

## Clusters in the Strategy of Economic Development (Clusters of Cities)

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**Abstract:** Cluster-based economic development within the framework of regions' smart specialization is gaining popularity due to several advantages in uniting firms around a particular type of activity. The purpose of the academic paper was to determine the role of city clusters in regional economic development strategies using the example of IT clusters of Ukraine and their activities within the city limits, and also spreading influence to neighboring countries. The research methodology included the methods of systematic analysis of quantitative and qualitative data on factors influencing the functioning of Kyiv and Lviv clusters. The method of comparing indicators of foreign trade in computer and information services of the regions was chosen to assess the development of clusters depending on the factors influencing their activity (innovations, scientific research and development, networks of higher educational institutions (HEIs)). The authors analyzed the strategies of smart specialization of the regions. The results show differences in developing IT clusters in the cities of Lviv and Kyiv, taking into account the different strategies of smart specialization. The IT sphere in Lviv region is included in the economic policy of the region. The cooperation of authorities and scientific institutes is defined as key favorable factors for development. As a result, the level of export of computer services in the region is increasing. On the other hand, there is an insufficient level of cooperation between the public-private and scientific sectors in Kyiv region. A decrease in the number of scientists in investigations and development in the region, an insufficient level of innovative activity of enterprises can be observed. As a result, the export volume of computer and information services is significantly lower in Kyiv region. The originality of the research lies in comparing the results of developing two IT clusters of cities, the factors affecting their functioning in the context of regions' smart specialization strategies.

**Keywords:** Competitiveness, clusters, cluster concept, organized collaboration, cluster-based economic development, economic diversification, economic policy.

### INTRODUCTION

In current economic conditions, the growth of competition, the development of ICT and creative industries, the expansion of cross-border cooperation, the role of clusters in economic growth is significantly strengthened. Technologies facilitate the expansion of cooperation between firms with common features, enhancing the synergy of their cooperation. As a result, the activity of clusters in a high-tech environment spreads within the city, between cities or even across the country. The geographical coverage of a cluster can vary from one city or a state to a country or even a network of neighboring countries (Porter, 2015). Clusters take

different forms. In most cases they include end product or service companies, suppliers of specialized materials, equipment, components, services, companies in related industries, financial institutions (Reese, 2006).

The development of clusters is taken into account in the economic development strategies of regions and the state as a whole, especially during the period of relevance of smart specialization strategies of regions and cities (Engel, 2015). Many countries, from resource-rich to transitional and developed countries, have launched competitiveness policies and multi-stakeholder cluster initiatives (Ketels & Memedovic, 2008). At the same time, the activities of clusters and the potential of unifying firms and institutions in different regions of the country are significantly differentiated depending on the strategy of smart specialization. The ability of state institutions to stimulate the activity of firms in order to promote economic development affects the ability of

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companies to interact. Considering the above, it is expedient to investigate the role of clusters in economic development strategies in more detail.

The purpose of the research is to determine the role of city clusters in regional economic development strategies using the example of Ukraine's IT clusters and their activities within the city limits, and also spreading influence to neighboring countries.

## LITERATURE REVIEW

A cluster is a voluntary, territorial, sectoral association of entrepreneurial structures closely cooperating with public organizations, scientific institutions, and local authorities to increase the competitiveness of their products and promote regions' economic development (Choe & Roberts, 2011). The strategy of economic development, based on the concept of "clusters" by Michael Porter from the Harvard Business School, assumes that geographically close and interconnected firms form clusters, which also involve institutes, scientific institutions and organizations (Desrochers & Sautet, 2004).

Clusters also often include companies in the processing industry (that is, channels or customers); manufacturers of additional products; specialized infrastructure providers; government and other institutions providing specialized training, education, information, research and technical support (for example, universities, think tanks, vocational training providers); and standard-setting agencies (Andersson & Larsson, 2016). Study of the issue of professional burnout of education workers in the management system (Kryshchanovych, M., Akimova, L., Akimov, O., Parkhomenko-Kutsevii, O. & Omarov, A., 2022). State bodies that significantly influence the cluster can be considered part of it. Finally, many clusters include trade associations and other private sector collegial bodies supporting cluster members (Porter, 2008). Rational use of agribusiness development in the period of worsening climate crisis (Dvigun, A. O., Datsii, O. I., Levchenko, N. M., Shyshkanova, G. A., & Dmytrenko, R. M., 2022), and ensuring financial and economic security in financial markets in the period of European integration (Novak, A., Pravdyvets, O., Chorny, O., Sumbaieva, L., Akimova, L., & Akimov, O., 2022). Implementation of an improved system of strategic planning of national security in the age of information society (Bondarenko, S., Bratko, A., Antonov, V., Kolisnichenko, R., Hubanov, O., & Mysyk, A., 2022) will provide a social assessment of sustainability population (Mulska, O., Vasylytsiv, T., Shushkova, Y., Kloba, L., & Parfenyuk, Y., 2022).

