

UNIVERSITY INNOVATION CENTERS AS CATALYSTS OF REGIONAL INNOVATION AND DEVELOPMENT

CENTROS DE INOVAÇÃO UNIVERSITÁRIOS COMO CATALISADORES DA INOVAÇÃO E DO DESENVOLVIMENTO REGIONAL

CENTROS DE INNOVACIÓN UNIVERSITARIOS COMO CATALIZADORES DE LA INNOVACIÓN Y DEL DESARROLLO REGIONAL

Sergio Tenorio dos Santos Neto¹, Adriano Carlos Moraes Rosa², Rosinei Batista Ribeiro³, Mauro Hugo Mathias⁴

DOI: 10.54899/dcs.v22i85.3856

Recibido: 22/11/2025 | Aceptado: 25/11/2025 | Publicación en línea: 15/12/2025.

ABSTRACT

University Innovation Centers have emerged as strategic structures for strengthening regional innovation ecosystems by bridging universities, firms, governments, and society. Nevertheless, their full integration into these ecosystems remains limited due to institutional, cultural, and territorial constraints. This study aims to analyze the relevance of University Innovation Centers through a systematic literature review, identifying theoretical evidence of their importance and proposing a multidimensional synthesis of their roles and contributions. The research employed a structured systematic review organized into three thematic axes: university innovation centers, innovation ecosystems, and university, industry and society collaboration. The search was conducted in the Scopus database, considering publications in English between 2005 and 2025. From 1,100 initial studies, the 30 most cited and the 30 most recent articles from each axis were selected, enabling the integration of both classical works and emerging trends. These studies were examined in detail to extract elements that could inform the present analysis. The results reveal sixteen factors that demonstrate the relevance of University Innovation Centers, grouped into five analytical dimensions: Institutional and Governance; Relational and Collaborative; Territorial and Regional Development; Scientific, Technological and Innovation; and Strategic and Systemic Integration. These dimensions highlight the role of such centers in knowledge transfer, the promotion of academic entrepreneurship, the strengthening of collaborative networks, the reduction of regional asymmetries, and the enhancement of institutional resilience and internationalization. Persistent challenges include bureaucratic constraints, limited governance structures, and weak collaborative cultures. The study concludes that University Innovation Centers possess strong potential to energize regional innovation ecosystems. By systematizing

¹ PhD in Mechanical Engineering, Universidade Estadual Paulista Júlio de Mesquita Filho (UNESP), Guaratinguetá, São Paulo, Brazil. E-mail: sergio.tenorio@unesp.br Orcid: <https://orcid.org/0000-0003-4165-5540>

² PhD in Production Engineering, Universidade Federal de Itajubá (UNIFEI), Itajubá, Minas Gerais, Brazil. E-mail: adriano.rosa@fatec.sp.gov.br Orcid: <https://orcid.org/0000-0001-6920-5993>

³ PhD in Engineering, Universidade Estadual Paulista Júlio de Mesquita Filho (UNESP), Guaratinguetá, São Paulo, Brazil. E-mail: rosinei.ribeiro@cpspos.sp.gov.br Orcid: <https://orcid.org/0000-0002-2150-4561>

⁴ PhD in Mechanical Engineering, Universidade Estadual Paulista Júlio de Mesquita Filho (UNESP), Guaratinguetá, São Paulo, Brazil. E-mail: mauro.h.mathias@unesp.br Orcid: <https://orcid.org/0000-0001-8593-1231>

dispersed evidence and proposing a multidimensional perspective, this research contributes to managers, scholars, and policymakers dedicated to fostering scientific and regional development.

Keywords: Academic Entrepreneurship. Knowledge Transfer. University Governance. Regional Development. Sustainability.

RESUMO

Os Centros Universitários de Inovação têm se destacado como estruturas estratégicas para fortalecer os ecossistemas regionais, articulando universidades, empresas, governos e sociedade. Contudo, sua integração plena a esses ecossistemas permanece limitada por fragilidades institucionais, culturais e territoriais. Este estudo tem por objetivo analisar a relevância destes Centros de Inovação a partir de uma revisão sistemática da literatura, identificando evidências teóricas de sua importância, culminando com a proposição de uma síntese multidimensional de sua atuação e relevância. A pesquisa adotou uma revisão sistemática estruturada em três eixos: centros universitários de inovação, ecossistemas de inovação e cooperação universidade, indústria e sociedade. A busca foi realizada na base Scopus, considerando publicações em inglês entre 2005 e 2025. A partir de 1100 estudos identificados, foram selecionados os 30 artigos mais citados e os 30 mais recentes de cada eixo, permitindo integrar obras clássicas e tendências emergentes. Estes trabalhos foram minuciosamente estudados a fim de serem extraídos elementos que pudessem compor o presente estudo. Os resultados apontam dezesseis fatores que evidenciam a relevância dos Centros de Inovação Universitários, organizados em cinco dimensões analíticas: Institucional e de Governança; Relacional e Colaborativa; Territorial e de Desenvolvimento Regional; Científica, Tecnológica e Inovadora; e Estratégica e de Inserção Sistêmica. Tais dimensões destacam o papel desses Centros de Inovação na transferência de conhecimento, estímulo ao empreendedorismo acadêmico, promoção de redes colaborativas, redução de assimetrias regionais e fortalecimento da internacionalização e da resiliência institucional. Persistem desafios relacionados à burocracia, governança limitada e baixa cultura colaborativa. Conclui-se que os Centros Universitários de Inovação possuem elevado potencial para dinamizar ecossistemas de regionais. Ao sistematizar evidências dispersas e propor uma visão multidimensional, o estudo contribui com gestores, pesquisadores e formuladores de políticas voltadas ao desenvolvimento científico e regional.

