms and tools for socio-economic recovery of some countries; acceleration in terms of the formation of digital platforms in the conditions of some inter-country rapprochement in industry and production, which will allow the implementation of the strategy of innovative development of Ukraine in the conditions of European integration.

Among the tasks set in the article are: argumentatively reveal the characteristic features of digital platforms involved in the clustering of ecosystems on the basis of innovation; determine and reveal the determinants and key signs of digitalization of the economy, which significantly affect the conditions and ways of doing business by economic agents and clustering processes; present the main features of platform business models, indicate the available types of digital platforms; to reveal the world’s best practices in the operation of digital platforms and tools for improving the policy of innovative and digital development of the European community; to present clusters and participants of the industry and production ecosystem that have experience in export and internationalization; to analyze the experience of progressive regional projects in the world and the prospects of implementation in economic practice in Ukraine; to indicate the main challenges and their solutions in the development of a strategy of innovative and digital development based on clustering.

## 2.4 Discussion of the Problem

From the standpoint of the institutional-network approach, [30], a cluster is a new form of

organization – a heterarchy that does not have pronounced hierarchical features, is only partially market-based and is characterized by organizational heterogeneity. Such a structure is a network that functions based on institutional mechanisms of coordination and cooperation. Its formation presupposes stable ties between participants due to various reasons, including geographical proximity and the presence of institutions, interaction with which is partially regulated by the market, [31].

A group of scientists, [32], have proven in their research that the cluster is a new scheme, model, strategic tool that allows companies, governments, and the community in general to be able to compete on a global scale. The researchers' theoretical and conceptual review of the cluster concept allowed them to claim that the globalization of the economy is consolidating over time, and local regions are adopting it to form new strategies for competitive development. The formation of clusters represents a local development trend that seeks to penetrate globalized markets, but with the conviction that this cannot be achieved “alone” so that the “collectivity” of industry business efforts becomes an alternative for the formation of a cluster and thus has every chance to be able to effectively meet the needs of globalization, [32].

The Swedish scientist R. Boschma pays special attention to the understanding of “territorial (geographic) proximity” when studying innovation clusters in his research. The researcher proved that there are problems of “excessive” proximity, which are expressed in the form of various blockages and can hinder innovation. R. Boshma considers geographical proximity as a complementary factor in the formation of institutional, social, organizational, and cognitive proximity. Analyzing the role of institutional factors, the scientist considers “territorial proximity” as a set of organizational and institutional forms of “proximity”, [33].

Foreign scientists, [34], devoted their research to the study of issues of convergence of new technologies and obligations of manufacturing enterprises, which formed a tendency to change the global production landscape based on clustering and innovative development.

The authors, [35], were able to research collaboration strategy and digital innovation and argue that high-quality collaboration can increase the impact of the development and use of company resources on business performance so that companies no longer have to independently develop and own with all its resources. Scientists, [35], managed to develop their cooperation strategy and

digital innovations, to argue that companies can focus on the development of key resources and additional digital innovations necessary to increase the company's competitive advantage.

## 2.5 Methodology

The methodological and methodical basis of this scientific work is based on dialectical, system, and matrix methods, clustering digital platforms, and the possibilities of automating business processes of enterprises, which determines the new search for reserves of economic growth and the strategic format of innovative business work based on network interaction, were investigated; a comparative analysis was used in terms of grouping features and types of platform business models; harmonization and coordination of developed ways, tools and effective recommendations for strengthening the innovative and digital development of Ukraine in the conditions of European integration.

The methodological support of the research will be based on a systematic approach that will allow us to justify the operation of digital platforms based on clustering. Based on analysis, synthesis, and system methods, a general description of digital platforms involved in ecosystem clustering will be provided.

The matrix method is expected to be used to study clustering digital platforms, the possibilities of automating business processes of enterprises, which determines the new search for reserves of economic growth, and the strategic format of innovative business work based on network interaction. It is worth noting that cluster analysis is a multidimensional statistical procedure that collects data containing information about a sample of objects and then arranges the objects into relatively homogeneous groups – clusters. In a general sense, cluster analysis performs the study of useful conceptual schemes for grouping objects.

Typical cluster models are connectivity models (for example, hierarchical clustering or taxonomy is built based on the distance between nodes), and group models (some algorithms do not provide an advanced model for their results, but simply describe the grouping of objects). Clustering is usually thought of as the set of clusters that contain all objects in a dataset. Additionally, the relationship between clusters can be considered. For example, the nesting hierarchy of clusters. From the point of view of methodology, it is possible to apply hard clustering (each object either belongs to a cluster) and soft clustering (also fuzzy clustering, each object belongs to each cluster to a certain extent) in practice, [36], [37].

The use of synergistic and evolutionary methods is expected when tools and mechanisms are disclosed, which will allow for speeding up clustering processes in Ukraine in the conditions of European integration. Methodological approaches to assessing the domestic competitiveness of digital platforms on the European market will be developed in terms of the practical application of a solution of the type of role distribution in accordance with real capabilities; gradual, integrative rapprochement; a single information field, regular communications; focus on quick wins; full integration with national initiatives.

### 3 Problem Solution

#### 3.1 Digital Platforms for Ecosystem Clustering

The positive effect of clustering in the national economy can be achieved only when the power of the interconnected “four” sectors is used: public, private, social, and scientific. The leading role in the creation of innovation and digital clusters belongs to the state. Moreover, such a role should be ensured on the principles of corrective and purposeful liberal-soft administrative influence on networks,

[15]. Platform business models ensure the creation of value for consumers through the wide use of digital and other breakthrough technologies of “Industry 4.0”, which enable the interaction of subjects of economic activity in real-time, equal access of producers and customers to information, and its reliable and availability, [17]. The general characteristics of the digital platforms involved in the ecosystem clustering are presented in Table 1.

Examples of high-quality work of digital platforms based on clustering are Airbnb, Couchsurfing, BlaBlaCar, Uber, eBay, Amazon, OLX, Rozetka, Prom, Fiverr, Upwork, and Bike sharing. Analyzing the work of digital platforms, it is worth mentioning their publicity, openness, and transparency as special characteristics. The intellectual core of digital platforms is formed from research laboratories, innovation and digital hubs, and industry institutes. Financial and investment support of digital platforms is represented by crowdfunding, crowd investing, venture funds, green funds, grants, and state financial and credit resources. Information and analytical support of digital platforms is represented by consulting, marketing, licensing and sales, and engineering companies.

