

N. A. Olesko, PhD student, Lviv Polytechnic National University

PUBLIC MECHANISMS FOR THE DEVELOPMENT OF INNOVATION ECOSYSTEMS IN THE EUROPEAN UNION AND COUNTRIES

The key role of public instruments in creating innovation ecosystems in the European Union, which is a catalyst for sustainable economic growth and innovative progress, is established. The legislative and program foundations of the EU aimed at stimulating innovation activity are analyzed, particularly the “New European Innovation Agenda” and “Horizon Europe”, as well as the activities of the EIC and EIT. It is determined that the key instruments are implementing innovative specialization strategies (S3), developing digital innovation hubs and activating cluster structures. The impact of public mechanisms on the innovation ecosystems of individual EU member states, such as Sweden, Estonia, Germany, Finland and Poland, is assessed. It is noted that these countries demonstrate the effectiveness of policies through national agencies, investment programs and targeted funding, which provides competitive advantages.

A comparative analysis of public mechanisms for supporting innovation ecosystems in Poland, the United Kingdom and Switzerland is conducted. It was found that the comprehensive integration of cluster policy and support for startups and research centers contributes to strengthening the innovation potential. It was revealed that Poland is a successful example of an Eastern European country that has successfully implemented innovative specialization strategies, created a network of clusters and actively attracts EU funding. The state of development of public mechanisms in Ukraine was analyzed, particularly the level of institutional support, R&D funding, implementation of cluster policy and implementation of S3. It was found that Ukraine is currently at the stage of forming a systemic innovation policy but has made positive progress due to participation in Horizon Europe, the launch of digital hubs and strategic initiatives of the Ministry of Education, Science and Technology and the Ministry of Economy.

The prospects for cluster policy development in Ukraine in the post-war period were assessed. It was concluded that activating public mechanisms will contribute to the sustainable development of Ukraine's innovation ecosystem and its integration into the European innovation space.

Public mechanisms for supporting innovation ecosystems play an important role in ensuring the competitiveness of EU countries. For Ukraine, which is in a state of war, developing such mechanisms is extremely important for integration into European structures. Effective practices for supporting innovation in EU countries have been identified. The situation in Ukraine has been analyzed, and proposals for the development of public mechanisms for innovation ecosystems have been developed. European experience demonstrates the importance of a comprehensive approach to developing an innovation ecosystem. For Ukraine, implementing cluster policy, supporting innovation structures, and adapting EU instruments to national characteristics are strategic.

Key words: innovation ecosystem, regulation, support programs, public mechanisms, innovation, smart specialization, cluster policy.

Н. А. Олесько. Публічні механізми розвитку інноваційних екосистем в Європейському Союзі та країнах Європи

Встановлено ключову роль публічних інструментів у творенні інноваційних екосистем в Європейському Союзі, що є каталізатором сталого економічного зростання та інноваційного поступу. Проаналізовано законодавчі та програмні фундаменти ЄС, що спрямовані на стимулювання інноваційної діяльності, зокрема “New European Innovation Agenda”, “Horizon Europe”, діяльність EIC та EIT. Визначено, що ключовими інструментами є впровадження стратегій розумної спеціалізації (S3), розвиток цифрових інноваційних хабів та активізація кластерних структур. Оцінено вплив публічних механізмів на інноваційні екосистеми окремих країн-членів ЄС, таких як Швеція, Естонія, Німеччина, Фінляндія та Польща. Зафіксовано, що ці країни демонструють ефективність політик через національні агенції, інвестиційні програми та цілеспрямоване фінансування, що забезпечує конкурентні переваги.

Проведено порівняльний аналіз публічних механізмів підтримки інноваційних екосистем. Встановлено, що комплексна інтеграція кластерної політики, підтримки стартапів та науково-дослідних центрів сприяє посиленню інноваційного потенціалу. Виявлено, що Польща є вдалим прикладом східноєвропейської країни, яка успішно впровадила стратегії розумної спеціалізації, створила мережу кластерів та активно залучає фінансування ЄС. Проаналізовано стан розвитку публічних механізмів в Україні, зокрема рівень інституційної підтримки, фінансування R&D, впровадження кластерної політики та реалізація S3. З'ясовано, що Україна наразі перебуває на етапі формування системної інноваційної політики, проте має позитивні зрушення завдяки участі в Horizon Europe, запуску цифрових хабів і стратегічним ініціативам МОН та Мінекономіки.