Significant features of a cluster are as follows: specialization in a single activity, location in the same geographical region, belonging to the cluster not only of companies of the same industry but also of adjacent ones, as well as government bodies and educational institutes (Chatterji, Glaeser & Kerr, 2014). The combination of these factors starts the work of a system of interconnected factors. Companies cooperate and compete with each other. The demand for production factors allows them to be gradually significantly improved, leading to development of related industries to the world level (Angelidou, 2014). The same goals are achieved by cooperation projects with government agencies and educational institu-

tions that improve the infrastructure, the level of graduates' training to meet the growing demand for a skilled workforce. Companies also exchange (both voluntarily and through information leaks due to geographical proximity and common circle of acquaintances) the latest acquisitions of management approaches and technological know-how (Lombardi et al., 2012). As a result, a kind of nutritious thicket is created for the accelerated development of the cluster's members. Therefore, a cluster is a system of interconnected firms and organizations, the significance of which as a whole exceeds the simple sum of its constituent parts.

In economic theory, clusters are considered as mutual cooperation established on the basis of mutual formal and informal interaction for economies of scale, exchange of information and knowledge, distribution of risks in the field of research and development (Chatterji, Glaeser & Kerr, 2014).

## METHODOLOGY

Clusters in the strategy of economic development refer to the grouping of firms, industries, and related institutions in a geographic area. Therefore, the scientific article uses a systematic approach to grouping ICT sector enterprises based on structural indicators of Lviv and Kyiv regions in 2010-2020. Structural indicators of ICT companies include:

1. Number of enterprises, units.
2. Number of employed workers, persons.
3. Number of hired workers, persons
4. Personnel expenses, million UAH
5. The volume of sold products (goods, services) without VAT, million UAH.

The present research uses the system analysis method to understand the reasons, factors and indicators of the growth of IT clusters in Ukraine in the largest cities: Kyiv and Lviv. The key indicators of the analysis are as follows:

- 1) quantitative: the number of specialists in the IT industry, the number of IT companies in each cluster, the dynamics of the IT market, the export index of the ICT sector and technological companies, the number of individual entrepreneurs in the field of information technologies; other structural indicators of ICT sector enterprises' activities of the regions, which make it possible to characterize the influencing factors on developing clusters;
- 2) qualitative: mission, vision, strategic goal and general strategy of activity;
- 3) forms (models) of business organization in the IT sphere contributing to the development of IT clusters;
- 4) development strategies of the respective regions and service export indicators in Lviv and Kyiv regions, in which the clusters operate to assess the relationship between the economic potential of the regions' development and the growth of IT clusters.

Case studies of developing IT clusters were conducted for such cities of Ukraine as Kyiv and Lviv. They have the competitive advantages of large cities, human resources, and a network of higher educational institutions training specialists for the IT sector of Ukraine, in which the offices of the larg-

est IT companies are concentrated, the employees of which often manage IT clusters and are members of supervisory boards.

The following resources were used to collect and process the data, namely: analytical reports on the development of the IT industry of Ukraine of the “IT Ukraine” Association, analytical company N-IX (Report, 2019); information about the activities of Kyiv IT Cluster (2023) and Lviv IT-cluster (2023a); statistical data on the favorable factors influencing clusters, posted on the websites of the Main Department of Statistics of Kyiv Region (2023a), the Main Department of Statistics in Lviv Region (2021a), StatBank of Lviv Region (2023a); development strategies of Lviv and Kyiv regions of the Ministry of Community and Territorial Development of Ukraine (2023).

**RESULTS**

**General characteristics of the development of IT clusters in Ukraine**

It is expedient to evaluate the dynamics of the IT market of Ukraine by the number of the main asset of companies – the personnel. the market has been showing steady growth of 10-12% annually in recent years. Despite the crisis, this is one of the few areas of the labor market and a sector that shows constant stable growth thanks to several factors: human resources, a network of higher educational institutions, cooperation between scientific institutes and IT companies in attracting specialists, and outsourcing.