Palavras-chave: Empreendedorismo Acadêmico. Transferência de Conhecimento. Governança Universitária. Desenvolvimento Regional. Sustentabilidade.

RESUMEN

Los Centros Universitarios de Innovación se han destacado como estructuras estratégicas para fortalecer los ecosistemas regionales, articulando universidades, empresas, gobiernos y sociedad. No obstante, su plena integración en dichos ecosistemas sigue siendo limitada debido a fragilidades institucionales, culturales y territoriales. Este estudio tiene como objetivo analizar la relevancia de estos Centros de Innovación a partir de una revisión sistemática de la literatura, identificando evidencias teóricas sobre su importancia y culminando en la propuesta de una síntesis multidimensional de su actuación y relevancia. La investigación adoptó una revisión sistemática estructurada en tres ejes: centros universitarios de innovación, ecosistemas de innovación y cooperación entre universidad, industria y sociedad. La búsqueda se realizó en la base Scopus, considerando publicaciones en inglés entre 2005 y 2025. De los 1.100 estudios

identificados, se seleccionaron los 30 artículos más citados y los 30 más recientes de cada eje, lo que permitió integrar obras clásicas y tendencias emergentes. Estos trabajos fueron analizados minuciosamente con el fin de extraer elementos que pudieran componer el presente estudio. Los resultados señalan dieciséis factores que evidencian la relevancia de los Centros Universitarios de Innovación, organizados en cinco dimensiones analíticas: Institucional y de Gobernanza; Relacional y Colaborativa; Territorial y de Desarrollo Regional; Científica, Tecnológica y de Innovación; y Estratégica y de Inserción Sistémica. Dichas dimensiones resaltan el papel de estos Centros en la transferencia de conocimiento, el fomento del emprendimiento académico, la promoción de redes colaborativas, la reducción de asimetrías regionales y el fortalecimiento de la internacionalización y la resiliencia institucional. Persisten desafíos relacionados con la burocracia, la gobernanza limitada y la baja cultura colaborativa. Se concluye que los Centros Universitarios de Innovación poseen un alto potencial para dinamizar los ecosistemas regionales. Al sistematizar evidencias dispersas y proponer una visión multidimensional, el estudio contribuye a gestores, investigadores y formuladores de políticas orientadas al desarrollo científico y regional.

Palabras clave: Emprendimiento Académico. Transferencia de Conocimiento. Gobernanza Universitaria. Desarrollo Regional. Sostenibilidad.



Esta obra está bajo una [Licencia Creative Commons Atribución- NoComercial 4.0 Internacional](https://creativecommons.org/licenses/by-nc/4.0/)

INTRODUCTION

In the contemporary global context, characterized by increasing digital connectivity, innovation has emerged as a critical strategic driver for sustainable regional development (Miller *et al.*, 2021). Within this framework, University Innovation Centers (UICs) assume a pivotal role, functioning as platforms that integrate universities, firms, governments, and civil society in accordance with triple and quadruple helix models. Beyond serving as environments for teaching, research, and outreach, these centers operate as organizational connectors capable of translating knowledge into applied solutions with substantial regional and global impact (Youtie & Shapira, 2008).

The literature on entrepreneurial universities and innovation ecosystems indicates that, in addition to their traditional functions, universities have been expanding their activities toward the so-called third mission, which encompasses technology transfer, business incubation, and the maximization of interactions with the productive sector (Link & Sarala, 2019; Gueguen & Delanoe-Gueguen, 2021). Studies such as Siegel *et al.* (2008) suggest that universities can act as levers for entrepreneurship, highlighting the importance of university ecosystems as

arrangements capable of transforming knowledge into economic and social development. In this context, the geographical proximity between universities and firms may facilitate knowledge transfer among key actors within regional innovation ecosystems (Abramovsky & Simpson, 2008; Frenken, Van Oort, & Ponds, 2010). However, according to Hausman (2022), proximity alone is insufficient for effective integration in the absence of robust and adequately equipped institutional structures.

Given this scenario, strategic opportunities arise from partnership creation, open innovation, and alignment with the Sustainable Development Goals (SDGs), positioning UICs as central actors in scientific advancement and regional competitiveness (Zaidan *et al.*, 2024; Blazquez *et al.*, 2025). The aim of this study is to demonstrate, based on the scientific literature, the importance of UICs for strengthening regional ecosystems, drawing parallels between their significance and existing opportunities.

From a scientific perspective, this study contributes to the advancement of knowledge by: (a) expanding the theoretical understanding of the role of UICs in connecting universities, firms, governments, and society; and (b) identifying theoretical elements that demonstrate the relevance of UICs for regional ecosystems. Practically, this study provides relevant insights for managers and policymakers by highlighting pathways to strengthen the integration between academia and regional ecosystems. Accordingly, the proposed analysis seeks to contribute to the construction of an analytical framework that assists researchers and managers in rethinking strategies and mechanisms necessary for UICs to consolidate as key actors in the global dynamics of regional ecosystems.

