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Models of Regions' Innovative Development: International Experience and Prospects for Ukraine within the Sustainability Paradigm

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Abstract

Regional innovation is essential to a nation's overall development since it boosts competitiveness, productivity, and economic growth. By promoting innovation through a variety of tactics, such as expanding the frontier of global knowledge or concentrating on the uptake and spread of already-existing breakthroughs, regions can realize their full potential. Supporting regional innovation requires efficient administration and customized policies that take into account local resources and involve a variety of stakeholders. The relevance of this study is determined by new complexities facing many countries due to geopolitical turbulence and the dynamics of the economic landscape. This article claims that the creation of regional innovation concepts, which predominantly draw from the experiences of advanced regions, has resulted in poor narratives about the experience of less-developed regions. Through content analysis and comparative research, the study critically examines the limitations of endogenous development approaches, particularly the role of formal dynamics within organizations and institutions in regional innovation systems. Drawing on a comprehensive literature review, the paper explores the regional innovation models adopted in the European Union and the United States, assessing their core principles and structural elements. Finally, it evaluates the applicability of these models to Ukraine, proposing context-sensitive pathways for fostering sustainable and inclusive regional innovation within the country's development agenda.

Keywords

Cohesion policy; Innovation policies; Innovation systems; Knowledge; Regional development; Sustainable development

Introduction

Innovation is a major force behind regional development since it promotes competitiveness, economic expansion, and long-lasting change. Strong innovation systems have the power to draw in capital, provide employment, and raise citizens' standard of living in general. Regions can shift their economic structures and guarantee sustainable wage development with the support of effective regional innovation programs. The innovator-learner dichotomy is the foundation of the conventional perspective on regional development and innovation: a few innovative regions create innovations, while others grow by taking inspiration from these pioneering regions. A growing body of geographical literature on innovation and regional development, however, resulted from academics' discovery in the 1980s that the distinction between innovation and learning was hazy. One of the primary forces behind regional development in developed economies, according to research conducted over the past forty years, is innovation. Rather than originating from a single inventor or firm, innovation typically emerges from a network of regional actors. Some regions possess cultural attributes that nurture innovation by fostering collaboration and communication. Moreover, innovation often builds upon existing local knowledge, while sustained progress requires the continuous introduction of external knowledge to create new opportunities for recombination. Although innovation is commonly associated with traditional core regions, transformative developments can also occur in peripheral areas. Nonetheless, it is mainly in developed economies that innovation-based regional development is most prevalent, with only a few non-core regions demonstrating similar effectiveness (Dhanaraju *et al*., 2024; Foyet *et al*., 2024; Sonn, 2021).

Over the previous four decades, research on innovation and regional development has yielded tremendous results. The traditional distinction between invention and learning has been destroyed, and theories have been developed to explain many elements of the subject. Numerous systematic quantitative investigations and detailed case studies have been produced to document the theoretical evolution. So far, it is safe to conclude that innovation is one of the most important research subjects in regional development studies.

Meanwhile, Marques and Morgan (2021) contend that insufficient narratives regarding the experiences of less-developed regions (LDRs) have resulted from the establishment of regional innovation concepts, which mostly draw from the experiences of advanced regions. The authors formulate three primary arguments based on their vast experience conducting research in LDRs. To understand the role of formal dynamics (in institutions and organizations) in innovation systems, they first examine the drawbacks of endogenous methods to regional growth (Arivazhagan *et al*., 2023). To avoid culturally deterministic interpretations of regional (under)development and to support the formulation of more effective policy interventions, it is crucial to understand the role of formal institutional dynamics. The study further explores the literature that reveals the complex interplay between innovation, institutions, and regional development. The authors argue that while firm-level innovation is vital for sustained economic growth, it alone is insufficient to drive comprehensive regional advancement. Lastly, the paper highlights policy implications by presenting alternatives to dominant paradigms such as innovation-led and export-driven development models.

Moulaert and Sekia (2003) summed up the findings on the localized nature of innovation systems as territorial innovation systems, drawing from a range of ideas and methodologies that date back to the literature on industrial districts, which in turn draws from Marshall's work from the nineteenth century. One of the most significant of them has been the idea of regional innovation systems (RIS), which is still widely used in academic and policy circles (Doloreux and Gomez, 2017; Isaksen, Martin and Trippl, 2018). The stylistic differentiation between two subsystems - the one that creates information and the other that utilizes it - is the foundation of this approach (see Figure 1). An institutional framework that encompasses social and cultural factors could either promote or impede innovation dynamics that frame the system. Additionally, some authors highlight the function of government institutions that can support the organizations in both subsystems, such as regional development or innovation agencies (Tödtling and Trippl, 2005).