Оцінено перспективи розвитку кластерної політики в Україні у післявоєнний період. Зроблено висновок, що активізація публічних механізмів сприятиме сталому розвитку інноваційної екосистеми України та її інтеграції в європейський інноваційний простір.

Публічні механізми підтримки інноваційних екосистем відіграють важливу роль у забезпеченні конкурентоспроможності країн ЄС. Для України, яка перебуває в умовах війни, розвиток таких механізмів є надзвичайно важливим для інтеграції

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в європейські структури. Визначено ефективні практики підтримки інновацій в країнах ЄС. Проведено аналіз стану в Україні та розроблено пропозиції з розвитку публічних механізмів інноваційних екосистем. Європейський досвід демонструє важливість комплексного підходу до розвитку інноваційної екосистеми. Для України стратегічним є впровадження кластерної політики, підтримки інноваційних структур та адаптація інструментів ЄС з урахуванням національних особливостей.

Ключові слова: інноваційна екосистема, регулювання, програми підтримки, публічні механізми, інновації, смарт-спеціалізація, кластерна політика.

Introduction. In modern global competition and rapid technological progress, innovation ecosystems are becoming a decisive factor in ensuring sustainable economic development and strengthening the competitiveness of regions and countries. This problem is significant for states that seek to integrate into the European financial, scientific, and technical space, particularly for Ukraine in the context of post-war reconstruction and digital transformation. The study's relevance is determined by the need to adapt European approaches to forming public mechanisms for the development of innovation ecosystems, which have already proven their effectiveness in the countries of the European Union.

The study's purpose is to analyze public mechanisms for supporting innovation ecosystems in European Union countries, in particular mechanisms for regulation, financing, cluster policy, and smart specialization strategies, and to assess the possibilities of their implementation in the Ukrainian context.

The study uses a systemic approach, structural and functional analysis, comparative analysis methods, analysis of documentation of the EU regulatory framework, and a case method to consider national examples of the implementation of public mechanisms in Sweden, Germany, Finland, Poland, and Estonia.

The subject of the study is public mechanisms used in the European Union to create and support innovation ecosystems.

Therefore, this study emphasizes the need to adapt successful European practices of public innovation management to Ukrainian conditions to increase the effectiveness of national innovation policy.

Analysis of Research and Publications. Ukrainian and foreign scholars pay considerable attention to implementing public mechanisms to develop innovation ecosystems in states.

Xiaoran Zheng and Yuzhuo Cai explore how public mechanisms and policies contribute to the transition from innovation systems to full-fledged ecosystems in their work, focusing on transformative innovation policies and the Triple Helix model [1].

Sara González Fernández, Renata Kubus, Juan Mascarenhas Pérez-Iñigo in their article investigate and assess innovation ecosystems in the European Union, providing a systematic assessment and theoretical framework for the development of innovation ecosystems in the contemporary European Union to reflect all actors and processes, and thus provide a more comprehensive and dynamic approach to assessing systems. A reinterpreted innovation spiral perspective is applied for actors, while a multilevel perspective is used for processes. Importantly, scholars at each stage of innovation progress allocate a slightly different role for actors to interact with each other in various ways, and the emergence and density of intermediary actors are considered essential aspects of ecosystem development [2].

I. Ienko in his work gives clear definitions of European public administration mechanisms, which are manifested through phenomena and processes occurring in the European Union and the establishment of vertical and horizontal connections between them and the importance of their proper functioning of developed coordination and communication, which ensures the stability of development [3].

I. Ivakhnenko in his article, considers the innovation ecosystem as a key factor of sustainable economic development and focuses on the need for state support for innovation infrastructure, a partnership between business, science and government, and the introduction of mechanisms to stimulate innovation [4].