IT clusters in Ukraine are one of the mechanisms of an effective innovative development, which include companies and enterprises of related industries (marketing, accounting services, design, etc.). A network of 22 IT clusters has been created in Ukraine, among which the leading ones are the associations of companies in Kyiv, Kharkiv, Lviv, Dnipro, Odesa thanks to a number of factors.

The perspective, prestige and dynamism of the IT sphere in Ukraine easily explains such rapid growth. There are also some advantages in terms of the working environment, from access to advanced technology to flexible working hours in most offices.

These IT clusters develop the IT industry in cities, unite leading companies and partners operating in the field of software product development, and provide export outsourcing services. In 2015, according to the estimates of the N-IX company, the number of IT specialists in Ukraine was 91 thousand people, and the income was 2,7 billion US dollars. According to estimates as of 2018, the number of personnel reaches approximately 154 thousand persons, of which 39 thousand (25%) work in the largest 25 IT companies: Epam, GlobalLogic, SoftServe, Luxoft, Ciklum, NIX, Infopulse, EVOPLAY, ELEKS, DataArt, etc. According to data as of 2019, there were 184 500 IT specialists in Ukraine, and more than 4 000 technology companies, the export figure of which amounted to 4,5 billion US dollars. (Pyshchulina, 2020). By the end of 2019, the number of IT specialists in Ukraine was about 200 thousand persons. In 2020, the figure increased to 214 thousand specialists or 89,7% of the total number of people employed in the IT sphere in Ukraine (Table 1) (N-IX

Report, 2019). According to GlobalLogic Ukraine’s estimates, under favorable conditions, the information technology sector can grow to 8,4 billion US dollars by 2025 or increase by 2,3 times (Pyshchulina, 2020). The largest 20% of leading companies have offices in Ukraine: Microsoft, Huawei, Samsung, and ABBY. According to the Fortune 500 ranking, more than 100 companies worldwide use Ukrainian firms’ services, and 18 outsourcing companies in Ukraine are among the 100 best outsourcing companies in the world (Sokolenko, 2020).

**Table 1. Number of Companies and IT Specialists in IT Clusters of Ukraine.**

IT Cluster Name	The Number of Employees Employed in IT Companies	Number of IT Companies
Kyiv IT Cluster	90,000	58
Kharkiv IT Cluster	45,000	511
Lviv IT Cluster	31,000	511
Dnipro IT Cluster	16,000	378
Odesa IT Cluster	10,000	6
Zaporizhzhia IT cluster	7,000	-
Vinnitsia IT cluster	5,000	-
Mykolaiv IT cluster	4,000	2
Ternopil IT cluster	3,000	-
Kherson IT cluster	3,000	16
Total:	214,000	1482

Source: compiled by the author based on the Office of Effective Regulation (2018).

IT clusters contribute to developing hybrid forms (models) of business organizations in the IT sphere to which they belong (Pyshchulina, 2020):

1. Freelance / self-employment, within which remote employment, telework, remote work is spread, including through job search platforms. Ukrainian self-employed workers work in the IT industry or related sectors. In 2021, the share of the freelance market of Ukraine by category was distributed as follows: information technologies (Web, Mobile & Software Development) – 83%; design and creativity – 6%; other categories (translation, SMM, engineering, sales and marketing, architecture) – 11%.

The private sector of Ukraine shows the most significant interest in digitalization. After all, the digitalization of economic activity and the use of information technologies ensure the growth of labor productivity in various sectors of the economy. Ukraine’s information technology sector is built on individual entrepreneurs’ activities, data on which became available in April 2016. The share of individual entrepreneurs in the field of information technologies among other individual entrepreneurs increased from 5% to 7,5%. According to data from Opendatabot, the number of individual entrepreneurs in the field of information technologies increased by 45% (by 40,7 thousand) since 2016 (at the same

time, the total number of private entrepreneurs decreased by 8%). Thus, the positive dynamics is characteristic of the field of information technologies. According to data of Mind24 (with reference to the IT Ukraine Association), according to the open data of the register of individual entrepreneurs at the beginning of 2018, 127 000 programmers were registered, of which about 90% were registered as individual entrepreneurs (Pyschulina, 2020). According to the data of the State Statistics Committee of Ukraine, the share of the products' volume sold by natural persons-entrepreneurs (IEs) – micro-entrepreneurs was 35% in 2010 (2 728 million UAH), 51% in 2015 (31 228 million UAH) from the total volume of products sold by business entities. In 2021, the volume of sold products of IEs – micro-entrepreneurs amounted to 195 104 million UAH, and the average sales growth rate was 49% in 2010-2021 (The State Statistics Committee of Ukraine, 2023).