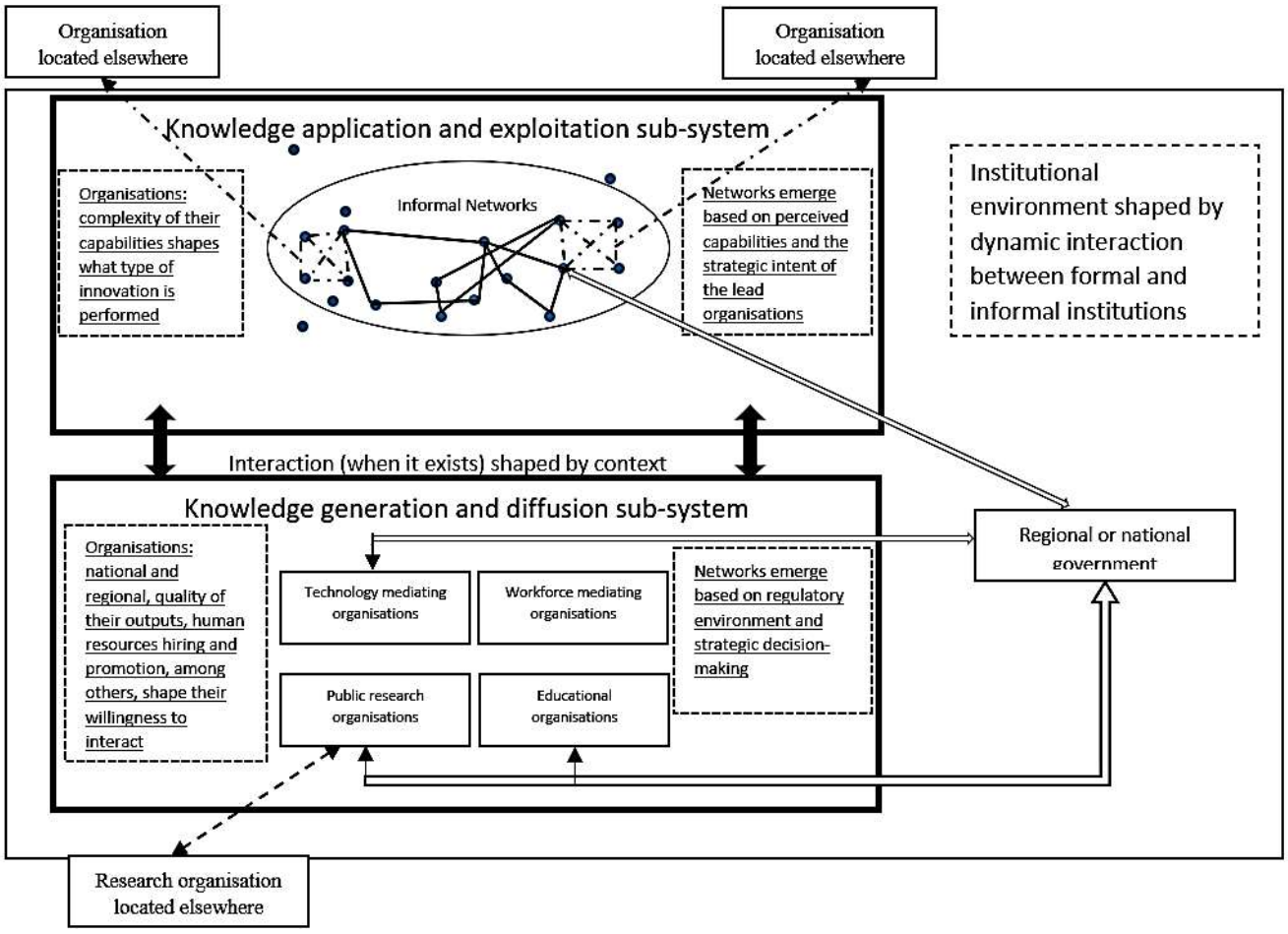


Figure 1: Updated regional innovation system model that includes multiple types of possible relationships based on organizational capabilities and types of networks (Marques and Morgan, 2021)

Indeed, by directing research and innovation policy through a key instrument, the Regional Innovation System, Samara *et al*. (2024) claim that regions play a significant

role in the global economy. According to the authors, RIS is a social system that improves local knowledge and creativity through the methodical interaction of the different organizations that make it up. It implies connections between different institutions in the public and commercial sectors, whose interactions and activities generate, introduce, and disseminate innovations. The process used to create and validate a mathematical model of regional innovation systems using the system dynamics technique is described in the publication by Samara *et al*. (2024).

One of the first to draw attention to the unique features of innovation systems in LDRs was the groundbreaking study by Tödtling and Trippl (2005), which made the case that RIS deficits vary by type in metropolitan, old industrial, and outlying areas. This classification was modified more recently by Trippl, Asheim and Miorner (2016), who contend that areas can be categorized based on their performance in two dimensions. These dimensions include institutional thickness/thinness and organizational thickness/thinness, which is also noted by Avedyan and Belyavtseva (2023). The former speaks to the existence (or lack thereof) of third-sector, governmental, corporate, and scientific groups that can produce critical mass. The latter speaks to the presence of both official and informal institutions that are able to maintain knowledge externalities and innovation dynamics.

Among the relevant scholarly contributions are studies that challenge the idea that innovation is confined to core regions (Eder, 2019; Fritsch and Wyrwich, 2021). These works align with our objective of questioning the assumption that core regions hold a monopoly on innovation, which is often cited as the primary reason for their sustained prosperity (Bashtannyk, Terkhanov and Kravtsov, 2024). In contrast, these researchers highlight how actors in peripheral regions can effectively utilize both internal resources and external knowledge to improve innovation outcomes, even in the absence of a local critical mass.

However, the main focus of these contributions is still on elucidating the location and timing of innovation in the periphery, rather than whether this is enough to spur regional development. Its dependence on correlational theorizing, which measures the influence of individual variables on outcomes (e.g., regional GDP per capita) while treating all other variables as independent attributes that must be held constant, contributes to this heuristic's inadequacy (Furnari *et al*., 2020). Here, individual variables include firm-level innovation or the degree of interaction between universities and the private sector. This type of reasoning is helpful in determining important, pertinent causal linkages. However, it ignores the intricate relationships between variables and the various ways that a particular result could be reached (Ferdman, Kravets and Akimova, 2025). This approach argues that explanations for disparate results cannot be symmetric; that is, the causes responsible for regional decline, for instance, are not the opposite of those responsible for regional growth, but rather a particular combination of variables working together to produce this trend. If one wishes to explain the plight of trailing regions, it is vital to look at their unique socioeconomic dynamics and acknowledge that changing a single variable, firm-level innovation, will not be enough to alter the entire regional backdrop.

The literature on measuring innovation at the regional level is reviewed by Szopik-Depczyńska *et al*. (2020). The authors stress that the regional policy of the European Union has long encouraged innovation in its member states. Numerous programs and initiatives that have structural funding co-funded their aims and measures do this (Antonescu, 2023; Gupta, Nagar and Srivastava, 2024; Poudel and Joshi, 2020). Significant advancements in science and industry have resulted from this. It implies, in particular, that many jobs have been created, living conditions and quality of life have improved, and technologies that limit material and energy consumption have been put into place, allowing for cleaner and more socially responsible production (Dziallas and Blind, 2018). Nevertheless, models in regional innovation structures continue to be varied, non-linear, and complicated despite significant costs and effort. This is the primary reason why policies, vision, and governance of development in European areas need to be continuously evaluated by researchers and society, particularly in the area of innovation development and implementation, according to Szopik-Depczyńska *et al*. (2020). It is also the cause of the widespread popularity among scientists and business professionals of the findings of different kinds of innovation level rankings that have been published for years (e.g., Global Innovation Index, European Innovation Scoreboard, and Regional Innovation Scoreboard).