Table 1. General characteristics of digital platforms involved in ecosystem clustering

<i>View of the platform</i>	<i>General characteristics and features of the content of the platforms</i>	<i>Examples of platforms</i>	<i>Market capitalization, billion dollars</i>
<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>
<i>Innovative</i>	Serves as the basis on which various business entities develop additional technologies, products, or services. In innovative platforms, one group of users can often subsidize engagement and services for another group of users. The innovation platform creates conditions for innovation developers that allow it to bring innovations to the market quickly and on a large scale. The basis is breakthrough digital technologies, these platforms have a significant number of innovators located in different countries and form the “innovation ecosystem of the platform”.	Microsoft, SAP, Intel, and Salesforce.	911
<i>Investment</i>	It is supported, as a rule, by large holdings that combine several brands, and provide the necessary infrastructure for various IT projects and an interface for users. Includes companies that develop a platform portfolio strategy, and act as a holding company and/or platform investor.	Softbank, Naspers, Rocket Internet, Priceline.	There are no data
<i>Integrated</i>	It combines the functionality of a transactional and innovative platform. This category includes companies such as Google, which provides users with a variety of platform solutions from web search to e-learning environments.	Google Play, Apple Store, Facebook, Alibaba and XiaoMi, Twitter, Amazon, Weibo.	2000
<i>Transactional</i>	The transaction platform provides conditions for interaction between users of the platform, without which this interaction would be excluded or unprofitable for both parties. They create “digital” conditions of interaction between sellers and buyers.	Netflix, eBay, Uber, eBay, Amazon marketplace, Mamondo.com, AirBnB.com, Booking.com.	1100

Source: compiled by the authors based on sources, [17], [38], [39], [40].

The industrial core of digital platforms is represented by corporations in the field of innovation, small and medium-sized enterprises of all sectors of the economy without exception, venture enterprises, industrial parks, and innovation-industrial clusters, [25].

In addition, it is worth noting that the number of Internet users worldwide has increased to 4.95 billion at the beginning of 2022, and the Internet penetration rate is now 62.5 percent of the total population of the world. The data shows that the number of internet users has increased by 192 million (+4.0 percent) over the past year, but current restrictions on research and reporting due to COVID-19 mean that the actual growth trends may be much higher than these figures, [38]. The world population exceeded 8 billion on November 15, 2022, and will reach 8.01 billion in early 2023. Now, a little more than 57% of the world's population lives in cities. Today, there are 5.16 billion Internet users in the world, which means 64.4 percent of the entire population of the planet is now online. The data shows that the total number of Internet users has increased by 1.9 percent in the last 12 months, [39]. In January 2022, there were 31.10 million Internet users in Ukraine. The level of Internet penetration in Ukraine at the beginning of 2022 was 71.8 percent of the total population, [41].

The main determinants and key features of digitalization of the economy, which significantly affect the conditions and methods of doing business and clustering processes, are as follows:

- Mobility and connection to the Internet;
- The development of digital technologies and artificial intelligence;
- Significant acceleration of economic processes;
- Datification (transfer of any information into a data format);
- Ubiquitous computerization – a process that involves: the introduction of computers into all spheres of human life;
- Development of new technologies of material production; using information as a direct productive force; increasing the level of education and awareness of society;
- Formation of a humanitarian orientation in the use of computer technologies; creation of computer networks that ensure, in particular, the effectiveness of management decisions;
- Ecosystem – contributes to the formation of an innovative business environment;
- Networkability (ensures the spread of technologies), [42].

### 3.2 Values and Characteristics of Digital Platforms

An important marker of a digital platform is to connect users and facilitate the exchange of products or social currency between them, contributing to the creation of value for all participants. An important marker of the platform is the network model of value creation, an example of the use of which is Airbnb. The latter, unlike the Hilton network, which is based on a linear model, does not use its own housing stock (network model) to create value. In addition, each additional user of the platform creates utility for other participants, which ultimately turns into a resource for self-development, that is, the so-called network effect is manifested. The transformation from a linear to a network model of value creation involves a transition:

- From the use of own resources to the coordination of others;
- From the emphasis on the quality of internal business processes to the improvement of external communications between platform users;
- From maximizing value exclusively for consumers to the overall value of the entire digital ecosystem.

The characteristics of digital platforms are network structure, network effect, resource creation ( $1+1=3$ ), internal currency, tokenization (one of the directions in the future), “win-win-win-win” – producer – seller – buyer – platform owner, Digital twin – functioning in two economic formats at once (virtual and analog), scaling platform – the Internet, data capitalization, data – a resource.

The main features of platform business models and types of platforms are presented in Figure 1 and Figure 2.

Usually, commercial platforms create more value than they can monetize and generate profits from their implementation. Platforms also face a problem when platform users are unwilling to pay to use the platform despite receiving value from its activities and expect to receive only “free” benefits from the platform.

In Ukraine today, there are opportunities for the development of digital platforms in the following areas:

- Electronic business interaction (e-contracting, e-invoicing, e-doc flow);
- Platforms of electronic services for business (LegalTech, FinTech, InsurTech), in particular with the use of blockchain technologies;
- E-supply chain and smart logistics platforms;

- Platforms for providing educational, medical, transport life activities, public safety, and environmental monitoring;
- Industrial and production digital platforms (industry and cross-industry business process management systems), [29].

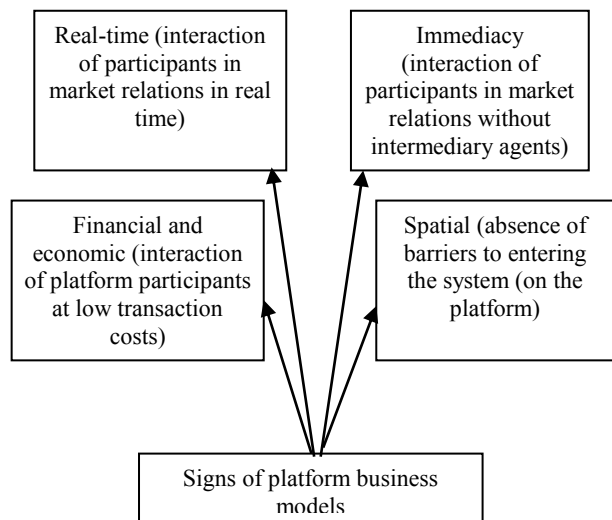


Fig. 1: Main features of platform business models  
 Source: composed by the authors.