THEORETICAL FRAMEWORK

Innovation is a driving force of economic growth and a structural element for nations (Gulbranson & Audretsch, 2008). In this context, innovation developed within universities can support and enhance regional ecosystems (Al Kharusi & Al Kindi, 2018; Yi & Long, 2021; Yildirim *et al.*, 2022). Universities act as key promoters of innovation by generating knowledge and facilitating technological transfer, thereby fostering development and creating the foundations for economic growth (Asgari *et al.*, 2023; Chen *et al.*, 2024; Medina-Tabares *et al.*, 2025).

They operate as structuring mechanisms, particularly when aligned with institutional policies and territorial knowledge networks (Ugnich *et al.*, 2016; Tseng *et al.*, 2020), which makes them essential for the social, economic, and technological development of the regions in which they are embedded (Smith, 2007). University innovation environments can foster strategic partnerships between universities and key actors within innovation ecosystems (Abramovsky & Simpson, 2011), thereby equipping public authorities and firms with solutions and tools that improve their performance and competitiveness (Tseng *et al.*, 2020).

To fulfill these functions, universities act through intermediary organizations such as innovation centers, hubs, or technology transfer units. These structures are fundamental for implementing initiatives and building interactions between universities and society. Moreover, they assume the role of agents of social, economic, and technological development, positively influencing the areas surrounding universities (Yeo, 2018; Wu *et al.*, 2022; Gao *et al.*, 2023). Their effectiveness can be further strengthened by policies that integrate teaching, research, and outreach with innovative practices, which underscores the importance of university and public managers in developing innovation-oriented programs (Yildirim *et al.*, 2022; Yi & Long, 2021; Medina-Tabares *et al.*, 2025).

In addition to formal programs, university innovation requires sensitivity to socio-territorial contexts and their local demands. Universities must therefore understand these contexts and commit to regional needs by articulating with governments, companies, and society to orient their research and outreach activities toward concrete demands that align with local expectations. Such articulation supports regionally rooted sustainable development models, particularly in emerging economies (Shakirova *et al.*, 2019; Chen *et al.*, 2024). Public policies and legal frameworks also enhance innovation. The Bayh–Dole Act (1980) and U.S. funding mechanisms are examples, as they strengthened university–industry interaction (Hausman, 2022; Grimaldi *et al.*, 2011).

Universities and their innovation environments act as facilitators by promoting knowledge circulation, strategic partnerships, and innovative projects. These environments function as innovation habitats and collaborative networks (Bellavista & Sanz, 2009; Ar & Baki, 2011; Vázquez-Urriago *et al.*, 2014), offering resources that support teaching, research, and outreach and often leading to the creation of advanced research centers, incubators, or science parks (Díez-Vial *et al.*, 2015; Hobbs *et al.*, 2016; Steruska *et al.*, 2019). The success of university–society interaction through innovation environments depends on institutional, organizational, and

territorial factors and is closely tied to the university's ability to position itself as a source of knowledge (Dooley & Kirk, 2007; Mezger *et al.*, 2018; Hayter *et al.*, 2018). This approach strengthens sustainable innovation and regionally grounded development, creating genuine regional innovation ecosystems (Tsiouris, 2025; Hooli *et al.*, 2024; Xu, Ye & Zhang, 2025). Innovation environments, therefore, possess intrinsic social value, encompassing territorial development and social cohesion (Blazquez *et al.*, 2025).

McAdam *et al.* (2005) argue that the effectiveness of university innovation environments depends on clarity in technology transfer processes, particularly in licensing technologies and creating new ventures. Another central aspect is knowledge spillover, which enhances collaboration and knowledge development (Martín-de Castro *et al.*, 2011). Within this concept, knowledge must flow among the actors engaged in innovation ecosystems, enabling the discovery of new concepts, solutions, products and services, thereby reinforcing another key element: open innovation. At its core, open innovation supports interaction among actors in innovation environments, stimulating the emergence of new ideas and solutions (Davoudi *et al.*, 2018). Bolliger *et al.* (2024) note that innovation environments characterized by diversity of actors and resources inherently exhibit greater integration potential, which facilitates knowledge sharing.

Nnanna *et al.* (2024) argue that innovation environments require adaptive strategies and cooperation among actors, while Mehtälä *et al.* (2025) show that collaborations grounded in social responsibility and sustainability broaden the role of universities, even in peripheral regions. University–industry collaboration drives innovation and creates opportunities for economic development, employment, and income (Ankrah & Al-Tabbaa, 2015). Appropriate organizational structures, incentive policies, and technology transfer programs play a decisive role in building and strengthening partnerships between universities and regional ecosystem actors (Abramo *et al.*, 2009).

Ultimately, clarity in technology transfer processes, licensing, and venture creation depends on the professionalization of management within universities (McAdam *et al.*, 2005). Thus, territorial articulation, effective governance, and the alignment of scientific competencies with regional needs enable universities to consolidate themselves as infrastructures of socioeconomic transformation (Chen *et al.*, 2024).