Research Results. Innovation ecosystems are the basis of sustainable economic growth and digital and green transition in the European Union. The European Union has developed policies and regulations in each country.

The key document in the European Union that determines the development and support of innovation is the New European Innovation Agenda, which has been in effect since 2022. The document's basis is to create conditions for developing deep technologies (Deep Technologies), support and scale startups and innovative enterprises, and increase investment in improving the work of R&D centres.

The goal is to support and develop new innovative technologies to solve social problems and bring them to the market, modernize public services through innovative solutions, and stimulate the growth of innovative companies in Europe. The new strategy aims to make the European Union a better place for talented experts and professionals to work for leading innovative companies and develop innovations [5].

To implement the new European Union program, 45 billion euros of investment are planned in the development of innovation infrastructures, including digital hubs, science parks, business incubators, and accelerators. It is important to note that the program pays attention to cooperation at different levels and reducing the innovation gap between Western and Eastern member states in the development of innovations [5].

Regulation of innovation activities and the functioning of innovation ecosystems is based on clearly developed public mechanisms of influence, which include legislative regulation, which will be considered in this article.

Fundamental acts, programs and documents of the European Union:

• The Horizon Europe program provides funding for research and innovation for more than 95.5 billion euros for 2021–2027 [6];

• EU Regulation on European Innovation Councils (EIC), which finance the scaling of startups and deep tech companies [7];

• The European Institute of Innovation and Technology (EIT) is a network that brings together business, education and science within the framework of Knowledge and Innovation Communities (KICs), effectively influencing the development of regional innovation ecosystems [8];

• Smart Specialisation Strategies (S3) are essential in developing EU innovation ecosystems. S3 approaches are focused on regions' competitive advantages, allowing you to concentrate resources on the most promising areas of innovative development [9]. It is worth noting that in Ukraine, this approach is also used at regional levels in strategic planning to determine priorities and necessary measures for economic development.

Most funding programs require ESG directives, social innovation, and inclusiveness in the distribution of funds [10].

According to the 2023 European Innovation Scoreboard, 25 of 27 EU member states improved innovation indicators due to specific public mechanisms or their integration into national programs at different levels and areas. It is worth noting that countries with active regional ecosystem support programs, such as Sweden, Finland and the Netherlands, took the highest positions [11].

Let's consider individual examples of implementing public mechanisms to support the development of innovations and innovation ecosystems. It is worth focusing on Switzerland, Estonia, Germany, Finland and Poland.

According to the European Innovation Scoreboard, Sweden has traditionally been leading. For example, in 2023, Switzerland retained the “innovation leader” status, showing an index of 136% of the EU average [11].

One of the public mechanisms that the country actively uses is integrating Horizon Europe tools and support through the national innovation agency Vinnova. One of the programs is “Innovation milieus”, which supports the creation of interdisciplinary clusters in the fields of bioeconomy and digital health with funding of up to 10 million per project [12].

Estonia is developing and creating networks for developing European Digital Innovation Hubs (EDIH). With the support of the European Union's EIT Digital program, the Tallinn EDIH Centre, which specializes in AI, IoT, and cybersecurity, was established. More than 300 small and medium-sized enterprises have already received consulting and innovation testing services at the centre [13]. According to open data, to develop innovations, Estonia annually allocates about 2% of GDP to R&D [14].

Germany is developing innovation clusters (Spitzencluster), which are powerful interregional business, science and government associations. The “MicroTEC Südwest” program unites more than 100 organizations in the field of microsystem technologies, attracting more than 80 million euros in support from the federal and European budgets. According to the Statistisches Bundesamt, Germany spent 3.1% of GDP on research and innovation in 2024 [15].

Another example among the Nordic countries that actively support innovation at the state level is Finland. One of the state support programs is “Business Finland”. The program aims to help startups and R&D companies in various fields. More than 3,000 innovation projects have already been financed [16]. With the financial support of EIT Raw Materials and EIT Health, the programs that help Finland be in the top 3 in the EU Innovation Index are being integrated [8].