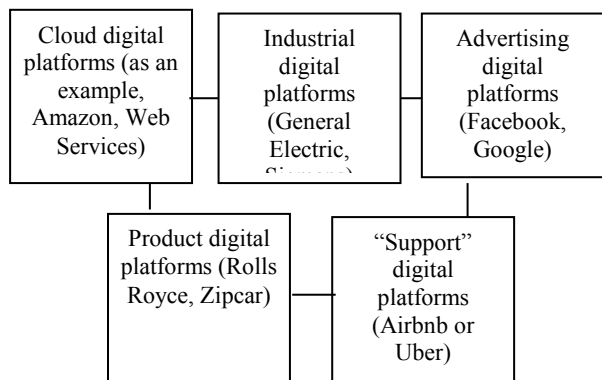


Fig. 2: Types of digital platforms  
 Source: grouped by the authors based on sources, [17], [38], [39], [43].

Platforms are creating new user-producer relationships through e-commerce, as they bring together a wider range of buyers and sellers and enable a greater variety of goods and services to be offered.

Companies seeking to gain indisputable advantages were the first to begin the mass use of information and communication technologies, and have advanced far in the digitization of business processes. According to S. Pasieka, the new (digital) economy is another technological system that restarts the competition on a new basis, and in this competition “the last can become the first”, [44]. According to the Boston Consulting Group analysis,

the B2C sectors are leading in the use of digital technologies: media; Retail; telecommunications; insurance; and banking services, [45]. The Interreg Europe program aims to improve EU regional policies and programs. It covers 4 strategies: innovative development, support of SMEs, green economy, and energy efficiency. In 2014–2020, 359 million euros were allocated for these programs within the framework of the European Regional Development Fund. An important direction of these programs is the digitization of industry.

### 3.3 Digital Platforms and Their Impact on the Economy. Global Practice of using Digital Platforms

It is useful to study the experience of SMARTY practice, namely smart SMEs, in the transition to Industry 4.0. The SMARTY project considers excessive fragmentation of Industry 4.0 (approaches, technologies, sectors, industries) as the main problem and aims to establish a unified knowledge base on best practices in regional development approaches (Table 2). The output of the project is 60+ measures to study the policies of different regions, 26 identified best practices, 4 guidelines with policy recommendations, 8 studies and action plans for the transfer of best practices to the regions, as well as tools for improving policies, [46].

Export and internationalization are a top priority for all engineering, automation, and mechanical engineering sectors. This is due to the fact that the domestic market is too small, and the dynamics of its development are simply depressing – the processes of deindustrialization continue in Ukraine. Therefore, many engineering firms and manufacturers are not needed in Ukraine in the number in which they exist today. In this case, the only way out is export and integration into global chains. The IT industry has already followed this path – about 90% of services produced in Ukraine find their foreign customers. Engineering companies could also move more actively in this scenario. Hannover Messe 2020 was supposed to be a breakthrough project in terms of financing these activities but was canceled due to COVID-19. Therefore, IAM sectors need stronger support – it is difficult for small and medium-sized businesses from these sectors to solve problems alone. The requirements and criteria of the internationalization process are different from export because we are talking about integration into global chains and innovation ecosystems, where the focus in the value proposition is not so much on the finished product



as on one’s expertise and understanding of how it can complement another.

Table 2. SMARTY global best practices and tools for improving innovation and digital development policy of European Union countries

<i>Project</i>	<i>The purpose of the project</i>
<i>1</i>	<i>2</i>
InnoHEI – improvement of research infrastructure: from fragmented to integrated and sustainable cooperation with business (7 EU countries)	Goal: to improve the culture of entrepreneurship and creativity in the EU regions for the development of innovation by improving the Entrepreneurial Discovery Process (EDP). The project involves overcoming numerous barriers in these unification processes.
PASSPARTOOL – key tools for assessing and improving the soft style of innovative development (7 EU countries)	The PASSPARTOOL project aims to develop new tools and indicators of innovative development in the field of the general innovative culture of enterprises. The idea is that it is better to stimulate informal. Project activities include: exchanges between countries, thematic workshops and trainings, identification of policy and practice tools that improve the development and implementation of action plans, and a lot of promotional materials.
INNO Industry (10 EU countries)	Goal: increase the share of clusters involved in Industry 4.0 projects by improving relevant regional and national policies. The project involves conducting research in 10 EU countries, identifying 30 best practices of clustering and Industry 4.0.
DIGITAL REGIONS – creation of regional policies adapted to Industry 4.0 in their digital transformation (8 EU countries)	Main strategy: improvement of innovation policies. Project partners will propose measures to improve regional policies, aimed at better involvement of SMEs and growth of their knowledge and skills in 4.0.

Source: grouped by the authors based on the source, [46].

Especially, these processes of shifting the focus in the chain of added value are important for innovative and high-tech sectors, and they require another level of cooperation, including internal ones. Today, as part of solving this problem, several challenges appear:

- Ukrainian high-tech industries have made little progress in digital marketing;
- Criticality of the resource for export and internationalization;
- Adjust the needs of clusters in export and internationalization, taking into account their differences, etc.

### 3.4 Ukraine’s Experience in Economic Clustering

In this national context, the activation of these processes and development attempts at the regional, cluster level is an additional and important tool for the joint improvement of Ukraine’s position in the spheres of export and internationalization, [47]. Clusters and participants of the ecosystem with export and internationalization experience are presented in Table 3.

Therefore, the determinants of the success of modern clusters are:

- Value proposition. This is the main factor from which any collective export begins;
- Initial investment factor. For young clusters, the initial investment is a start for activity. Without

initial and powerful external investments, export clusters cannot take off in Ukrainian conditions;

- Strategy of entering foreign markets;
- Marketing tactics adapted to Covid-19, martial law and industry specifics;
- Strong internal collaboration, [47].

In 2021, for 1.5 months, the cluster team of the Maritime Cluster of Ukraine (MCU) created its development strategy, a portfolio of regional maritime industry projects, conducted a study of individual segments of the industry, and entered into negotiations with the regional authorities regarding the inclusion of relevant priorities in the strategy until 2027. This result looks somewhat fantastic in terms of its speed and against the background of other regions. If you don’t know that, behind him is almost 2 years of work to rally the local business community around the challenges of shipbuilding and the maritime industry more broadly. On the other hand, returning to the model, it is the method of integrating individual parts of this movement into a single regional agenda that creates this dynamic, as it involves all the main stakeholders, [48].