METHODOLOGY

To achieve the proposed objective, we conducted a systematic literature review focused on identifying, analyzing, and synthesizing scientific evidence related to the role of University Innovation Centers (UICs), their integration with innovation ecosystems, and their relevance to regional ecosystems. We structured the methodological process according to steps inspired by Kitchenham's (2004) approach for systematic reviews and adapted it to the context of this study. First, we defined key search terms and organized them around three central axes: (i) university innovation centers, (ii) innovation ecosystems, and (iii) integration and cooperation among universities, industry, and society.

Using these terms, we searched the Scopus database, which is recognized for its international relevance and multidisciplinary. We selected articles and reviews published in English between 2005 and 2025, identifying 1,100 studies. From this initial set, we applied a second filter by selecting the 30 most cited and the 30 most recent works for each axis, which allowed us to combine classical and well-established studies in the literature with the most current discussions on the topic. This strategy enabled us to build a balanced reference base that integrates high-impact scientific contributions with emerging trends, ensuring greater theoretical depth and practical relevance for understanding the role of UICs and their integration into innovation ecosystems.

After applying this second filter, 180 studies remained. These were submitted to a third selection through critical reading and analysis by the authors, with the aim of identifying works that addressed, directly or indirectly, the topic examined in the present study.

RESULTS AND DISCUSSIONS

The integration of University Innovation Centers (UICs) into regional ecosystems has emerged as a topic of growing academic and strategic relevance, particularly in light of the need for institutional models capable of driving and amplifying regional scientific, economic, and social development. The literature demonstrates that UICs play a structuring role within these ecosystems, acting as organizational intermediaries that coordinate flows of knowledge, social capital, and technological resources among universities, firms, governments, and society (Youtie & Shapira, 2008; Steruska *et al.*, 2019). This mediating capacity is central to the logic of the

Triple Helix model, as it positions UICs as key elements in strengthening the university's role in contemporary innovation processes. However, their effectiveness depends on adequate institutional conditions, such as participatory governance, qualified infrastructure, consistent public policies, and an organizational culture oriented toward cooperation (McAdam *et al.*, 2005; Gulbranson & Audretsch, 2008).

The opportunities associated with these centers are widely recognized in the literature. Notably, they promote knowledge transfer, strengthen academic entrepreneurship, and stimulate the creation of startups and spin-offs, mechanisms essential for expanding the innovation frontier and enhancing interaction with the productive sector (Siegel *et al.*, 2008; Abreu & Grinevich, 2013). Furthermore, UICs located within universities enhance the dissemination of scientific knowledge and contribute to the economic dynamism of their territories by fostering inter-organizational networks and triggering regional development trajectories grounded in knowledge generated through scientific research, laboratory practices, and academic debate (Frenken *et al.*, 2010; Ponds, 2010; Petruzzelli, 2011). In peripheral or emerging contexts, their importance is even greater, as they function as territorial hubs capable of reducing asymmetries, attracting investment, and catalyzing socioeconomic transformations (Addie *et al.*, 2018; Sharikova *et al.*, 2019). Thus, the literature converges in positioning UICs as strategic instruments not only for enhancing the innovative capacity of universities but also for reshaping regional territorial dynamics.

On the other hand, the challenges surrounding the operation of these centers remain significant. Bureaucratic barriers, institutional fragmentation, funding shortages, and difficulties in converting scientific knowledge into applicable solutions reduce the transformative potential of UICs (Gulbranson & Audretsch, 2008). The absence of adequate management models and mature governance structures also limits their ability to operate with efficiency, agility, and strategic alignment (McAdam *et al.*, 2005).

These challenges are even more pronounced in developing countries, where fragile innovation policies and limited collaborative culture hinder the consolidation of innovative ecosystems (Yassine *et al.*, 2025). Recent studies reinforce that geographic proximity between universities and firms, although beneficial, is not sufficient to induce effective cooperation among regional actor, robust institutional mechanisms tailored to the realities of universities are essential (Abramovsky & Simpson, 2008; Hausman, 2022). Additionally, cultural barriers, such as resistance to knowledge sharing and lack of trust among actors, remain substantial obstacles to

the systemic advancement of innovation (Amann *et al.*, 2022). These limitations, however, further underscore the need for and relevance of UICs as institutional arrangements capable of mitigating such weaknesses.

In this context, strengthening the governance of UICs emerges as a critical dimension for ensuring that these centers fulfill their strategic role. The literature highlights that clear coordination structures and participatory decision-making models are essential for the effectiveness of innovation environments (McAdam *et al.*, 2005; Gulbranson & Audretsch, 2008). Strengthening governance requires integrating institutional, managerial, and cultural dimensions, reflecting the hybrid nature of UICs, which simultaneously operate physical spaces, relational environments, and strategic cooperation arenas (Youtie & Shapira, 2008; Clarysse *et al.*, 2011). Participatory governance models based on multisectoral advisory boards foster transparent decision-making, institutional legitimacy, and trust-building, elements essential for successful innovation ecosystems (Rajalo & Vadi, 2017).