2. The IT industry in Ukraine mainly works in terms of outsourcing services, providing services to foreign companies, which is one of the obstacles to establishing high-tech companies in Ukraine. One of the reasons for this situation is the ability of outsourced companies to actively develop without institutional support and proper infrastructure, because the main resource is the workforce. The outsourcing services market in Ukraine is growing rapidly: according to experts, the market growth is 10-25% annually. The most common form of outsourcing is business processes, involving the transfer of current standardized operations (for instance, handling customer phone calls to specialized call centers, usually located in places with cheaper labor). The following services in Ukraine are transferred for outsourcing, namely: IT services (40,5%), logistics (35,1%), resource support for production processes (27%), marketing services (21,6%), recruitment (18,9%), accounting (13,5%), calculation of wages (13,5%), processing and systematization of information (8,1%), outsourcing of medical representatives (8,1%), personnel accounting and personnel support (5,4%), administrative functions (2,7%) (Pyshchulina, 2020).

### **The Role of IT clusters in the Strategy for the Development of the Regions of Ukraine**

The IT sphere in the Development Strategy of Lviv Region for 2021-2027 is identified as one of the most promising in the region's creative industry, demonstrating high growth rates during 2018-2020 (The Ministry of Development of Communities and Territories of Ukraine, 2023a). In the Strategy, the IT sphere is classified as an economic activity with economic, labor and innovation potential to ensure regional growth. The IT sector is also included among the branches of smart specialization of the region based on the indicator of the dynamics of changes in the degree of its concentration in the economy of the region and Ukraine for the period 2013-2017 (growth in the share of production output, growth in the number of employees in the structure of the economy of Lviv region) (The Ministry of Community Development and territory of Ukraine, 2023a).

The number of new IT companies grows by almost 30% every year, and the number of specialists increases by 25%. The

IT industry is concentrated in the city of Lviv. The factors of its successful development are the proximity of the city to the EU countries, the development of air connections, the availability of highly qualified personnel, a favorable investment climate, the cooperation of the industry with educational institutions and the city authorities, as well as the rapid development of the IT infrastructure. In order to coordinate the work of IT companies, Lviv IT Cluster was formed. It is an association of companies in the field of information technologies, which, together with schools, universities and local authorities, develop the business environment of the industry (The Ministry of Development of Communities and Territories of Ukraine, 2023a).

Lviv IT Cluster participates in developing the IT industry at the local and state levels, contributing to strengthening the competitive position of Ukrainian IT education and making maximum efforts to ensure that the IT business in Ukraine works stably even under the most difficult conditions.

Lviv IT cluster positions itself as the largest community of IT companies in Ukraine, which develops the technological industry in the region and in Ukraine in cooperation with government and education representatives. The vision of the IT cluster is to become the technological center of Eastern Europe. The vision includes several components and activity goals (Lviv IT-cluster, 2023a):

1. Creation of a new positioning and brand strategy of the city thanks to the success stories of local companies and products, the concentration of technological talents in Lviv, the presence of large-scale technological events.
2. A city for comfortable living and improvement of Lviv's infrastructure to the level of leading European cities; an association of like-minded people from the IT industry in a comfortable and safe suburban space of the IT Village; establishing a mental health center for people who need help during wartime.
3. Technical Education Center of Ukraine: innovations, novelties and modernization of the educational system, together with the maximum involvement of experts and mentors of IT companies, contribute to strengthening the brand of scientific and student Lviv; the number of graduates of technical specialties in Lviv in accordance with the IT industry's requirements increases.
4. The most attractive Ukrainian city for IT specialists, involving talented IT specialists for temporary and/or permanent relocation; the IT cluster is a center of career opportunities for IT specialists from different regions of Ukraine; after the start of the full-scale Russian invasion of Ukraine, the cluster released a series of Victory Projects to support the Armed Forces and improve security in Lviv and the region.
5. The city of innovative projects and startups; Startup Competition is held within the IT Arena – it is a large-scale event for innovative startups in Eastern Europe, which supports startups of Lviv, the region and Ukraine in general; it helps develop new successful technological businesses and products.