A similar situation can be observed in other regions, which allows us to assert the adaptability and scalability of the proposed model for all regions that seek to develop industrial sectors.

Table 3. Clusters and participants of the innovation ecosystem, who have experience in export and internationalization

<i>Clusters and participants</i>	<i>Current experience and unresolved issues</i>
<i>1</i>	<i>2</i>
Sea Cluster of Ukraine (MCU)	Active networking should take place not only within the cluster but immediately with potential international partners. MKU participates in several international online events, and thanks to the presence in the cluster of 2 companies of Dutch origin (MDEM and C-jobs), these relations already have strong support and experience. Online tools offered on the market are diverse, for example, the SMM (Shipbuilding Machinery & Marine Technology) forum exhibition in Hamburg. The maritime cluster is looking for co-financing opportunities for participation in similar exhibitions. In addition to the “ticket” to access such a platform, it is necessary to invest in quality content – presentation video content.
Company 482. Solutions	The Southeast Asian region is the target market for the company, where Singapore is the center of the ASEAN zone, which includes 10 leading countries in the region and is the 3rd largest economic zone in the world after the US and the EU. Singapore is essentially a hub, a cluster, a marketplace open to all players in this area. The company actively applies for grants.
Ukrainian Association of Furniture Makers (UAM)	Exports in UAM are tied to the initial development of a strong value proposition for consumers. For this, UAM builds a developed ecosystem of production cooperation, involving architects and designers, and at the same time improves the level of the offer of each category – trainings, webinars, and workshops are held constantly. In 2021, exports went to 114 countries in the world, 80% of them – to EU countries. At the same time, there are still reserves for improvement. The most effective tools used in UAM are: participation in foreign exhibitions, scout missions and trade missions, and organization of national exhibitions the attract buyers to Ukraine.

Source: grouped by the authors based on source, [47].

This model is “not a copy-paste” of European smart specialization, and what we have observed so far in Ukraine, namely the adaptation (localization) of the main principles of this main European mainstream in the development of innovations to Ukrainian conditions. The main focus of this adaptation was aimed at overcoming numerous problems that our stakeholders encounter in practice – fragmentation, lack of leadership, weak communications, disintegration of policies and programs, etc. The Ukrainian version of the EDP reveals several features on how to accept and overcome these challenges (Table 4).

Table 4. The main challenges and their solutions in the development of the strategy of innovative and digital development based on clustering

<i>Challenges</i>	<i>Decision</i>
<i>1</i>	<i>2</i>
Inefficiency of plans and actions, lack of responsibility	Distribution of roles according to real capabilities
Circle of mistrust, fragmentation	Gradual, integrative convergence
Weak and broken communications	A single information field, regular communications
Lack of integrity and consistency	A single agenda (road map)
Unclear S3 goals and outcomes	4 categories of SMART results
Inadequate time settings	Focus on quick wins
Disintegration of regional and national policies and programs	Full integration with national initiatives

Source: grouped by the authors based on sources, [18], [20], [41], [48], [49].

Based on the existing global experience and the focus of the government of Ukraine on a quality

strategy of innovative and digital development, it is worth considering some important working points:

– “Do not make false assumptions” – the message is addressed, firstly, to representatives of the central government, as well as developers of regional strategies 2027 and the action plan 2021–2023;

– Several projects implemented in Ukraine have already shown the power of clusters and their ability to become drivers and leaders of innovative regional development;

– Implemented projects made it possible to rethink the development of the 4.0 movement and consider them in the context of regional challenges. The results of the benchmarking review with EU countries show that all developments (projects) – such as regional Centers 4.0, IAM clusters, industry road maps of digital transformation, landscapes of innovators, etc. – are completely identical to European practices. All these should be elements and tools for the development of innovative and digital ecosystems of industrial hi-tech. In the context of orientation towards the European Union, so to speak, this movement “from below” looks much closer to European standards than state regional strategies, [48].

The consistency and systematic of steps to build regional innovation ecosystems for industry is not to follow European or any other methods without any adaptation. The first step in this adaptation is to define an effective configuration of forces and actors at the local level, where the role of each participant is specified and corresponds to common challenges at the regional level.

Doing business is becoming more difficult, both due to weak or negative dynamics of market growth and global competition. Local entrepreneurs understand that they need to change because the factors of competitiveness are shifting towards the quality of products and the ability to compete in exports. Regarding contact with scientists and innovation, there is a need, but it is difficult for businesses to move several issues on their own, such as financing modern R&D laboratories, in particular in the chemical industry. Regarding the regional development strategy, there are no clear directions today, and measures are scattered. We need new productions, and modernization of existing ones, to move towards the EU and export. In the regional strategies, there is no analysis of the potential of

traditional industrial sectors, such as instrument building, which is currently tending to revival. Clusters are recognized in the regional strategy as an important growth tool, and it is indicated that their potential should be further analyzed, [50].

### 3.5 Foreign Regional Clustering Projects and Lessons for Ukraine

All the years of its independence, Ukraine was primarily concerned with the issue of survival and was not interested in innovative and digital development. The state, de facto, can be said to have distanced itself somewhat from the tasks of developing industrial hi-tech segments.

Table 5. The experience of progressive regional projects in the world and the possibility of its use in Ukraine