It is important to note, however, that these rankings evaluate the degree of innovation (or innovativeness) of, say, nations or global regions. This discourse is mainly in terms of mean values derived from a chosen set of indicators that are typically split into multiple groups, such as financial resources, human resources, employment impact, or sales impact (Mykolaichuk, Pozniakovska and Hudenko, 2025). This is a popular method for examining the degree of innovation in different socioeconomic items. However, it can lead to inaccurate findings, especially when there is significant variation among the several sectors that are typically taken into account when assessing innovation level (Nekhai, Melnyk and Bilyk, 2024). The primary objective of various types of innovation programs and strategies is to strive for high results in each of these areas at the same time (Krysovatyy *et al*., 2025; Mirea and Nistoreanu, 2021). But at the same time, it is normal for surveyed countries or regions to be significantly diverse in this regard. For instance, high results regarding financial or human resources may not correlate with high results regarding patents obtained or sales and exports of innovative products. This explains the significance of research and analysis, which aims to analyse the underlying structure of the innovation in addition to creating rankings of its level of innovation.

Some scholars investigate the so-called “regional paradox of innovation” (Ng, 2013). This paradox describes the apparent inconsistency between the need for more investment in innovation in lagging regions and their reduced ability to accept public funds designated for innovation promotion in comparison to more developed regions. This geographical paradox demonstrates how government, corporate, and scientific spending on R&D have strong complementarities, while innovation and industrial policies typically have opposing effects.

According to several academics, the creation of a policy of smart specialization is one of the key elements influencing the growth of innovations. In particular, McCann and Ortega-Argilés (2014) address the relationship between innovations and smart specialization from a regional viewpoint, pointing out that the way the topic of smart specialization is

approached also depends on the economic peculiarities of the region (Pasichnyi, Bykova and Nekhai, 2024). There is therefore no single (uniform) smart specialization template that can be applied to every area. To identify their own best practices and solutions, regions must operate within their governance framework and experience.

In contrast to local technological specificities, Camagni and Capello (2017) discuss the need to move past the oversimplified division between the European Union's core and its periphery, between an advanced "research area" (the core) and a "co-application area" of general-purpose technologies (the periphery) (Pavlovskyi, Blikhar and Karpa, 2024). They stress that to create "smart innovation" policies, "innovation patterns" must be identified. For every regional innovation model, they suggest innovation policies.

The increasing significance of "social learning" in regional innovation networks is highlighted by Sol, Beers and Wals (2013). In the framework of regional development, they view it as a crucial precondition for sustainable development. A new method for assessing the performance of Italian regions that takes into consideration the growth of a sustainable industrial environment is presented by Arbolino *et al*. (2018).

Stronger metropolitan-scale concentration is increasingly linked to the global spread of technological growth. It is possible to view these tendencies as complementary rather than interchangeable. Images of a concentrated dispersion or a globalized hub-to-hub (or hotspot-to-hotspot) system are the best ways to depict this new geography (Poliova, Polova and Stepanenko, 2024). Through a spiky geography of knowledge creation and a global network of these spikes or hubs, the world system of innovation connects national and regional systems of innovation and global firms. In terms of knowledge creation and diffusion, many of these hubs are more connected to one another than to their respective national hinterlands.

The above concerns are highly relevant for Ukraine now, both in terms of the country's unequal regional development since gaining independence and in terms of ongoing war, which led to a cardinal restructure of performance and innovativeness of Ukraine's regions (Pyatnychuk, Vengerskyi and Pershko, 2024). The war in Ukraine had a severe impact on the region's inventive and industrial development, exacerbating the structural issues of technological backwardness in firms. At the same time, for the western regions of the country, which were not affected by the hostilities, new unprecedented opportunities for innovative development are opening up, including within the framework of international cooperation. Innovative development of the regions of Ukraine during the war is a complex and multifaceted topic that requires an integrated approach (Serhieiev, Voronina and Rovynska, 2025). Regional innovative development can help not only to support economic activity in war conditions, but also to form new, sustainable development models after the war ends. In this context, the study of existing models and vectors of innovative regional development of countries is an urgent scientific task.

Methodology

This study was conducted within a constructivist paradigm, as the challenges associated with innovative growth in regions are complex and often contradictory, and there is a notable lack of integrative research in this domain. The emphasis on how areas are

socially created is a defining feature of the modern regional geography paradigm. Although there is a lot of discussion over how to conceptualize a region, no consensus has been reached (Sydorchuk, Kharechko and Khomenko, 2024). The purpose of this paper is to add to the current conversation. With a particular focus on the conceptualization of the institutionalization of the region based on the heuristic literature review, it analyses the various approaches to region and aims to offer a more complex (though not definitive) theoretical conceptualization of region that should be able to bridge the duality of region. It is addressed as an "animate" phenomenon that is always changing and serves as a resource for regional actors to achieve their specific goals. People may perceive and feel attached to it while further mediating their images of it. "Given" (practice of region), "made" (representation of region), and "perceived" (concept of region) are the three levels of region that must be included in any comprehensive approach to region, according to Semian (2016). We also base on the idea that a region' innovative development ultimately determines the societal production of the region (see Figure 2).