**Table 2. The Structure of Export of Services of Lviv Region in 2013-2021, %.**

	Lviv region								
	2013	2014	2015	2016	2017	2018	2019	2020	2021
Total, thousands US dollars	395 672,20	411 326,80	369 661,60	393 659,80	471 123,10	570 638,20	610 207,70	641 228,00	861 682,80
Services in the field of telecommunications, computer and information services, thousands US dollars	101 080,50	122 100,90	130 348,90	141 538,20	142 956,70	190 284,40	253 646,60	284 032,10	434 663,40
Share in the total volume, %	25,50	29,70	35,30	36,00	30,30	33,30	41,60	44,30	50,40
Computer services, thousands US dollars	86 703,40	96 665,60	113 075,30	132 776,20	132 547,10	180 448,70	242 353,90	270 779,60	416 597,00
Share in the total volume, %	21,90	23,50	30,60	33,70	28,10	31,60	39,70	42,20	48,30

Source: calculated by the author based on StatBank of Lviv region (2023a).

6. The most powerful business community: leaders and participants of the cluster develop the IT community of Lviv to the scale of the most powerful and influential; their cluster opinion is taken into account when making strategic decisions, and for this, they strengthen and improve interaction with authorities at various levels.

The factors mentioned above have had a positive impact on developing the region's IT industry, as evidenced by the share of the region's computer services export in 2021, which amounted to 48,3% of the total volume of service exports (The Main Department of Statistics in Lviv Region, 2021a). The main partners in the export of services were Malta (20,4%), Poland (14,4%), Denmark (13,2%) and Germany (11,6%). At the same time, the share of financial intermediation services (9,3%), services during business trips (9,1%) and computer services (7,6%) was significant in the import of services of Lviv region in 2021 (The Main Directorate of Statistics in Lviv region, 2021a).

The IT cluster conducted an analytical market study, the results of which testify to the sphere's potential for smart specialization in the region. According to the calculations of the IT cluster for 2018, 317 IT companies worked in the city of Lviv (+28% growth by 2017). Half (50,9%) of IT companies are small (11-50 specialists); 26,9% of companies have less than 10 specialists. IT companies with 51-100 specialists make up 13,3% of the market; medium IT companies (101-250 specialists) - 6% of the market; large ones (251-400 specialists) - 0,6%; and more than 400 specialists - 2,2%. Despite the fact that the vast majority of the IT market is small and medium-sized companies, half of Lviv's IT specialists work in large companies (251+). According to the results of 2019, the number of industry specialists was expected to grow to 24 000. At the same time, the total number of IT specialists in the research did not include about 4 000 freelancers (people who did not cooperate with IT companies, but received orders through freelance exchanges). This indi-

cates the availability of reserves for increasing the scope of the sphere (The Ministry of Development of Communities and Territories of Ukraine, 2023a).

In general, the number of enterprises in the ICT sector of Lviv region is growing by 4% annually for 2010-2020, especially in 2017-2020, in particular small and micro-enterprises (Table 3). At the same time, employment in this area has decreased by 3% annually over ten years. At the same time, it increased among micro-enterprises, which may also indicate their transition to other forms of organization of activity. Personnel expenses in all types of enterprises are growing by 21% annually, which indicates the attractiveness of this sector from the perspective of the remuneration level. The volume of products sold by all ICT enterprises in the region grew annually by 29%, in particular by 39% in micro-enterprises.

The analysis of the educational potential of the region indicates the presence of good opportunities for the further development of the IT industry. There are 11 universities and 13 educational institutions of the I-II levels of accreditation among the educational institutions of Lviv city for training IT specialists of a technical profile (in particular, narrow IT specialties). During 2018-2020, 18 new technical specialties were opened in higher educational institutions of Lviv (The Ministry of Development of Communities and Territories of Ukraine, 2023a). In 2020, 37% of scientific personnel in the fields of science in Lviv are specialists of technical specialties (The Main Department of Statistics in Lviv Region, 2021b). Of 13 836,000 students who studied in institutions of I-IV levels of accreditation, approximately 5 000 students of 4-6 years were ready to work in IT companies in Lviv by the end of 2019 (The Ministry of Development of Communities and Territories of Ukraine, 2023a). IT sphere has a positive impact on developing other industries in the region: construction, tourism, insurance, health care, etc. Consequently,