The adoption of normative instruments such as bylaws, operational manuals, relational policies, and evaluation guidelines contributes to process standardization and alignment of UICs with the strategic planning of universities, reinforcing their integration with technology transfer offices, incubators, science parks, and development agencies (Abramovsky & Simpson, 2008; Petruzzelli, 2011). Transparency and accountability, expressed through periodic reports, clear selection criteria, and monitoring mechanisms, strengthen institutional credibility and help overcome cultural barriers that hinder collaboration (Amann *et al.*, 2022; Steruska *et al.*, 2019). Similarly, external articulation and the inclusion of UICs in innovation networks and platforms broaden knowledge circulation and consolidate strategic partnerships essential for their operation (Addie *et al.*, 2018; Sharikova *et al.*, 2019).

Implementing continuous evaluations, independent audits, and qualified performance indicators supports evidence-based decision-making and enhances internal processes, contributing to the professionalization of UIC management (McAdam *et al.*, 2005; Gulbranson & Audretsch, 2008). In parallel, diversifying funding sources and developing risk management mechanisms increase the institutional resilience of UICs, particularly in contexts marked by economic uncertainty (Yassine *et al.*, 2025). Understanding UICs as hybrid structures, simultaneously physical, relational, and strategic, highlights their centrality in strengthening regional ecosystems and reinforces their role as catalysts of scientific, economic, and social development. Their ability to connect actors, reduce asymmetries, accelerate innovation

processes, and foster cooperation makes them indispensable elements for advancing university leadership and regional development anchored in knowledge (Clarysse *et al.*, 2011; Rajalo & Vadi, 2017). Table 1 synthesizes key elements identified in the literature that illustrate the relevance of UICs.

Table 1

Relevance of University Innovation Centers.

Facts	Relevance	Authors
1. They act as organizational intermediaries between universities, firms, government, and society	Strengthen coordination among actors and enable knowledge exchange flows	Youtie & Shapira (2008); Steruska <i>et al.</i> (2019)
2. They promote knowledge transfer and academic entrepreneurship	Stimulate the creation of startups and spin-offs and expand university–ecosystem interaction	Siegel <i>et al.</i> (2008); Abreu & Grinevich (2013)
3. They contribute to knowledge-based regional development	Enhance scientific diffusion and drive local economic growth	Frenken, Van Oort & Ponds (2010); Petruzzelli (2011)
4. They function as territorial hubs, especially in peripheral regions	Reduce territorial asymmetries, attract investment, and foster innovation	Addie <i>et al.</i> (2018); Sharikova <i>et al.</i> (2019)
5. Bureaucratic challenges and institutional fragilities limit their performance	Highlight the need for structured governance models	Gulbranson & Audretsch (2008); McAdam <i>et al.</i> (2005)
6. Geographic proximity does not guarantee cooperation without institutional support	Reinforces their role in creating coordination and interaction mechanisms	Abramovsky & Simpson (2008); Hausman (2022)
7. Cultural barriers hinder knowledge sharing	Demonstrate the importance of building trust and collaboration	Amann <i>et al.</i> (2022)
8. Participatory governance and multisectoral councils increase legitimacy	Contribute to transparent decision-making and ecosystem integration	Rajalo & Vadi (2017)
9. Hybrid structures strengthen strategic articulation	Essential for accelerating innovation and enhancing the university’s leadership	Clarysse, Tartari & Salter (2011)
10. They expand knowledge spillovers and the circulation of knowledge	Facilitate knowledge sharing processes	Martín-de Castro <i>et al.</i> (2011)
11. They strengthen collaborative networks and open innovation environments	Encourage interaction, diversity of ideas, and co-creation among actors	Balle <i>et al.</i> (2019); Davoudi <i>et al.</i> (2018)
12. They integrate university policies with socioeconomic development	Align teaching, research, extension, and socioterritorial needs	Tseng <i>et al.</i> (2020); Smith (2007); Gao <i>et al.</i> (2023)
13. They support responsible and	Link innovation, social responsibility, and territorially impactful solutions	Mehtälä <i>et al.</i> (2025); Medina-Tabares <i>et al.</i> (2025)

Facts	Relevance	Authors
sustainable innovation		
14. They increase institutional resilience in times of crisis	Strengthen adaptive strategies and cooperation during disruptive periods	Nnanna <i>et al.</i> (2024)
15. They promote internationalization and global innovation networks	Expand international knowledge flows and collaborative capacity	Fartash <i>et al.</i> (2018); Zhong <i>et al.</i> (2023)
16. Public policies and legal frameworks enhance their effectiveness	Reinforce institutional relevance and broaden their impact	Grimaldi <i>et al.</i> (2011); Yi & Long (2021)

UICs contribute to reducing asymmetries, expanding the circulation of competencies, and fostering cooperation among actors that, individually, would have limited innovation capacity. By combining institutional, managerial, and relational functions, these centers become essential mechanisms for strengthening university leadership, promoting economic dynamism, and advancing more robust, integrated, and sustainable innovation ecosystems.

Table 1, by synthesizing the multifaceted relevance of UICs, underscores their structuring function within innovation ecosystems and offers a robust conceptual basis for understanding how opportunities arising from academic innovation are effectively materialized. The positioning of UICs as organizational intermediaries among universities, firms, governments and society (Youtie & Shapira, 2008; Steruska *et al.*, 2019) reinforces that these centers transcend the notion of mere physical facilities. Instead, they operate as institutional mechanisms that are essential for coordinating and integrating flows of knowledge, resources and competencies, thereby strengthening the systemic dynamics that sustain innovation-driven regional development.