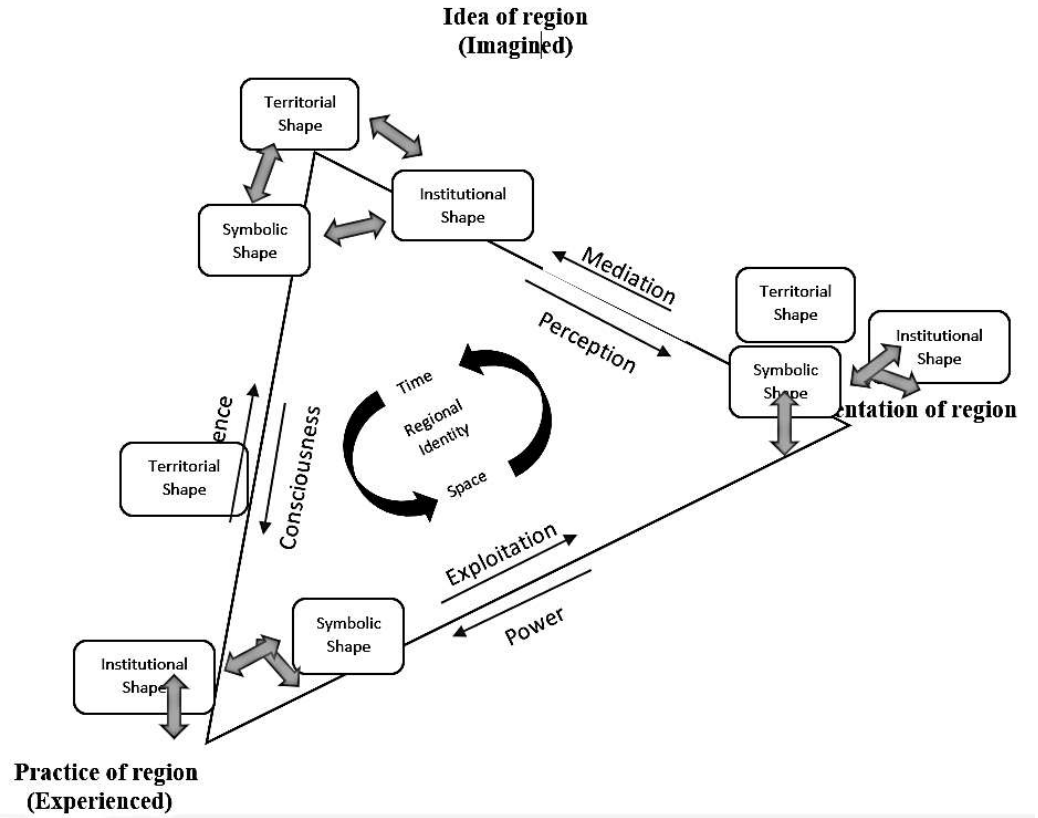


Figure 2: Societal production of region (Semian, 2016)

To explore these ideas empirically, the study uses a two-step qualitative methodology: Scoping Review. We began with an automated search using the Scite platform, which enables the retrieval of sources by scanning a combination of metadata, abstracts, and - where available - full-text content from open-access publications. This initial search yielded 148 sources relevant to the thematic focus of the study. Qualitative Content Analysis: Using elements of grounded theory, the initial set of sources was reviewed to

develop thematic categories. A refined sample of 37 key sources was then selected for in-depth qualitative content analysis. This process allowed us to synthesize diverse perspectives and trace how different theoretical constructs of region and innovation systems intersect in existing literature.

Results and Discussion

Many industrially developed countries that moved to a higher technological level have ensured their economic well-being by transforming regions into innovation-industrial growth points. Their experience shows that they all invest significantly in strengthening the industrial potential of regions, bringing together people, resources, policies, and organizations to transform new ideas using advanced technologies into commercial products and services (Chornyi *et al*., 2025). This trend allows taking advantage of the effects of agglomeration, the concentration of resources in one place, the availability of infrastructure, and favourable conditions for innovative development. A key area of focus in regional innovative development is the promotion of industrial parks - specially designated zones that cluster industrial companies with complementary production processes or services. These parks facilitate the formation of large-scale industrial ecosystems by integrating various segments of the value chain, fostering synergies among firms with shared goals and interests. Through proximity and collaboration, industrial parks reduce logistical costs, support the modernization of enterprises, stimulate the growth of small and medium-sized enterprises (SMEs), and generate employment opportunities. Moreover, industrial parks contribute significantly to local communities by boosting tax revenues for municipal budgets and advancing the development of urban infrastructure (Voronina, Lopushynskyi and Grechanyk, 2024).

Industrial parks have demonstrated their effectiveness in economically developed countries, serving as catalysts for regional innovation and industrial modernization. Their success highlights their potential relevance for Ukraine, particularly in the context of formulating an effective regional innovation and industrial development policy. Given Ukraine's current challenges - including the defence of its national identity and territorial integrity, the loss of substantial human capital, and the destruction or displacement of significant industrial infrastructure - industrial parks may offer a strategic mechanism for economic recovery. By fostering localized industrial regeneration, supporting SMEs, and attracting investment, they can play a pivotal role in rebuilding Ukraine's regional economies and enhancing resilience in post-conflict reconstruction.

During the war in Ukraine, significant changes occurred in the economic and social conditions of the development of its regions. According to the Centre for Economic Recovery, the front-line regions lost 30-40% of GRP from the full-scale invasion, while in the central and western regions, GRP decreased by 10-30% (Kichurchak and Paslavska, 2024). Like the rest of Ukraine, its western regions, although experiencing the negative impact of the war on their economy and environmental situation, managed to preserve their existing scientific, educational, entrepreneurial potential, and human capital. The western regions also became the largest recipients of relocated enterprises. Lviv region received 24%, Zakarpattia region - 15%, Chernivtsi region - 10%, Ivano-Frankivsk region - 8%, Khmelnytskyi region - 7% and Ternopil region - 6% of the total number of such enterprises. About 20% of enterprises took advantage of the relocation

program. Under the influence of the Russian invasion, 80% of regions changed their positions in the regional ranking. Among the top 10 regions of Ukraine with the highest development indicators over the past 2 years, 5 are western regions (Lviv, Chernivtsi, Ivano-Frankivsk, Ternopil, and Volyn regions) (Kichurchak and Paslavska, 2024). Given this, it is advisable to consider regional development models adapted to a wide range of environmental conditions of the environment.