<i>Project</i>	<i>Opportunities for Ukraine</i>
<i>1</i>	<i>2</i>
Creation of regional hubs 4.0, focusing on the development of the innovative ecosystem of the region in a specific field with the help of regional clusters. The KPI of such projects is the number of startups and innovative solutions, specialized laboratories, a common marketplace and a support database, and in the future, an increase in the number of jobs.	The idea of regional, ecosystem hubs 4.0 is close to the Ukrainian concept of Centers 4.0 from 2018. One of their main roles is to become regional centers of the 4.0 ecosystem.
Innovation vouchers in the field of Industry 4.0 are considered a tool for the promotion of 4.0 in the environment of SMEs, which stimulates them to implement technologies and change business models more quickly. A similar scheme with a state fund of 12 million euros was implemented in Portugal in 2018. The size of one voucher is 7,500 euros. The entire scheme covers 1,200 enterprises. The tool has already attracted 600 enterprises, with the issuance of 3.5 million euros.	There are no similar tools in Ukraine. Instead, successful experience is demonstrated by the Green-cubator in the project with the EBRD, which is aimed at green and energy-efficient technologies.
Promotion of National programs of Industry 4.0 – with consideration of the features of these programs and determination of their strengths. Among the areas of the program are faster adaptation of 4.0 SMEs, development of the ecosystem, promotion of the best technology providers, and attraction of investments in the local 4.0 ecosystem.	A similar program has been operating in Ukraine since 2018, but it does not have any state support, all projects are implemented by the business itself, supported by international donors.
Digital Innovation Hubs (DIH) is a tool for supporting SMEs in the transition to 4.0. SMEs make up 90% of the EU economy, but only 20% of them have a high level of digitalization. There is a whole network of DIH centers in the EU, designed to be centers of demonstration, consultation, and transfer of new 4.0 technologies to SMEs. As part of the smart specialization and DIH development strategy, Italy has created a special agency – CNA HUB 40 to support 10 local DIHs.	This tool is part of the improvement program of the DIH development. The total European budget for the development of these centers in the EU reaches more than 100 million euros in the Horizon 2020 program alone. National and regional funds to support DIH should be added to this. In Ukraine, Centers 4.0, which is a prototype of DIH, functions on a volunteer basis.
Regional program for the development of Industry 4.0 in Lithuania. Panevezys was a well-known industrial center where the Ekranas enterprise played a major role. The main idea is to turn the city into a hub for industrial automation and robotics. The developed business plan envisages the creation of the STEAM Center (€370,000) and ROBOLABS – a specialized robotics laboratory (€470,000), and separately – a regional development agency (annual budget – €270,000).	This experience and the example of the regional program are relevant for Ukraine. After all, half of the Ukrainian regions are industrial, but this potential is rapidly being lost.
Center for Mechatronics and Engineering in Mechanical Engineering (M&M) in Belgium. Several universities in West Flanders have combined 4 laboratories and a technology hub into an open innovation platform. The goals were to improve the position of West Flemish SMEs in the regional and international dimensions. The main strategy is the growth of innovations and innovative solutions of Industry 4.0 through better integration of SMEs in this center, and acceleration of their innovation cycles.	The idea of unifying laboratories, both at the level of a single university and several universities of the same city or region, was embedded in the concept of Centers 4.0 back in 2018.
Implementation of the MFCA methodology in the food industry, in France. This project aims to implement the MFCA (Material Flow Cost Accounting) methodology, which allows you to assess the true value of losses, which include not only logistical losses (for example, in transportation) but also internal ones (related to the cost of raw materials, their processing, energy resources, labor, etc).	Modern technical standards and their implementation significantly increase competitiveness, and also pave the way for export and internationalization.

Source: grouped by the authors based on the source, [46].

As a result, the mentality and behavior of many managers has changed. The focus of the Industry 4.0 movement is systemic changes in the construction of innovative digital ecosystems. Movement 4.0 projects may be interesting for machine builders: the creation of a network of Centers 4.0 based on leading, regional ZVO; continuation of the series of Hackathons and competitions, one of the goals of which is related to personnel development; creation of startup schools based on these centers (not IT – namely for the needs of industrial hi-tech); accelerated transition to modern technical standards; attraction of grant funding, [51]. The experience of progressive regional projects in the world and the possibility of its use in Ukraine are presented in Table 5.

At the same time, it is worth developing ways, and tools and providing effective recommendations to strengthen the innovative and digital development of Ukraine in the conditions of European integration, in particular:

- Include and profile already existing and verified Industry 4.0 Strategy projects. Regional Centers 4.0, IAM clusters, 4.0 accelerators, holding Technology & Innovation Days, Industry 4.0 landscapes – all these are ready-made concepts, formats, and methods, and even ready-made project grant applications, [46];

- Scaling of tools developed in Ukraine. This is because we already know well what works and how, and what does not work and why. But this does not mean that other initiatives, projects, or tools cannot be introduced;

- Generate and filter ideas in successive meetings. The generation of ideas and initiatives in the field of Industry is at a low level everywhere in Ukraine;

- Joint consolidation with the government (round tables, online public discussions, joint lobbying of Industry 4.0), [46];

- Innovative clusters remain the driver of 4.0 at the regional level. Their support and development, both from local authorities and businesses, is a priority. These are the structures that each of all stakeholders of industrial and high-tech development will be able to rely on literally in 1–2 years.

It is worth noting that Ukraine is currently developing quite a few strategies for its development, but all of them are multidirectional and not of a systemic nature, often not coordinated with each other, and do not provide for the decomposition of goals. As a result, many goals that are not subordinate to each other make it much more difficult to formulate a clear strategic vision of the

country's development. Considering the above, we believe that the breakthrough strategy should include both traditional drivers of development and innovative digital ones, in particular those that involve the wide use of digital technologies, and the creation of digital platforms based on clusters.

## 4 Conclusion

Based on the results of our research, we concluded that intelligent network interaction, the work of ecosystems, and cluster formations increase the degree of synergy among all technological factors of growth. So, if high-speed broadband networks provide high download rates, broadband networks combined with artificial intelligence enable fast operation and secure networks with fewer failures. IoT sensors in ecosystems allow reading large data sets. New business models in clusters and applications arising as a result of intelligent network interaction are changing the ways of conducting business, consuming products and services, and becoming drivers of the expansion of the digital economy.

In particular, it is worth noting that digital platforms and clusters play a leading role in the creation of innovative ecosystems in countries, and the development of digital platforms based on clustering and the strategy of innovative development causes turbulence in the market situation, increased competition in both foreign and global markets. This puts participants and economic agents working on digital platforms in conditions where the digital transformation of business processes and management models becomes a matter of increasing competitiveness and innovativeness. In addition, digital platforms encourage industrial transformations on the ground, offering solutions for system modernization, and opportunities to experiment and scale innovation.

The analysis of European projects is useful for all Ukrainian stakeholders of Industry 4.0, and primarily for those involved in the “Integration 4.0” project. In several projects, the method of entrepreneurial discovery has been worked out. The study of European practices gives new ideas and guides and points to trends that can be traced in the world. And all the more so in the context that today these development ideas are not translated into concrete projects. However, in Ukraine, there is a lack of effective state support for the development of Industry 4.0. This is the main challenge that needs to be changed. At the same time, many regional administrations also have their

expectations. Firstly, regarding specific projects of investment and innovative development. Therefore, regional communities of educators, namely scientists, developers, and industrialists, should be more mobilized around specific 5–7 projects for the development of Industry 4.0 at the regional level.