**Table 3. Dynamics of Structural Indicators of Enterprises in the field of Information and Telecommunications of Lviv Region, 2010 – 2020.**

	2010	2016	2017	2018	2019	2020	Average Annual Growth Rate, %	Deviation, +/- 2020-2010
<b>Number of Enterprises, Units</b>								
All enterprises	667	623	752	852	930	954	4%	287
large and medium-sized enterprises	24	22	19	21	20	21	-1%	-3
small enterprises	643	601	733	831	910	933	4%	290
of small – micro-enterprises	528	515	648	744	817	838	5%	310
<b>Number of Employed Workers, Persons</b>								
All enterprises	8 443	6 063	5 482	5 736	6 393	6 037	-3%	-2406
large and medium-sized enterprises	4 265	2 461	1 762	1 913	1 858	1 989	-5%	-2276
small enterprises	4 178	3 602	3 720	3 823	4 535	4 048	0%	-130
of small – micro-enterprises	1 661	1 819	1 953	2 058	2 550	2 163	3%	502
<b>Number of Hired Workers, persons</b>								
All enterprises	8 302	5 896	5 301	5 592	6 004	5 909	-3%	-2393
large and medium-sized enterprises	4 260	2 461	1 762	1 913	1 857	1 989	-5%	-2271
small enterprises	4 042	3 435	3 539	3 679	4 147	3 920	0%	-122
of small – micro-enterprises	1 609	1 677	1 792	1 925	2 181	2 041	3%	432
<b>Personnel Expenses, Million UAH</b>								
All enterprises	207,3	558,4	588,4	723,4	928,4	1 297,20	21%	1089,9
large and medium-sized enterprises	124,3	317,1	226,6	327	354,7	490,4	18%	366,1
small enterprises	83	241,3	361,8	396,4	573,7	806,8	27%	723,8
of small – micro-enterprises	29,2	87,2	108,6	155,1	226,6	264,6	26%	235,4
<b>The volume of sold products (goods, services) without VAT, million UAH</b>								
All enterprises	934,7	4 932,60	5 539,90	7 685,50	9 881,80	10 806,20	29%	9871,5
large and medium-sized enterprises	594,6	2 449,30	2 710,10	4 255,40	5 354,50	5 629,90	28%	5035,3
small enterprises	340,1	2 483,30	2 829,80	3 430,10	4 527,30	5 176,30	32%	4836,2
of small – micro-enterprises	115,1	844,8	1 119,80	1 770,90	2 418,00	2 749,00	39%	2633,9

Source: calculated by the author based on StatBank of the Lviv region (2023b).

Table 4. Structural Indicators of Enterprises in the Field of Information and Telecommunications of Kyiv Region, 2020.

	Total, Units	Including							
		Large		Medium-sized		Small		of which	
		Enterprises		Enterprises		Enterprises		Microenterprises	
		Units	%*	Units	%*	Units	%*	Units	%*
<b>Number of Enterprises in the Region, Total, Units</b>									
Total	20320	42	0,2	1028	5,1	19250	94,7	16321	80,3
Information and telecommunications	533	–	–	5	0,9	528	99,1	450	84,4
<b>Number of Employees, Persons and %.</b>									
Total, persons and %.	329278	75338	22,9	155663	47,3	98277	29,8	38257	11,6
Information and telecommunications, persons and %.	3184	–	–	485	15,2	2699	84,8	1067	33,5
<b>Number of Hired Employees at Enterprises, Persons and %.</b>									
Total	326387	75333	23,1	155540	47,6	95514	29,3	35848	11
Information and telecommunications	3109	–	–	485	15,6	2624	84,4	1002	32,2
<b>Labor costs at Enterprises, Million UAH and %.</b>									
Total	46111,2	16262,6	35,3	21725,6	47,1	8123,0	17,6	2360,2	5,1
Information and telecommunications	320,8	–	–	69,7	21,7	251,1	78,3	75,6	23,6
<b>Volume of products (goods, services) sold by enterprises, million UAH and %.</b>									
Total	579023,0	220469,6	38,1	231293,2	39,9	127260,2	22	36804,4	6,4
Information and telecommunications	2441,2	–	–	386,1	15,8	2055,1	84,2	665,7	27,3
* in % of the total number of enterprises of the corresponding type of activity									

Source: calculated by the author based on StatBank of the Kyiv region (2023).

the dynamics of development and the essence of creative types of economic activity, that is, the use of the potential of creativity in types of economic activity with high added value without depletion of natural resources, allow defining creative industries as potential branches of smart specialization.