It should be highlighted that, despite the fact that creative activity is expanding around the world, there are powerful agglomeration dynamics at work that cause innovators, innovative businesses, and innovative institutions to cluster. In greater agglomerations, researchers are more productive (Moretti, 2019). In the sense that those patents cite earlier patents from an odd variety of technology classes, innovation produced in larger, more diverse agglomerations is typically more unconventional (Berkes and Gaetani, 2021). Agglomeration effects boost overall productivity in addition to encouraging innovation. According to one estimate, tripling job density in Europe would have a 5% impact on productivity (Kijek, Kijek and Matras-Bolibok, 2023). R&D investment has very concentrated impacts; for example, doubling R&D spending in a region is thought to boost innovation outputs in that area by 80-90%, whereas spillover effects within a 300 km radius are only predicted to be 2-3% (Kijek, Kijek and Matras-Bolibok, 2023).

University graduates and workers in science, engineering, and technology are concentrated in the same areas as innovative activity (Davis and Dingel, 2019). This is consistent with a concentration of skilled positions, especially in skilled service jobs, from small and medium-sized counties into several major cities in the United States. Evidence of both transnational and interregional movement of inventors in particular and graduates in general toward creative locations supports this picture and strengthens their advantage over underdeveloped regions (Iammarino and Marinelli, 2015).

Among the centripetal pressures that draw agents to crowded labour markets are localized networks (Kranjac and Salom, 2023). Different levels of "embeddedness" can be defined as the strength, type, quality, and breadth of ties inside the network. This promotes knowledge dissemination and improves group learning in clusters. According to De la Roca and Puga (2017), these effects directly favour the skilled, who can profit from learning and experience premiums by being in the geographic hotspots where networks are deep and their critical nodes are centred (Zayats, Serohina and Mazalov, 2024). Although workers in a variety of occupations used to profit from the city-size premium, data suggest that only skilled people now do so, which has led to a sharp increase in the geographic disparity in skilled workers' wages and a widening of wage inequalities within cities (Autor, 2019). The labour supply affects how inventive agglomerations form. "Social filters" can be used to describe the local population's attributes that are important to the local innovation system, including skill endowments, employment rates, and demography. Both in the US and the EU, they have been shown to affect regional innovativeness. Additionally, they influence choices about where to invest, demonstrating that companies recognize the value of these regional resources (Crescenzi, Pietrobelli and Rabellotti, 2016).

Social innovations also represent important discourse. The research by Morgan and Henderson (2023) focuses on new models of innovations for old industrial regions. This

work is particularly interesting in light of the new impetus for industrial regions of Eastern, Central, and Southern Ukraine, some of which were severely impacted by hostilities and suffered from infrastructure destruction and human capital loss. According to the authors, scholarly and policy discourses have recently started to take a much more comprehensive approach to innovation, taking into account social and ecological forms of innovation. These advancements may present more opportunities for innovation as a place-based process that respects the demands of the economy, society, and environment in former industrial areas. Three such models - of social innovation, mission-oriented innovation, and foundational economy, are examined by Morgan and Henderson (2023).

The concept of social innovation highlights how innovation can be used to meet societal goals and unmet and recognized needs. It highlights how social innovation can help find answers to major problems like population growth, climate change, and health and well-being. It suggests socially innovative practices that produce socially just results by fostering community development and coming up with new solutions in cross-border learning communities; establishing broader collaborative networks; and questioning established social institutions through this cooperative action (Zilinska, Avedyan and Kyrychenko, 2022). This emphasizes social innovation's discursive character while also highlighting its capacity to yield revolutionary results. S&T and social innovation are said to have a potentially complementary role to play in addressing system-wide challenges like modernizing public services and promoting societal well-being, despite the fact that some authors view social innovation as a separate type of innovation (Coenen, Moodysson and Martin, 2015; Moulaert and Mehmood, 2020). An important step in educating (European) regional organizations about the relevance of social innovation is the inclusion of social innovation in the official guidelines for smart specialization. Social innovation advocates have urged for bottom-up action to allow communities to respond to marginalization and deprivation while guaranteeing their benefits, even though the implementation alternatives are unclear. In order to ensure revolutionary change, scaling up and spreading best practices beyond these small-scale projects is another policy challenge.

It is also expedient to mention the concept of 'mission'. Mission-oriented innovation policy has become a particular model to address long-term social difficulties as well as those associated with ecological and economic challenges, even though the policy alternatives for social innovation are still immature. These missions, like the Apollo Mission and the Manhattan Project, were first developed in response to technological difficulties. The concept of missions has been expanded in more recent work to encompass environmental degradation, climate change, health, and welfare. The following characteristics can be used to describe missions (Morgan and Henderson, 2023):

- Bold, motivating, with broad societal impact;
- A definite direction: focused, measurable, and time-bound;
- Research and innovation initiatives that are both ambitious and practical;
- Innovation that is multidisciplinary, multisectoral, and multi-actor;
- Diverse, bottom-up solutions.

In addition to increasingly decentralized governance structures, the mission-oriented approach to great issues necessitates the participation of numerous actors, public,

private, and non-profit organizations, and users. Compared to previous technological missions, this is a more intricate and unstructured process (Wanzenböck *et al*., 2020). Collaboration across several policy agendas and administrative borders is another requirement of mission governance. This demonstrates the intricacy of these missions, taking into account various demands, finances, and strategic direction for action. Although it acknowledges that a diverse portfolio of projects contributing to a mission might help to lessen the risks associated with a single, broad purpose, the inclusion of several interrelated projects within an overall mission further increases this complexity.

Most descriptions of mission-oriented innovation point to the government as being at the forefront. In addition to being a financier, this function can involve a convening role, trust-building, and brokering, as well as a longer-term readiness to accept uncertainty. A significant shift from traditional S&T concepts of the innovation process is represented by the ambitious agenda outlined for mission-oriented innovation policy. This creates revolutionary improvements by addressing the shortcomings of conventional innovation policies. Although mission-oriented innovation policy is often perceived as a top-down endeavour, studies have also demonstrated that missions can develop spontaneously in local communities. In this case, it is serving as the foundation for a "gradual, yet in-depth change in a desired direction| while seeming less dangerous to long-standing interests (Bours, Wanzenböck and Frenken, 2021).