It is proposed to include digital rules, digital values, digital traditions, and digital order within which economic agents can function among the characteristic features of digital platforms. Companies, organizations, institutions, and enterprises operating on digital platforms are more powerful in terms of innovation, register more patents, and create a large number of new jobs than when they operate outside clusters and platforms. Networked digital platforms feature full automation of machines and production lines, along with task optimization for machines and robots, soft and hard digital infrastructure based on digital hubs, and mass customization of products.

Digital platforms are a breakthrough innovation that can fundamentally change the structure of the national market. On the one hand, digital platforms make it possible to avoid the chain of intermediaries, offering the end consumer the maximum list of possibilities. On the other hand, in the event of a “digital monopoly”, the owners of successful platforms receive effective levers of market control (including due to the asymmetry of information) and can impose their price policy. That is, the “traditional” business tactically greatly benefits from the appearance of digital boards, but strategically it is exposed to the danger of losing sales channels and becoming completely dependent on platform owners.

Digital changes have at least two dimensions: one is technological and institutional, and the other is managerial, psychological, mental, moral, and spiritual. Practical examples in this article prove that one of the main vectors of digital transformation is the creation of prerequisites for the formation of new business models. The practical implementation of new business models, namely platform ones, changes all components of economic activity. Currently, the areas of application of platform business models are, firstly, industries (sub-industries) with a high share of information in relation to other factors of production. In such industries (sub-industries), competition between companies is rapidly being replaced by competition between business platforms, and separate niches remain for firms with traditional business models. Effective business transformation in conditions of sudden market changes and lack of time depends on the speed of processes. Both top-down and bottom-

up quick decision-making can be very beneficial during a crisis. But this requires constant monitoring of the changing situation.

What is fundamentally new for business, in the context of the digital revolution and innovative development that is currently taking place, is its impact on the B2B sector. It is in B2B that the possibilities of digitalization and innovation are not limited to the possession of limited resources of the consumer, but allow endlessly approaching new heights of efficiency and productivity in the course of economic clustering.

#### References:

- [1] Hanin I.H. (2012). Information and technological prerequisites for the formation of a post-industrial society as a concept of a new global civilization. *Effective economy*, no. 9, [Online]. (in Ukrainian) <http://www.economy.nayka.com.ua/?op=1&z=1765> (Accessed Date: September 11, 2023).
- [2] Katz R. (2017). *Social and economic impact of digital transformation on the economy*. International Telecommunications Union, July 30, 2017, 41 p., [Online]. [https://www.itu.int/en/ITU-D/Conferences/GSR/Documents/GSR2017/Soc\\_Eco\\_impact\\_Digital\\_transformation\\_finalGSR.pdf](https://www.itu.int/en/ITU-D/Conferences/GSR/Documents/GSR2017/Soc_Eco_impact_Digital_transformation_finalGSR.pdf) (Accessed Date: August 24, 2023)
- [3] Zvirgzdina R., Skadina H., Linina I. (2023). Appropriate communication of the strategy as an impact factor for business model digitalization. *WSEAS Transactions on Business and Economics*, vol. 20, Art. #151, pp. 1709-1718, <https://doi.org/10.37394/23207.2023.20.151>.
- [4] Linina I., Vevere V., Zvirgzdina R. (2023). Strategy development for use of influencers in communication of small and medium-sized enterprises (SMEs) with consumers. *WSEAS Transactions on Business and Economics*, vol. 20, Art. #141, pp. 1607-1614, <https://doi.org/10.37394/23207.2023.20.141>.
- [5] Davtyan G. (2019). Traditional performance metrics and digital platforms. *LinkedIn*, May 26, 2019, [Online]. (in Russian) <http://surl.li/lielp> (Accessed Date: August 13, 2023).
- [6] Davtyan G. (2019). The future of processes: how they will change as technology advances. *LinkedIn*, November 22, 2019, [Online]. (in Russian) <https://www.linkedin.com/pulse/будущее-процессов-как-будут-меняться-по-мере->