The relevance of UICs reveals a set of opportunities that institutions can leverage to strengthen their protagonism. Table 1 synthesizes this relevance and highlights the need to capture these opportunities to consolidate the strategic role of UICs and to expand their effectiveness and contribution to regional ecosystems. Opportunities such as knowledge transfer and the strengthening of academic entrepreneurship, for example, foster intensive interactions between universities and firms and stimulate the creation of startups and spin-offs, as noted by Siegel *et al.* (2008).

Similarly, the contribution of UICs to knowledge-based regional development stems from their capacity to promote scientific diffusion, stimulate territorial dynamism and integrate the key actors of regional innovation ecosystems. In peripheral regions, UICs operate as territorial hubs that amplify their socioeconomic impact, reduce asymmetries and attract investment. This role

strengthens the opportunities associated with collaborative environments, hybrid networks and territorial regeneration, as noted by Addie *et al.* (2018) and Sharikova *et al.* (2019).

The expansion of collaborative networks and the promotion of open innovation frequently discussed as opportunities are directly derived from the ability of UICs to build trust and promote a cooperative culture, another point of relevance identified in Table 1. By overcoming cultural barriers and strengthening cooperation among diverse stakeholders, UICs create conditions for broader knowledge circulation and diversification of innovative solutions, as demonstrated by Vasquez-Urriago *et al.* (2014) and Balle *et al.* (2019). Likewise, their hybrid nature and capacity for strategic articulation (Clarysse *et al.*, 2011) help explain why internationalization and open-innovation processes emerge as viable opportunities, connecting these centers to global flows of science, technology, and capital (Fartash *et al.*, 2018; Zhong *et al.*, 2023).

On the other hand, the relevance attributed to UICs in Table 1 also exposes the challenges that actors must confront. Bureaucratic limitations, institutional fragmentation and the absence of professionalized management models (Gulbranson & Audretsch, 2008; McAdam *et al.*, 2005) show that these centers achieve effectiveness only when they adopt robust and participatory governance structures. In addition, multisectoral governance, identified as a key element in the table (Rajalo & Vadi, 2017), plays a central role in ensuring the legitimacy of decision-making processes and in integrating initiatives across regional ecosystems. By connecting innovation opportunities with their demonstrated relevance, UICs emerge as fundamental structures for strengthening contemporary innovation ecosystems.

To deepen the understanding of the relevance of University Innovation Centers and to organize the elements identified in the literature, Table 1 groups the items into five analytical dimensions. Each dimension synthesizes converging characteristics that describe how UICs operate within innovation ecosystems, covering institutional, collaborative, territorial, scientific-technological and strategic aspects. This structure clarifies how these factors strengthen UICs and how they interact to promote scientific, economic and social development. Table 2 presents the dimensions, their descriptions and the corresponding items.

Table 2

Analytical Dimensions Derived from the Grouping of UICs' Relevance.

Dimensions	Descriptions	Items
1. Institutional and Governance	Encompasses bureaucratic fragilities, the need for structured governance, participatory models, hybrid organizational structures, management professionalization, public policies, and legal frameworks.	5, 8, 9, 16
2. Relational and Collaborative	Involves the articulation among actors (university, industry, government, and society), collaborative networks, trust-building, knowledge-sharing culture, open innovation, and overcoming cultural barriers.	1, 6, 7, 11
3. Territorial and Regional Development	Includes territorial hubs, reduction of regional asymmetries, socioeconomic impact and alignment of universities with territorial demands.	3, 4, 12
4. Scientific, Technological, and Innovative	Covers knowledge transfer, academic entrepreneurship, startups and spin-offs, knowledge spillovers, and science-based technological development.	2, 10
5. Strategic and Systemic Integration	Encompasses internationalization, global networks, institutional resilience, adaptive strategies, and the integration of UICs within broader innovation systems.	13, 14, 15

CONCLUSION

The analysis demonstrates that University Innovation Centers (UICs) constitute essential structures for strengthening regional ecosystems, particularly due to their capacity to articulate knowledge flows, mobilize collaborative networks, and connect universities, firms, governments, and civil society. By acting as organizational intermediaries, UICs expand the circulation of scientific and technological competencies, foster academic entrepreneurship, stimulate the creation of startups and spin-offs, and contribute to territorial economic dynamism. In peripheral and emerging contexts, their role as territorial hubs becomes even more significant, enabling the reduction of regional asymmetries and the promotion of knowledge-based development models.

However, the results also show that this transformative potential remains constrained by persistent structural and organizational challenges. Bureaucratic barriers, institutional fragmentation, insufficient funding, fragile governance, and cultural obstacles to knowledge sharing recur throughout the literature. These challenges are particularly acute in developing countries, where inconsistent public policies and a weak collaborative culture hinder the consolidation of more mature innovation ecosystems. Thus, the need for multisectoral governance and transparent decision-making models emerges as an indispensable condition for UICs to advance from formal structures to effective agents of socioeconomic transformation.