In contrast to mission-oriented innovation policy, the foundational economy is a new paradigm of social innovation that firmly focuses on the sectors of the economy that deal with the daily delivery of goods and services at the local level (Morgan and Henderson, 2023). In addition to material infrastructure, such as pipes and cables delivering gas, electricity, water, and telecommunications, as well as banks, construction, and food, the foundational economy also includes essential services like healthcare, elementary and secondary education, and welfare support. By acknowledging that inwardly invested, high-tech companies may not necessarily transfer advantages back to their local economies, the foundational economy notion undermines conventional, neoliberal policy recommendations for regions. The fundamental economy takes the opposite tack and concentrates on common sectors rooted in the economy and the collective consumption of these goods and services, rather than focusing on top companies. Although innovation may be seen as a component of the conventional industrial policy paradigm, this is a limited understanding of the idea.

Regional differences and specialization are another important point. Reducing regional differences and fostering economic, social, and territorial cohesion are the goals of the European Union's cohesion policy. Funding and assistance for investments in fields like innovation, smart specialization, sustainable development, and the green and digital transition are ways to do this. With initiatives to build ecosystems that support entrepreneurship, R&D, and economic transformation, innovation is a major area of focus. The four primary categories of EU regions are leader, strong, moderate, and modest. If a region deviates from the assigned average level for each group, it is divided into "plus" and "minus" regions to internally distinguish the regions categorized into these groups. This makes it possible to split the regions under study into 12 smaller groups, with three in each major group. Conversely, the regions known as the modest group, which consists of just 23 regions, are the least numerous groups.

The findings of the Regional Innovation Scoreboard (RIS) were utilized in the research conducted by Szopik-Depczyńska *et al*. (2020). The European Innovation Scoreboard (EIS), which evaluates the innovation of European regions, has a regional variant called the RIS. The authors contend that there is still a lack of adequate innovativeness measurement techniques and algorithms. Analyses based on numerous variables that describe different aspects of regional innovation development are the most widely used approach. The average outcome for a certain location, determined using partial indicators, is typically the ultimate conclusion. However, over-generalization may emerge from averaging fragmentary results. In reality, different places frequently yield wildly disparate outcomes in different domains. Because of groups of indications, it is frequently vital to search for regions that are comparable to one another. Analysis of the current study's findings reveals that the areas that we typically think of as the greatest are comparable to those that do marginally worse. In this instance, the internal structure of the degree of innovation in a region is far more diverse than would appear from conventional studies in this field. Dividing the indicators into five distinct sections and looking for regional similarities while taking each region's results into account individually are crucial in this case. The use of the mean value as a measure of innovativeness may result in the classification of objects as average if they have extreme values (a low value of one or a group of indicators and higher values of the remaining ones). This allows for the resolution of one of the most commonly mentioned limitations in the literature: the joint analysis of a set of indicators.

However, smart specialization is a customized road plan that assists each EU region in identifying its strengths and then equips it with the resources to excel in those areas. This idea emphasizes the distinctiveness of European regions and aids them in creating their formula for success, which is in line with the place-based approach of the Cohesion policy.

Using each region's natural capabilities and encouraging cooperation between companies, academic institutions, government agencies, and civil society are key focuses of Smart Specialization Strategies (S3). By employing a bottom-up strategy, the EU empowers regions to develop and implement their innovation plans that meet local knowledge and international market needs. Smart Specialization, emphasizing the interconnections between entrepreneurship, skill development, and research and development, seeks to foster a dynamic and cohesive European economy. This strategic approach aims to leverage regional strengths and promote innovation, thereby enhancing competitive advantages across diverse sectors. Additionally, choosing winners does not impose priorities. Rather, an inclusive, multi-level, and collaborative process is used to choose the strategy. In this manner, both public and private stakeholders can offer their opinions on the best course of action while taking into account the particular circumstances of their area, its socioeconomic makeup, and its history.

Through an Entrepreneurial Discovery Process, S3 looks for activities that have the potential to demonstrate a distinct competitive edge. Collaboration between stakeholders at all levels of governance and priority-setting is essential to this process. With current crises requiring ongoing stakeholder engagement throughout implementation, this governance method is being strengthened over the 2021-2027 programming period (Di Cataldo, Monastriotis and Rodriguez-Pose, 2022).