Kyiv IT Cluster positions itself as a public organization uniting Kyiv IT community. On the basis of the cluster, IT companies, outsourcers, startups, product teams and other players form a single ecosystem. These players bring together stakeholders, conduct training, provide communication with authorities or search for international partners. The cluster's mission is to raise the living standard of the region and the country by developing the local IT ecosystem. The strategic goal lies in uniting the community and improving the participants' production, experience and professionalism and creating the central IT location of Eastern Europe in Kyiv. The general strategy is to make Kyiv IT Cluster a communication platform for the region and help implement the potential of local IT specialists (Kyiv IT Cluster, 2023).

The development strategy of Kyiv region does not comprise the development of Kyiv IT cluster; only certain factors favorable to the unification of companies in this area and strategic development goals are defined (The Ministry of Development of Communities and Territories of Ukraine, 2023b). The strategic priority of developing the economy of Kyiv region until 2027 is the development of innovation-oriented sectors of the economy, which will provide an impetus for developing other areas. They will contribute to implementing the export potential of the economy's key sectors, the modernization and technical and technological re-equipment of industrial enterprises, the development of knowledge-intensive, energy- and environmentally-efficient and high-tech industrial productions with growing economic and social returns, expansion of sales markets for the products of domestic manufacturers. The economic policy is based on the strategy of smart specialization to ensure the region's development, which stimulates innovations, and activates long-term structural changes in the economy (The Ministry of Development of Communities and Territories of Ukraine, 2023b).

**Table 5. Annual Indicators of Foreign Trade in Services in Kyiv Region (Thousands US Dollars), 2021.**

	Export	Import	Balance	Coefficient of coverage of imports by exports
Total, thousands US dollars	340393,4	244624	95769,4	139%
Services in the field of telecommunications, computer and information services	48651,8	24335,6	24316,2	200%
Telecommunication services	-	642,9	-	-
Computer services	-	17694,7	-	-
Information services	35048	5998	29050	584%
Business services	41570,3	53982,8	-12412,5	77%
Of which:				
Services of research and development	7546,4	3309,2	4237,2	228%
Professional and consulting services	19402,2	38131,2	-18729	51%
Scientific and technical services	8606	6594,1	2011,9	131%
Services of operational leasing	1537,7	1190,5	347,2	129%
Trade related services and intermediary services	3487,6	3628	-140,4	96%
Other business services	990,3	1059,9	-69,6	93%

Source: The Main Department of Statistics of the Kyiv region (2023b).

As evidenced by the data in Table 4, the number of ICT sector enterprises in Kyiv region is 2,42% of their total number in 2020. The share of employed persons in the ICT sector was 0,97% of all employed persons at enterprises of the region; the share of employees in the ICT sector was 0,95% of all employed persons at enterprises of the region in 2020. In general, the number of ICT enterprises in Kyiv region is smaller compared to Lviv region by 421 units in 2020. Accordingly, the region has significantly lower rates of employment of workers in the industry (by 2854 people and 2800 people in 2020, respectively), creating much less added value of the industry. As a result, labor costs for ICT workers in Kyiv region are less by 976 million UAH, and the volume of products sold is less by 8,365 million UAH. Accordingly, the contribution of cluster activity to the regional economy in Kyiv region is significantly lower.

The achievement of operational goals is foreseen within the strategic goals of developing innovation-oriented sectors of the economy on the basis of smart specialization, within which potential favorable factors for the activity of IT clusters as a sector of creative industries are determined.

The first factor is the activity of innovative enterprises, which will positively affect the development of the innovation ecosystem. At the beginning of 2019, there were about 20 enterprises and organizations that ensured the development of innovative activities in Kyiv region, including a number of industrial parks, business incubators, consulting centers, a regional center for investments and development, etc. (The Ministry of Development of Communities and Territories of Ukraine, 2023b). The main challenges include the level of innovative activity and its results, which indicate the insufficient efficiency of the existing innovative infrastructure facilities in the region, the low level of interaction and

cooperation between the subjects of innovative activity, including with regional and local authorities. There are practically no innovation structures in Kyiv region that provide innovators with a number of specialized services for developing, promoting, prototyping, implementing innovations, etc.