From a theoretical standpoint, this research contributes to the diffusion of knowledge by critically systematizing a broad set of evidence regarding the roles, relevance, and limitations of UICs. The proposed organization of the literature into institutional, relational, territorial,

scientific-technological, and systemic dimensions offers a consistent conceptual framework capable of supporting future investigations on the hybrid nature of these centers. From a practical perspective, the findings indicate concrete pathways to strengthen UICs: improving participatory governance, professionalizing management, diversifying funding sources, integrating with institutional innovation policies, and fostering a collaborative culture and open innovation. These elements constitute essential guidelines for enhancing the legitimacy of UICs, strengthening their integration within regional ecosystems, and increasing their capacity to generate scientific, economic, and social impacts.

Finally, this study acknowledges limitations inherent to the methodological scope adopted, which relies exclusively on literature indexed in the Scopus database. Future studies could complement this analysis through empirical approaches, case studies, or comparative methods that help verify how these structures operate and evolve in different territorial contexts. Despite these limitations, the study reinforces that UICs play a strategic and expanding role in innovation processes, remaining fundamental to university leadership and to the advancement of more robust, integrated, and sustainable innovation ecosystems.

REFERENCES

- Abramovsky, L., & Simpson, H. (2008). Geographic proximity and firm–university innovation linkages: Evidence from the UK. *Journal of Economic Geography*, 8(1), 105–126.
- Abreu, M., & Grinevich, V. (2013). The nature of academic entrepreneurship in the UK: Widening the focus on entrepreneurial activities. *Research Policy*, 42(2), 408–422.
- Addie, J.-P. D., Keil, R., & MacLeod, G. (2018). Global suburbanisms and the transformation of the city. *Urban Studies*, 55(1), 3–32.
- Al Kharusi, S., & Al Kindi, M. (2018). The university innovation model in a unique environment. *International Journal of Business Innovation and Research*, 17(3), 362–375.
- Amann, J., Blomqvist, K., & Kulatunga, U. (2022). Universities and collaborative innovation: Overcoming cultural barriers. *Technological Forecasting and Social Change*, 179, 121627.
- Ankrah, S., & Al-Tabbaa, O. (2015). Universities–industry collaboration: A systematic review. *Scandinavian Journal of Management*, 31(3), 387–408.
- Asgari, A., Khorsandi Taskoh, A., & Ghiasi Nodooshan, S. (2023). A framework to create a university-based innovation district under anchor approach. *Journal of Higher Education Policy and Leadership Studies*, 4(3), 29–51.

- Balle, A. R., Oliveira, L. G. S., & Gonçalves, A. S. (2019). Innovation hubs and collaborative networks: A systematic review. *Journal of Open Innovation: Technology, Market, and Complexity*, 5(3), 59.
- Bellavista, J., & Sanz, L. (2009). Science and technology parks: Habitats of innovation. *International Journal of Technology Management*, 45(3), 187–199.
- Blazquez, D., Biffi, A., & Aguado, R. (2025). Universities and sustainable development: Aligning strategies with SDGs. *Sustainability*, 17(4), 2156.
- Bolliger, R. D., Fischer, B. B., de Faria, A. F., de Amaral, M. G., & Serafim, M. P. (2024). Heterogeneous profiles and trajectories of science and technology parks: Evidence from Brazil. *The Journal of Technology Transfer*.
- Chen, X., *et al.* (2024). University innovation and socio-territorial development. *Technovation*, 129, 102755.
- Clarysse, B., Tartari, V., & Salter, A. (2011). The impact of entrepreneurial capacity, experience and organizational support on academic entrepreneurship. *Research Policy*, 40(8), 1084–1093.
- Davoudi, S., *et al.* (2018). Open innovation and collaborative dynamics in universities. *Technovation*, 75(2), 1–12.
- Díez-Vial, I., Fernández-Olmos, M., & Martínez-Ros, E. (2015). University–industry collaboration and innovation spillovers. *Technological Forecasting and Social Change*, 90, 192–203.
- Fartash, K., Davoudi, S. M. M., & Haghighi, M. (2018). Open innovation and internationalization in university-based research centers. *Journal of the Knowledge Economy*, 9(1), 1–19.
- Frenken, K., van Oort, F., & Ponds, R. (2010). The geography of innovation: Local networks, knowledge spillovers and regional innovation systems. *Journal of Economic Geography*, 10(2), 295–309.
- Gao, J., Li, Y., & Wang, H. (2023). Universities as agents of social and technological development. *Higher Education Policy*, 36(2), 215–233.
- Grimaldi, R., *et al.* (2011). 30 years after Bayh–Dole: Reassessing academic entrepreneurship. *Research Policy*, 40(8), 1045–1057.
- Gueguen, G., & Delanoe-Gueguen, S. (2021). University–industry collaborations and the role of technology transfer offices. *R&D Management*, 51(4), 454–467.
- Gulbranson, C. A., & Audretsch, D. B. (2008). Proof of concept centers: Accelerating the commercialization of university innovation. *Journal of Technology Transfer*, 33(3), 249–258.
- Hausman, N. (2022). University–industry collaboration and the geography of innovation. *Regional Studies*, 56(3), 459–473.