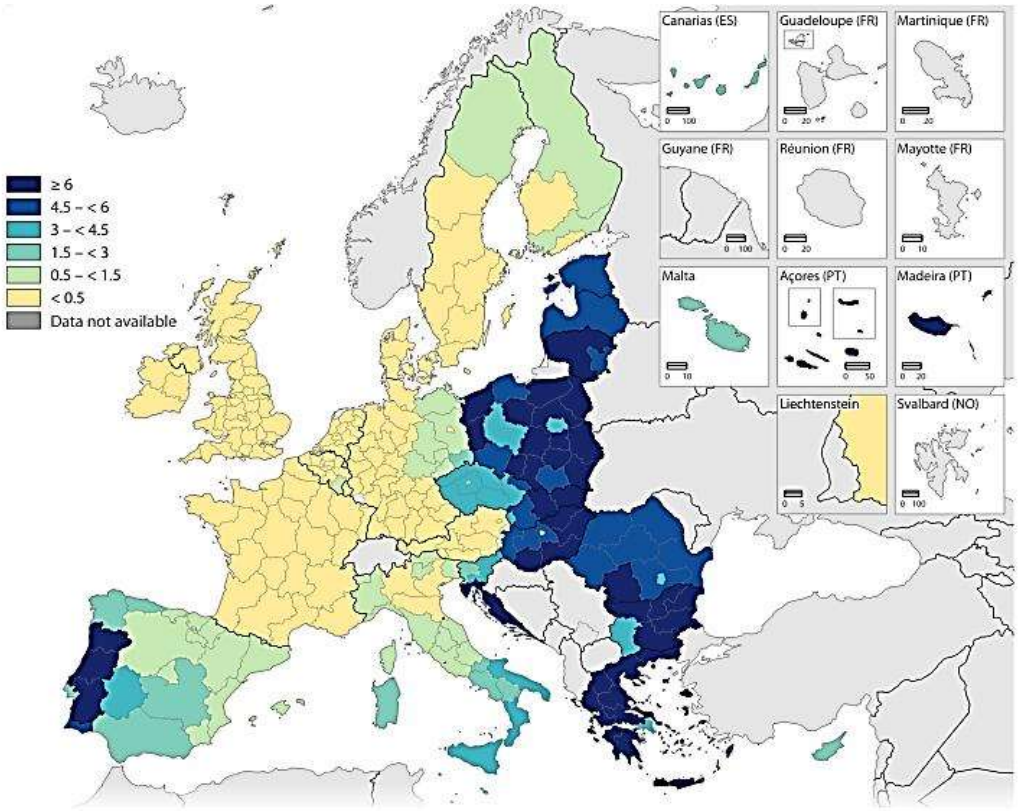
An example of these beneficial collaborations can be found in Puglia, Italy, where EU funding allowed Tersan 3, a company, to initiate and grow its operations. Tersan elevates the circular economy and waste reduction concepts to a whole new level. Its activity, which is firmly grounded in science, refines organic waste to produce natural fertilizers for farming while redistributing clean energy from the industrial process's by-product back into the local grid. It has been able to expand, refine its procedure, and employ personnel for research and development to produce customized fertilizers for various crops, thanks to EU funding (Gancarczyk, Ujwary-Gil and Gonzalez-Lopez, 2021). Another example is Slovakia, which is leading the way in developing early warning systems for neurological disorders thanks to €978,000 in EU funding. A project in Bratislava is transforming the diagnosis of Alzheimer's disease. The research created software and applications to identify several forms of cognitive impairment, including Alzheimer's, by examining speech patterns. This discovery allows for early treatment and slows the progression of the disease. The project's output includes the BRAINTEST app, which evaluates IQ, memory, and attention, as well as an app called EWA that is specifically designed for Alzheimer's patients. Instead, the Kaunas-based company Inno Hemp is poised to transform single-use packaging manufacturing in Lithuania, spearheading the transition from plastics to biodegradable hemp fiber. Although hemp bioplastic is not a novel technology in and of itself, Inno Hemp expands its potential with circular economy solutions with the aid of about €28 million in EU financing (Gancarczyk, Ujwary-Gil and Gonzalez-Lopez, 2021).

The evaluation of the 2014-2027 Cohesion Policy reveals a favourable, albeit variable, effect on both net contributor nations and the regions that receive assistance. The positive effects are partly due to spillover, a phenomenon where initiatives in one region of the EU also benefit other regions, especially those with strong trade links to the main beneficiaries. The findings indicate that when the beneficial effects of the 2014-2027 reforms peak in 2030, the coefficient of variation, which gauges the degree of regional variations in GDP per capita, declines by roughly 3%. The effect of the Cohesion strategy 2014-2027 on the regional GDP in 2030 for NUTS2 (Nomenclature of Territorial Units for Statistics) is depicted in figure 3.

Statistical analyses of Smart Specialisation Strategies (S3) reveal two key trends simultaneously. First, most regions have concentrated on "relevant" economic domains - those closely aligned with their existing industrial strengths and areas of specialization. This path-dependent approach reflects a pragmatic alignment of innovation policies with local capacities. Second, however, there has been a notable proliferation of specializations across the European Union, with a significant number of regions selecting an extensive array of domains. This has resulted in considerable overlap in specializations across territories, thereby diluting distinctiveness and potentially undermining the comparative advantage principle intended by S3 frameworks (Di Cataldo, Monastriotis and Rodriguez-Pose, 2022).

Governance is fundamental to innovation districts, influencing how choices are made, resources are distributed, and collaborations are overseen, as evidenced by the experience of innovations in underdeveloped areas and districts in the United States. Collaboration must change from unofficial collaborations to more official agreements as innovation districts develop. Innovation districts must continue to be flexible in response

to shifting community demands, economic conditions, and technological advancements. Innovation districts flourish as urban centres that include businesses, research, and public areas. Of these, governance is arguably the most essential since it encompasses the laws, regulations, and practices that facilitate efficient decision-making, teamwork, and eventually sustainable development. Research indicates that up to 50% of company ecosystems fail due to governance concerns, even though they are thought to be crucial for success by guaranteeing that money, resources, and assets are optimized (Kranjac and Salom, 2023).



Impact of Cohesion policy 2014-2027 on NUTS 2 regional GDP in 2030 (% variation with respect to the baseline - a scenario without cohesion policy investment).

Figure 3: Impact of Cohesion policy 2014-2027 on NUTS2 regional GDP in 2030 (European Commission, 2024)

Strong public-private sector cooperation can leverage investment, regenerate inner cities, build on industrial legacy, and diversify the economy, as demonstrated by Detroit's Gratiot Site Innovation District and Michigan Central. From Henry Ford Health's $1.5 billion campus expansion to Bedrock's 14-acre innovation zone centred on life sciences, which is scheduled to open in 2027, the region has drawn substantial investment. In order to increase public trust, a robust community supports this development focus in the six nearby areas and data transparency initiatives. The Media and Innovation District in Diriyah, Saudi Arabia, is undergoing rapid development. It uses a dual governance approach to organize commercial development and draw in foreign investment while maintaining local heritage, a high standard of living, and community and labour market

outcomes linked to the Kingdom's Vision 2030 and a larger 14-kilometer-square masterplan. The neighbourhood, which will include more than 250,000 square meters of office space in addition to residential and retail space, represents an early activation of the innovation ecosystem. The successful implementation of the innovative life cycle stages in a district or region requires the following sequence:

1. Establishing an innovation region/district. Simplicity and agility are critical for resiliency and ensuring partners see value in an innovation district. Mutual benefit and vision must be defined at the outset, especially when investors determine that an innovation district is the best development option over competing investment goals. Governance must be examined both internally and externally; clear and robust internal corporate structures are required to maintain investor confidence, whilst external community participation fosters local support and feedback. Community participation, transparency, and trust are important to innovation districts' long-term success and growth.
2. Maintaining momentum. Initial partnership energy can wane over time as partners become absorbed with their business needs. Focus and a competitive advantage are required to maintain partner alignment and participation incentives. Effective outcome tracking is critical to sustaining interest, reaping broader regional benefits, and staying within innovation district limits. Beyond occupancy rates and land value, new evaluation metrics are required to account for technological advancements, labour market shifts, and local variations.
3. Scale and evolution. Avoiding mission drift is critical as innovation districts grow and include additional partners. Partners need both formal and informal relationships, along with mutual motivations, to effectively collaborate toward a common goal. In line with this, self-sustaining finance arrangements must be established to create a long-term effect, leverage multi-partner investment, and prevent one-time public sector handouts. As innovation districts mature, stakeholders must address technological obsolescence while remaining focused on a new frontier of prospects from many viewpoints.