Poland is an eastern member of the European Union and is actively developing a network of science and technology parks and clusters, particularly through the “Start in Poland” program. This state innovation support program grants up to PLN 1 million for startups. Thanks to Horizon and Structural Funds funding, over 5,000 innovative SMEs were supported in 2020–2022 [17].

In addition, since 2014, Poland has been implementing Smart Specialisation Strategies in all voivodeships, which has enabled it to attract over €10 billion in investments in regional innovation projects [18].

Table 1

Compares the public mechanisms used by the UK (ex-EU country), Switzerland (central non-EU country), and Poland (east EU country) in the development of innovation ecosystems, taking into account funding

Country	Key support instruments	Funding/investment
<i>Poland</i>	– Smart Specialization Strategy (S3) at the regional level – Polish Agency for the Development of Entrepreneurship (PARP) – Horizon and EIC innovation funding programs	– 1.5% of GDP for R&D – University–industry R&D collaboration score 82.4 – State of cluster development score 81.8 – Joint venture/strategic alliance deals/bn PPP\$ GDP 0.1
<i>Switzerland</i>	– Innovation Agency Innosuisse – Swiss Innovation Park – Technology grants for startups	– 3.3% of GDP on R&D (one of the highest in the world) – University–industry R&D collaboration score 100.0 – State of cluster development score 97.3 – Joint venture/strategic alliance deals/bn PPP\$ GDP 0.1
<i>United Kingdom</i>	– UKRI (UK Research and Innovation) – Catapult Centres – “Innovate UK” programme	– 2.9% of GDP on R&D – University–industry R&D collaboration score 39.1 – State of cluster development score 46.1 Joint venture/strategic alliance deals/bn PPP\$ GDP 0.0

*Compiled based on Global Innovation Index [19].

Analyzing the European Union's experience, Ukraine should take certain steps towards integrating new public mechanisms for the development of innovations and innovation ecosystems.

According to Finland's example, Ukraine should develop and implement a national integrated strategy for the development of innovations. This strategy should combine scientific policy, support for the creation and development of SMEs, digitalization, international support, and improvement of mechanisms for attracting financial resources.

An important step will also be developing a strategy to support the creation of clusters, as is done in Germany through the Spitzencluster program at the government level. It is also worth considering regional smart specialization, which operates in Ukraine and is actively supported in Poland. These actions will contribute to the possibility of attracting financing and developing the region's economic potential.

From 2024 to 2025, Ukraine received financial support under the HORIZON program to strengthen digital transformation in the EU enlargement region. The European Union will support new European Digital Innovation Hubs (EDIHs). The new hubs will provide local businesses, start-ups and public institutions access to cutting-edge technologies, expertise and financial opportunities, fostering innovation and economic growth with a particular focus on AI. Six projects from Ukraine were selected as part of the call for proposals. The total budget of the call is €14.6 million, of which €4.5 million is allocated to hubs in Ukraine [20].

Poland is an Eastern partner country of the European Union, and Table 2 compares them in terms of the development of public mechanisms for ecosystem development.

Analyzing the comparison, we can conclude that the countries have certain standard features and differences. Similar features include governments implementing the cluster model as part of the development of innovations and separate state institutions constantly implementing the necessary steps and strategies for innovation policy. The two countries are focused on the European network for developing and supporting innovations and digital transformation in their programs. At the same time, Poland has more opportunities to attract funding from EU funds, whereas Ukraine has certain limitations. Poland has more experience implementing a single national Smart Specialisation strategy and cluster policy, and the level of funding in the field of R&D in Poland is higher than in Ukraine. In 2024, Ukraine completed the preparation of a state policy for supporting clusters with coordination from the Ministry of Economy of Ukraine and the Ministry of Education and Science of Ukraine.

Developing innovation ecosystems is a key factor in strengthening the national economy. Public mechanisms, particularly clustering and innovative specialization policies, act as tools for coordinating, financing, and stimulating innovation and are worth additional consideration in this article.