- [розвиття-гарик-давтян/](#) (Accessed Date: September 27, 2023).
- [7] Yfantis V., Ntalianis K., Ntalianis F. (2020). Exploring the implementation of artificial intelligence in the public sector: welcome to the Clerkless public offices. Applications in education. *WSEAS Transactions on Advances in Engineering Education*, vol. 17, Art. #9, pp. 76-79, <https://doi.org/10.37394/232010.2020.17.9>.
- [8] Caputo F., Cillo V., Candelo E., Liu Y. (2019). Innovating through digital revolution: the role of soft skills and Big Data in increasing firm performance. *Management Decisio*, vol. 57, no. 8, pp. 2032–2051, [Online]. <https://www.emerald.com/insight/content/doi/10.1108/MD-07-2018-0833/full/html> (Accessed Date: September 18, 2023).
- [9] Kotarba M. (2017). Measuring digitalization – key metrics. *Foundations of Management*, vol. 9, no. 1, pp. 123-138, <https://doi.org/10.1515/fman-2017-0010>.
- [10] Riss U., Cigaina M. (2017). Digital business modeling. A structural approach toward digital transformation. Version 2. *SAP White Paper. Digital transformation*, January 2017, <http://dx.doi.org/10.13140/RG.2.2.22643.73766/1>.
- [11] Schallmo D., Williams C. (2018). *Digital Transformation Now! Guiding the Successful Digitalization of Your Business Model*. Springer International Publishing: 1st ed. 2018 (January 19, 2018), 84 p.
- [12] Schallmo D., Williams C., Boardman L. (2017). Digital transformation of business models – best practice, enablers, and roadmap. *International Journal of Innovation Management*, vol. 21, no. 8, pp. 1740014-1–1740014-17, <http://dx.doi.org/10.1142/S136391961740014X>.
- [13] Gomes J., Okano M., Simoes E., Otolá I. (2019). Management strategy and business models in the era of digital transformation. *South American Development Society Journal*, vol. 5, no. 14, pp. 252-271, <http://dx.doi.org/10.24325/issn.2446-5763.v5i14p252-270>.
- [14] Castaldo A., Fiorini A., Maggi B. (2018). Measuring (in a time of crisis) the impact of broadband connections on economic growth: an OECD panel analysis. *Applied Economics*, vol. 50, no. 8, pp. 838–854, <https://doi.org/10.1080/00036846.2017.1343448>.
- [15] Ivanov V.B., Ilchenko V.Yu., Litvyshko L.O., Razvodovskaya V.O., Hrebelnyk M.M. (2022). Modeling the eco-cluster management system in the context of globalization and COVID-19. *Efficient economy*, no. 1, pp. 1–8, <https://doi.org/10.32702/2307-2105-2022.1.72>.
- [16] Liashenko V.I. (2018). *Digital modernization of Ukraine's economy as an opportunity to breakthrough development*. Kyiv: Academy of Sciences of Ukraine, Institute of Industrial Economics. 252 p. (in Ukrainian)
- [17] Kolot A., Herasymenko O. (2020). Digital transformation and new business models as determinants of formation of the economy of nontypical employment. *Social and labour relations: theory and practice*, vol. 10, iss. 1, pp. 33–54, [http://dx.doi.org/10.21511/slntp.10\(1\).2020.06](http://dx.doi.org/10.21511/slntp.10(1).2020.06)
- [18] Pizhuk O.I. (2019). Formation of the strategy of economic development of enterprises in the “VUCA” environment. *Banking*, no. 1, pp. 37–46. (in Ukrainian)
- [19] Tsybmal I.B., Zovtun A.A., Lymanskyi E.L. (2015). The VUCA world as a modern context of informational and socio-political changes. *Scientific journal of the M.P. Drahomanov NPU*, vol. 17, pp. 43–47, [Online]. (in Ukrainian) [https://enpuir.npu.edu.ua/bitstream/handle/123456789/22608/Nchnpu\\_022\\_2015\\_17\\_10.pdf?sequence=1&isAllowed=y](https://enpuir.npu.edu.ua/bitstream/handle/123456789/22608/Nchnpu_022_2015_17_10.pdf?sequence=1&isAllowed=y) (Accessed Date: September 29, 2023)
- [20] Chmeruk H.H., Kralich V.R., Burlakova I.A. (2018). Some aspects of digital transformation of enterprises. *Economics and enterprise management*, vol. 34, pp. 97–101, [Online]. (in Ukrainian) [http://bses.in.ua/journals/2018/34\\_2018/21.pdf](http://bses.in.ua/journals/2018/34_2018/21.pdf) (Accessed Date: September 16, 2023)
- [21] Kraus K., Kraus N., Manzhura O., Ishchenko I., Radzikhovska Y. (2023). Digital Transformation of Business Processes of Enterprises on the Way to Becoming Industry 5.0 in the Gig Economy. *WSEAS Transactions on Business and Economics*, vol. 20, Art. #93, pp. 1008–1029, <https://doi.org/10.37394/23207.2023.20.93>.
- [22] Manzhura O., Kraus K., Kraus N. (2021). Digitalization of Business Processes of Enterprises of the Ecosystem of Industry 4.0: Virtual-Real Aspect of Economic Growth Reserves. *WSEAS Transactions on Business and Economics*, vol. 18, Art. #57, pp. 569–

- 580,  
<https://doi.org/10.37394/23207.2021.18.57>.
- [23] Kraus N., Marchenko O. (2021). Innovative digital entrepreneurship as key link of Industry X.0 formation in the conditions of virtual reality. *Baltic Journal of Economic Studies*, vol. 7, no. 1, pp. 47–56, <https://doi.org/10.30525/2256-0742/2021-7-1-47-56>.
- [24] On the approval of the Information Society Development Strategy in Ukraine: Decree of the Cabinet of Ministers of Ukraine no. 386 of May 15, 2013. *The only web portal of executive authorities of Ukraine: Government portal*, [Online]. (in Ukrainian) <https://www.kmu.gov.ua/npas/246420577> (Accessed Date: October 12, 2023).
- [25] Digital Agenda of Ukraine – 2020 (“Digital Agenda” – 2020). Conceptual foundations (version 1.0) (2016). Priority areas, initiatives, projects of “digitalization” of Ukraine until 2020. *HITECH office*, [Online]. (in Ukrainian) [https://ucci.org.ua/uploads/files/58e78ee3c392\\_2.pdf](https://ucci.org.ua/uploads/files/58e78ee3c392_2.pdf) (Accessed Date: September 19, 2023).
- [26] About the sustainable development strategy “Ukraine 2020”: Decree of the President of Ukraine no. 5 of January 12, 2015. *Verkhovna Rada of Ukraine. Legislation of Ukraine*, [Online]. (in Ukrainian) <https://zakon.rada.gov.ua/laws/show/5/2015#Text> (Accessed Date: September 17, 2023).
- [27] On the approval of the Concept for the Development of the Digital Economy and Society of Ukraine for 2018-2020 and the Approval of the Action Plan for its Implementation: Order of the Cabinet of Ministers of Ukraine no. 67-p of January 17, 2018. *Verkhovna Rada of Ukraine. Legislation of Ukraine*, [Online]. (in Ukrainian) <https://zakon.rada.gov.ua/laws/show/67-2018-p#Text> (Accessed Date: August 30, 2023).
- [28] Strategy of sustainable development of Ukraine until 2030 (2017). *UNDP*, December 27, 2017, [Online]. (in Ukrainian) <https://www.undp.org/uk/ukraine/publications/стратегія-сталого-розвитку-україни-до-2030-року> (Accessed Date: September 26, 2023).
- [29] Ukraine 2030E is a country with a developed digital economy (2018). *Ukrainian Institute of the Future*, [Online]. (in Ukrainian) <https://strategy.uifuture.org/kraina-z-rozvinutoyu-cifrovoyu-ekonomikoyu.html> (Accessed Date: October 11, 2023).
- [30] Malyi I.I. (2013). The dichotomy of hierarchy and network structures in the institutional architectonics of transformational economics. *Hierarchy and networks in the institutional architectonics of economic systems: a monograph*. Ed. member-corr. NAS of Ukraine A. A. Gritsenko; NAS of Ukraine, Institute of Economics and Forecasting. Kyiv, pp. 175–195.
- [31] Tyshchenko O.M. (2010). Clusters as a vector of economic development: organization, essence and concepts. *Theoretical and applied issues of economics*, vol. 21, pp. 74–80.
- [32] Eneis J.R., Sandra Lucia A.F., Yanier Alberto H.T. (2022). Cluster: the Globalization of Economies. *WSEAS Transactions on Business and Economics*, vol. 19, Art. #142, pp. 1576–1583, <https://doi.org/10.37394/23207.2022.19.142>.
- [33] Boschma R. (2005). Proximity and innovation: a critical assessment. *Regional Studies*, vol. 39 (1), pp. 61–74.
- [34] Arumugam A., Khazaei H., Bhaumik A., Kanesan T. (2022). Analysing the Factors Influencing Digital Technology Adoption in Manufacturing Sectors: Leadership Effectiveness as a Mediator. *WSEAS Transactions on Business and Economics*, vol. 19, Art. #159, pp. 1764–1787, <https://doi.org/10.37394/23207.2022.19.159>.
- [35] Hidayat S., Setiawan M., Rohman F., Hussein A. (2023). Reawakening Digital Innovation and Collaboration Strategy: Strategies to Improve Business Performance. *WSEAS Transactions on Business and Economics*, vol. 20, Art. #32, pp. 342–351, <https://doi.org/10.37394/23207.2023.20.32>.
- [36] Cluster analysis (2023). *Wikipedia*, [Online]. (in Ukrainian) <http://surl.li/cdity> (Accessed Date: October 17, 2023).
- [37] Pang-Ning T., Steinbach M., Vipin K. (2005). Cluster Analysis: Basic Concepts and Algorithms. *Introduction to Data Mining*. Addison-Wesley, [Online]. [https://web.archive.org/web/20181018092755/https://www-users.cs.umn.edu/~kumar001/dmbook/ch7\\_clustering.pdf](https://web.archive.org/web/20181018092755/https://www-users.cs.umn.edu/~kumar001/dmbook/ch7_clustering.pdf) (Accessed Date: October 17, 2023).
- [38] Kemp S. (2022). Digital 2022: Global Overview Report. *DataReportal*, January 26, 2022, [Online]. <https://datareportal.com/reports/digital-2022-global-overview-report> (Accessed Date: September 21, 2023).