Insufficient active interaction between enterprises and research institutions for qualitative structural transformations in the region's economy is also among the challenges in developing Kyiv IT cluster. Taking into account the main problems that hinder the development of the scientific and technological potential of transformations of the region's economy, the primary directions of joint efforts in the near future should be as follows: the development of a modern research base and technology transfer infrastructure at scientific institutions and higher educational institutions; creation of the infrastructure of business incubators, business accelerators and technology parks for scientists and businesses; implementation of an effective mechanism of the mutually beneficial partnership of the triple spiral "government-business-science"; centers of innovation and transfer of technologies; creation of innovative and creative clusters in the region, etc. (The Ministry of Development of Communities and Territories of Ukraine, 2023b).

The second factor affecting the IT cluster of Kyiv is an insufficient scientific and innovative activity in the smart specialization's sectors. Smart specialization involves developing selected areas based on the results of scientific studies and developments, which turn into innovations. Accordingly, the stimulation of scientific and innovative activities should be one of the primary measures for the successful development of smart specialization in Kyiv region. For the period 2010-2019, the share of enterprises of the region that introduced



innovations increased from 6,9% to 11,9% (The Main Statistics Department of the Kyiv Region, 2023a). During the period 2012-2019, the number of organizations that carried out scientific studies and development in the region decreased to 30 units, of which 43% represent the state sector of the economy, 50% - entrepreneurial, 7% - higher education (The Ministry of Community and Territorial Development of Ukraine, 2023b). The main directions of scientific activity are agriculture, technical, natural and medical sciences. The majority of state scientific institutions are subordinate to the National Academy of Agrarian Sciences of Ukraine and the National Academy of Sciences of Ukraine, which improves access to the results of scientific studies of other scientific institutions subordinate to these academies.

Considering a number of unfavorable factors for stimulating the activity of the IT cluster, the share of exports of services in the field of telecommunications, computer and information services in Kyiv region is much lower, amounting 14% in 2021 (Table 5). The share of the export of related services was low (business – 12%), while the share of import of business services in the region was 22% in 2022.

The third factor influencing the IT cluster of Kyiv is an insufficient level of human capital development to support the region's smart specialization. During the period 2010-2020, the number of employees involved in scientific studies and development decreased from 3172 people to 1523 people; that is, there is a decrease in the participation and activity of scientists (The Main Department of Statistics of the Kyiv Region, 2023c). The number of students in higher educational institutions is also decreasing, including in STEM specialties (The Ministry of Development of Communities and Territories of Ukraine, 2023b). As a result, opportunities to create and implement innovations in the medium and long term are limited. At the same time, better access is provided to the results of the scientific activities of institutions and organizations located in Kyiv, especially in relation to the agro-industrial complex, energy, pharmaceuticals, etc. The largest number of employees involved in implementing the scientific studies of development is observed in the agricultural sector – 984 people, which is 54,7% of the total number (The Ministry of Development of Communities and Territories of Ukraine, 2023b).

## CONCLUSIONS

In Ukraine, the concept of cluster-based economic development is being implemented within the framework of smart specialization of regions. Determination of the role of city clusters in regional economic development strategies on the example of IT clusters of Ukraine shows the following conclusions. Firstly, the clarity of defining key potential areas to ensure regional growth contributes to the positive results of IT clusters, which is shown by the example of the IT area of Lviv region. The share of the export of computer services has increased significantly in the region, in particular thanks to the established network of connections between higher educational institutions, private structures and state authorities. The IT sphere in Lviv region is included in the region's economic policy. It is also worth noting that the region has traditionally been an attractive location for IT specialists. Secondly, the lack of clear favorable factors influencing the

activity of the IT cluster and the IT sphere as a whole adversely affects its development, in particular, the potential of exporting services in the industry. As the experience of establishing the smart specialization strategy of Kyiv region shows, state authorities recognize the insufficient level of cooperation with the private sector, the low level of innovation and the involvement of scientists in the field of research and development. The development strategy of the Kyiv region doesn't define the IT sphere as one of the priority sectors of economic development. At the same time, the strategic document indicates the factors adversely affecting the IT sector. As a result, significant differences were revealed in the development of IT clusters in the cities of Lviv and Kyiv, including due to different smart specialization strategies.

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