Many Ukrainian cities and settlements experienced hostilities and occupation that somehow resemble American Detroit at the beginning of the 21st century. Over the last 60 years, Detroit has gone through a terrible period of extraordinary urban contraction. Abandoned buildings and significant household vacancies have transformed numerous Detroit neighbourhoods into ghost towns. However, place-based revitalization strategies implemented in recent years by coalitions such as the Live6 Alliance[1]Combined with Greenways infrastructure and investments by Fortune 500 firms, it promises to turn a new leaf in Detroit's socioeconomic history. With proper municipal monitoring, there are grounds to be cautiously optimistic that the advantages of the recent surge of investment will be spread equally. For a truly equitable recovery, large enterprises' investments are insufficient; small businesses must also grow and profit from new economic prospects. Non-profit organizations, such as Live6 Alliance, are giving critical networks, information expertise, and even implementation assistance to small businesses seeking to repopulate vacant commercial corridors. These collaborations are essential for a more equitable distribution of socioeconomic benefits. The recent inflow of

[1] https://www.live6detroit.org/

investment in downtown districts, particularly through Bedrock Companies, has resulted in a socioeconomic separation between Detroit's core and outlying neighbourhoods. Community leaders and city stakeholders can form coalitions to reduce unfairness by offering resources to small enterprises that would otherwise be inaccessible. This experience can be successfully applied to the innovative development of Ukraine's currently poor regions.

The experience in Detroit illustrates a blend of mission-oriented and foundational economy strategies, focusing on targeted investments in public goods and the revitalization of essential economic infrastructures. In contrast, the EU's Cohesion Policy aligns more closely with a social innovation approach, focusing on inclusive development, capacity building, and community-based problem-solving. While both approaches have yielded tangible outcomes in their respective contexts, their divergence highlights the critical importance of a highly customized, place-based vision for regional development. This underscores the necessity of tailoring innovation and development strategies to the unique institutional, socio-economic, and cultural characteristics of each region.

Conclusion

From a policy perspective, this paper argues that one of the most significant challenges lies in fostering effective cooperation across territorial scales - from local to national and supranational levels. Place-based policies are designed to be sensitive to the unique and often nuanced conditions of less-developed regions, leveraging both explicit and latent assets of regional actors while incorporating local knowledge into development strategies. However, the study concludes that standardized methodological approaches, particularly those relying on multiple variables grouped into broad categories, often fail to capture the complexity of regional innovation dynamics. The study advocates for an alternative, differentiated perspective - one that moves beyond uniform models and embraces context-specific configurations - to yield more accurate and actionable insights into regional innovation processes.

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Authors' Declarations and Essential Ethical Compliances

Authors' Contributions (in accordance with ICMJE criteria for authorship)

Contribution	*Author 1*	*Author 2*	*Author 3*	*Author 4*	*Author 5*	*Author 6*
Conceived and designed the research or analysis	Yes	No	Yes	Yes	No	No
Collected the data	No	No	Yes	Yes	Yes	Yes
Contributed to data analysis and interpretation	Yes	Yes	No	No	No	No
Wrote the article/paper	Yes	Yes	No	No	No	No
Critical revision of the article/paper	No	Yes	No	Yes	No	No
Editing of the article/paper	No	Yes	Yes	No	Yes	Yes
Supervision	No	No	Yes	Yes	Yes	Yes
Project Administration	Yes	No	Yes	No	No	No
Funding Acquisition	No	No	No	No	No	No
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Research involving human bodies or organs or tissues (Helsinki Declaration)
The author(s) solemnly declare(s) that this research has not involved any human subject (body or organs) for experimentation. It was not clinical research. The contexts of human population/participation were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of Helsinki Declaration does not apply in cases of this study or written work.

Research involving animals (ARRIVE Checklist)
The author(s) solemnly declare(s) that this research has not involved any animal subject (body or organs) for experimentation. The research was not based on laboratory experiment involving any kind animal. The contexts of animals were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or ethical obligation of ARRIVE does not apply in cases of this study or written work.

Research on Indigenous Peoples and/or Traditional Knowledge
The author(s) solemnly declare(s) that this research has not involved Indigenous Peoples as participants or respondents. The contexts of Indigenous Peoples or Indigenous Knowledge were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or prior informed consent (PIC) of the respondents or Self-Declaration in this regard does not apply in cases of this study or written work.

Research involving Plants
The author(s) solemnly declare(s) that this research has not involved the plants for experiment and field studies. Some contexts of plants are also indirectly covered through literature review. Thus, during this research the author(s) obeyed the principles of the Convention on Biological Diversity and the Convention on the Trade in Endangered Species of Wild Fauna and Flora.

Research Involving Local Community Participants (Non-Indigenous) or Children
The author(s) solemnly declare(s) that this research has not directly involved any local community participants or respondents belonging to non-Indigenous peoples. Neither this study involved any child in any form directly. The contexts of different humans, people, populations, men/women/children and ethnic people were only indirectly covered through literature review. Therefore, an Ethical Clearance (from a Committee or Authority) or prior informed consent (PIC) of the respondents or Self-Declaration in this regard does not apply in cases of this study or written work.

PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses)
The author(s) has/have NOT complied with PRISMA standards. It is not relevant in case of this study or written work.

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