Table 2

Comparison of public mechanisms for ecosystem development in Ukraine and Poland

Criteria	Poland	Ukraine
<i>Institutional support</i>	Polish Agency for Entrepreneurship Development (PARP), NCBiR, regional authorities, implementation of Smart Specialisation Strategies	Ministry of Economy, Ministry of Education and Science, State Agency for Science and Innovation, individual regional initiatives, Ministry of Digitalisation, Ukrainian Startup Fund.
<i>EU funding</i>	Receives direct funding from the EU (is a full member), in particular from Horizon Europe, ERDF funds	Limited access to EU programs, participates in Horizon Europe as an associated country
<i>R&D investment (% of GDP)</i>	1,5% [19]	0,3% [19]
<i>Innovation clusters</i>	State and regional support, including European programs	Most initiatives are private or donor-funded
<i>Incentive mechanisms</i>	Tax benefits, subsidies, R&D loans, systemic cluster policy	Tax benefits are limited, lack of a unified cluster strategy or innovation policy
<i>Smart Specialisation Strategy</i>	Successful implementation in all regions within the EU	In the process of adaptation and piloting, supported by international projects
<i>Access to grants and competitions</i>	Permanent open calls through PARP, Horizon Europe, EIC	Limited competitions from the Ministry of Education and Science, USAID (until 2024), GIZ, Horizon Europe
<i>IT and digital initiatives</i>	Digital Poland Programme, participation in the EU digital transformation	Diia.City, digitalization at the state level, support for startups through the Ukrainian Startup Fund", Seeds of Bravery and European Digital Innovation Hubs.

Support for the development of cluster policy in Poland is an effective public mechanism for fostering innovation and promoting economic stability.

Since the early 2000s, Poland has been actively implementing cluster policy. Clusters have become an important tool for regional development, especially after joining the EU. They have been integrated into smart specialization strategies and financed through national PARP programs and European Horizon Europe instruments.

- According to the European Cluster Observatory, Poland has 19 active clusters, covering over 1,200 companies and research institutes [21].

- The effectiveness of cluster policy is reflected in the growth of cluster enterprises' exports by 30% in 2017–2022 [22].

Table 3

Provides a comparative analysis of clustering and smart specialization in Poland and Ukraine

Criteria	Poland	Ukraine
Smart Specialization Strategy (S3)	S3 has been implemented since 2014. Each voivodeship has its own regional S3 strategy within the national (Smart Growth Operational Programme). For the period 2021–2027, S3 is integrated into regional innovation programmes [23].	S3 has been implemented since 2019 through pilot projects in the Western region (Lviv, Ivano-Frankivsk, Ternopil regions), with the support of the EU [24].
Development of cluster policy	Poland has over 130 officially recognized clusters, of which at least 17 have the status of National Key Cluster. The state provides them with tax breaks, R&D funding, and infrastructure support [25].	The Ukrainian Cluster Alliance (UCA) unites 58 cluster organizations, which include over 2,000 enterprises and research institutions. This confirms the active development of the cluster movement in Ukraine, even with limited state support [21].
Cluster financing	Attracting funds from the EU (Horizon Europe, ERDF), co-financing by the state on a competitive basis.	There are initiatives, GIZ, EU (HORIZON), but the scale is limited.
Institutional support	Polish Agency for Enterprise Development.	– Ministry of Education and Science; – Ministry of Economy; – Ministry of Digitalisation; – Ukrainian Startup Fund;
Integration into European innovation networks	– COSME; – Interreg; – Horizon; – EEN programs.	Ukrainian ones are limited, due to the war and the lack of systemic support for European integration of clusters.

It is worth noting that cluster support in Ukraine today is more fragmented and proactive. To develop cluster support in Ukraine, it is worth creating an interdepartmental group under the Cabinet of Ministers to coordinate cluster initiatives during the war period. It will also be important to continue cooperation with international partners (GIZ, EU4Business) and integrate cluster policy into economic recovery plans through the Post-War Recovery Program.

Legislative regulation of cluster policy will be important in the post-war period. It is worth noting that to achieve the results and effectiveness of such a policy; it will be important to launch a state program for co-financing clusters, following the example of PARP in Poland, and integrate cluster policy into the Strategy for Smart Specialization of Regions in coordination with the Ministry of Economy.