- [39] Kemp S. (2023). Digital 2022: Global Overview Report. *DataReportal*, January 26, 2023, [Online]. <https://datareportal.com/reports/digital-2023-global-overview-report> (Accessed Date: September 24, 2023).
- [40] UN Comtrade Database (2022). *Comtradeplus*, [Online]. <https://comtradeplus.un.org> (Accessed Date: September 29, 2023).
- [41] Kemp S. (2022). Digital 2022: Ukraine. *DataReportal*, February 15, 2022, [Online]. <https://datareportal.com/reports/digital-2022-ukraine> (Accessed Date: September 26, 2023).
- [42] Digital Economy and Society Index (DESI) 2020 (2020). *European Commission*, [Online]. <https://eufordigital.eu/wp-content/uploads/2020/06/DESI2020Thematicchapters-FullEuropeanAnalysis.pdf> (Accessed Date: September 30, 2023).
- [43] Schmid G. (2010). Non-standard employment and labour force. Participation: a comparative view of the recent development in Europe. *IZA Discussion Papers*, no. 5087, [Online]. <https://docs.iza.org/dp5087.pdf>. (Accessed Date: September 19, 2023).
- [44] Pasięka S.R. (2012). Effective employment as a form of realization of social and labour potential. *Scientific journal of ChSIEM. Economic Series*, vol. 2, no. 14, pp. 109–113, [Online]. (in Ukrainian) [http://eprints.cdu.edu.ua/3139/1/cgiirbis\\_64%20%2827%29.pdf](http://eprints.cdu.edu.ua/3139/1/cgiirbis_64%20%2827%29.pdf) (Accessed Date: September 11, 2023).
- [45] Banche B. (2018). Business digitalization. *Vlast*, [Online]. (in Russian) <https://vlast.kz/corporation/24539-cifrovizacia-biznesa.html> (Accessed Date: September 14, 2023).
- [46] The best projects and practices of EU regional development in Industry 4.0 (2021). *INDUSTRY4UKRAINE*, [Online]. (in Ukrainian) <https://www.industry4ukraine.net/eu-regional-development-in-industry-4-0/> (Accessed Date: October 10, 2023).
- [47] Export and Internationalization is the best experience of Ukrainian clusters (2020). *INDUSTRY4UKRAINE*, December 23, 2020, [Online]. (in Ukrainian) <https://www.industry4ukraine.net/publications/eksport-ta-internacjonalizacziya-dosvid-krashhyh-klasteriv/> (Accessed Date: October 13, 2023).
- [48] The report of the “Integration 4.0” project is the beginning of the movement for the reindustrialization of the regions (2021). *INDUSTRY4UKRAINE*, March 14, 2021, [Online]. (in Ukrainian) <https://www.industry4ukraine.net/publications/integracziya-4-0-yak-pochatok-nacziionalnogo-ruhu-na-re-industrializacziyu-regioniv/> (Accessed Date: October 16, 2023).
- [49] Wollschlaeger M., Sauter T., Jasperneite J (2017). The future of industrial communication: automation networks in the era of the Internet of Things and Industry 4.0. *IEEE Industrial Electronics Magazine*, vol. 11, Iss. 1, pp. 17–27, <https://doi.org/10.1109/MIE.2017.2649104>. (Accessed Date: October 12, 2023) (in English)
- [50] Integration 4.0 – a round table in the Vinnytsia region (2022). *INDUSTRY4UKRAINE*, December 24, 2020, [Online]. (in Ukrainian) <https://www.industry4ukraine.net/publications/smart-specials/integracziya-4-0-kruglyj-stil-po-vinnyczkomu-regionu/> (Accessed Date: October 18, 2023).
- [51] Fedak M. (2018). Industry 4.0 in mechanical engineering, the state in Ukraine and prospects for development: analytical report of APPAU. *Industry 4.0 in Ukraine*, October 18, 2020, [Online]. (in Ukrainian) <https://industry4-0-ukraine.com.ua/2018/10/18/аналітичний-звіт-індустрія-4-0-в-машино/> (Accessed Date: October 20, 2023).



### **Contribution of individual authors to the creation of a scientific article (ghostwriting policy)**

- Nataliia Kraus, formulation of the purpose and tasks of research, describe digital platforms for ecosystem clustering, assessment of digital platforms and their impact on the economy, research on the global practice of using digital platforms, outlining the values and characteristics of digital platforms, selection of literature and its analysis, literature review, preparation of a discussion on the research topic.
- Kateryna Kraus, determination of the methodological apparatus, study of Ukraine's experience in economic clustering, review of foreign regional clustering projects and the identification of lessons from them for Ukraine, visualization of the presented material, drawing up a list of references, technical design.
- Ilona Babukh, collecting analytical data for scientific research, generalization of research results into conclusions.
- Viktoriia Lisitsa, writing the introduction to the article, preparation of an abstract for a scientific publication.
- Olha Novikova searches for practical examples of clustering in Ukraine and abroad.

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