The development of cluster policy in Ukraine will effectively stabilise the economy: potential GDP growth of 2.5–3% annually due to the development of clusters [26]. Ukraine can rise 10–15 positions in the Global Innovation Index (currently 60th out of 133) [19]. Formation of a cluster registry and assignment of “national” status (for example, as in Poland) for priority access to financing and infrastructure. Expanding access to European programs.

Considering that in 2024, Ukraine's investment in R&D is 0.3% of GDP [19], which is significantly lower than the EU average (2.3% of GDP) and that Ukraine is associated with Horizon Europe, has access to the Digital Europe and EDIHs programs. With EU support, 6 European Digital Innovation Hubs (EDIHs) have started operating in Ukraine-based universities, with an allocation budget of €4.5 million for 2024–2025. We have prepared the stages of development of the innovation ecosystem as a roadmap (Table 4).

By the end of 2030, we project that R&D investments will raise up 1% of GDP. We propose that the number of active innovation clusters will rise up to 100+. By implementing targets, Ukraine will change its position in the Global Innovation Index within 45–50 places.

Table 4

Key milestones of the roadmap

Period	Targets	Actions	Possible results
2024–2025	Finalization of the regulatory framework and programs for smart specialization and cluster policy	Working with stakeholders; Adoption of legislation and regulatory framework; Preparation of necessary steps at various levels of management to implement necessary tasks.	Increasing transparency of funding; Forming a network of 80+ clusters; Resumption of smart specialization at regional levels and support programs.
2025–2026	Strengthening participation in EU programs	Expanding participation in Horizon Europe, EDIH, EIC programmes; Creating the first National Key Clusters (following the example of Poland).	More than 30 Ukrainian consortium in Horizon Europe projects; Up to €50–70 million in funding attracted to Ukraine.
2026–2027	Increasing investment in R&D	Development of a National Innovation Development Strategy (based on the Business Finland model); Support of the regional/ national innovation ecosystem based at the Universities	Possible increase in R&D spending to 0.7% of GDP.
2027–2028	Support the development innovation policies of Smart Specialization and Cluster politics	Integration of regions in the EEN network, Interreg Europe.	Creation of regional Smart Specialization and Cluster network.
2028–2030	Formation of a sustainable national innovation ecosystem	Launch of the state program for co-financing cluster projects; Scaling EDIH hubs across Ukraine.	Increasing the position in the Global Innovation Index by 10–15 places (currently 60th position); Increasing investment in R&D up to 1% of GDP; Attract additional funding from Horizon Europe, EIC, Digital Europe over €300 million; Increasing share of exports of innovative products in GDP up to 10%.

Conclusions. The study allowed for a comprehensive analysis of public methods of supporting the development of innovation ecosystems in the countries of the European Union, to identify key instruments for regulating innovation activity and to assess their impact on economic growth, the renewal of public administration, digital transformation and the competitiveness of regions. It was found that public policy aimed at supporting innovation is multifaceted and combines institutional, regulatory, financial and organizational mechanisms. The most effective were those states where public mechanisms are integrated into sustainable development strategies, smart specialization, digitalization and a regional approach to clustering.

The study's scientific novelty is the systematization of the European Union's approaches to forming innovation ecosystems through the prism of public management mechanisms, taking into account multi-activism, regional characteristics, and inter-sectoral interaction.

It was found that the most effective ways to stimulate innovation activity are state agencies for supporting entrepreneurship and startups, funding through the Horizon Europe, EIC, and EIT programs, the creation of regional digital innovation hubs, and the implementation of smart specialization strategies with the involvement of local stakeholders. Cluster policy as a tool of regional development deserves special attention.

The study's results are of practical importance for Ukraine, as they outline specific ways to implement European approaches to the development of the innovation ecosystem. Compared to Poland, which has been implementing a policy of smart specialization and cluster support for more than ten years, Ukraine is only forming the principles of state policy in this area.

Prospects for further scientific research lie in the development of methodological approaches to integrating innovation and cluster policies within the framework of the national economic development strategy. Given the challenges of wartime and the need for rapid economic growth, Ukraine's innovation ecosystem must be adaptive, open to international cooperation, and focused on creating added value.

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