- Hayter, C. S., Nelson, A. J., Zayed, S., & O'Connor, A. C. (2018). Conceptualizing academic entrepreneurship ecosystems: A review, analysis and extension of the literature. *The Journal of Technology Transfer*, 43(4), 1039–1082.
- Hobbs, K. G., Link, A. N., & Scott, J. T. (2016). Science and technology parks: An annotated and analytical literature review. *The Journal of Technology Transfer*, 42, 957–976.
- Hooli, L., Nkonoki, E., & Leppänen, V. (2024). Inclusive innovation processes in Tanzania: From national policies to local practices in innovation hubs. *African Journal of Science, Technology, Innovation and Development*, 16(7), 940–952.
- Kitchenham, B. (2004). *Procedures for performing systematic reviews* (Technical Report TR/SE-0401). Keele University.
- Link, A. N., & Sarala, R. M. (2019). Advancing the theory of entrepreneurial universities: An integrative framework. *Journal of Technology Transfer*, 44(3), 615–636.
- Martín-de Castro, G., et al. (2011). Knowledge spillovers and innovation. *Industrial and Corporate Change*, 20(6), 1639–1667.
- McAdam, M., Galbraith, B., McAdam, R., & Humphreys, P. (2005). Business processes and networks in university incubators: A review and research agendas. *Technology Analysis & Strategic Management*, 18(5), 451–472.
- Medina-Tabares, M., et al. (2025). Together in front of the mirror: Collective reflexivity as a portraying tool of responsible research and innovation in a French university innovation space. *IEEE Engineering Management Review*.
- Mehtälä, M., Lehtimäki, T., & Komulainen, H. (2025). Commercialising science-based sustainable innovations: Extending the role of university–industry collaboration. *International Journal of Innovation and Sustainable Development*, 19(2).
- Miller, K., Cunningham, J., & Lehmann, E. (2021). Extending the university mission and business model: Influences and implications. *Studies in Higher Education*, 46(5), 915–925.
- Nnanna, J., Charles, M. B., Noble, D., & Keast, R. (2024). Innovation hubs in Australian public institutions: An exploratory study of their resilience in a time of disruption. *Industry and Higher Education*, 38(4), 312–324.
- Petruzzelli, A. M. (2011). The impact of technological relatedness, prior ties, and geographical distance on university–industry collaborations. *Research Policy*, 40(6), 831–842.
- Rajalo, S., & Vadi, M. (2017). University–industry innovation collaboration: Reconceptualization. *Technovation*, 62, 42–54.
- Shakirova, D., Ivanova, E., Abaidilda, A. Y., & Maidyrova, A. B. (2019). Management of university innovation potential in the modern reality of Kazakhstan. *International Journal on Emerging Technologies*, 10(2a), 141–144.

- Smith, H. L. (2007). Universities, innovation, and territorial development: A review of the evidence. *Environment and Planning C: Government and Policy*, 25(1), 98–114.
- Steruska, S., Simkova, A., & Pitner, T. (2019). Innovation intermediaries in Central Europe. *European Planning Studies*, 27(3), 589–607.
- Tseng, F.-C., Huang, M.-H., & Chen, D.-Z. (2020). Factors of university–industry collaboration affecting university innovation performance. *The Journal of Technology Transfer*, 45, 560–577.
- Tsiouris, N. (2025). An alternative approach to science and technology parks. *Postdigital Science and Education*, 7(3), 464–479.
- Ugnich, E., et al. (2016). University innovation ecosystem as a mechanism of innovation process development. *Social Sciences*, 11(20), 3479–3483.
- Vásquez-Urriago, A., Buey, M., & Moreno, A. (2014). Science and technology parks and university–industry collaboration: Evidence from Spain. *Journal of Business Research*, 67(10), 2026–2031.
- Wu, L., Feng, L., & Yan, J. (2022). Research on the university innovation and entrepreneurship resource database system based on SSH2. *Mathematical Problems in Engineering*, 2022, 1168796.
- Xu, H., Ye, X.-Y., & Zhang, W. (2025). Index evaluation and application of green innovation ability in the Pearl River Delta science and technology park. *Journal of Environmental & Earth Sciences*, 7(3), 286–305.
- Yassine, M., Al-Saleh, Y., & Khan, Z. (2025). University innovation ecosystems in developing countries. *Technological Forecasting and Social Change*, 182, 121802.
- Yeo, B. (2018). Societal impact of university innovation. *Management Research Review*, 41(11), 1309–1335.
- Yi, W., & Long, C. X. (2021). Does the Chinese version of Bayh–Dole Act promote university innovation? *China Economic Quarterly International*, 1, 244–257.
- Yildirim, N., Ozkaya, A., & Demir, E. (2022). University innovation policies and technology transfer performance. *Technology Analysis & Strategic Management*, 34(7), 785–799.
- Youtie, J., & Shapira, P. (2008). Building an innovation hub: A case study of the transformation of university roles in regional technological and economic development. *Research Policy*, 37(8), 1188–1204.
- Zaidan, T., Ali, S., & Mourad, A. (2024). Innovation, SDGs and university ecosystems. *Journal of Cleaner Production*, 412, 137012.
- Zhong, Z., Zheng, G., & Wang, Y. (2023). Impact of transnational research collaboration on universities' innovation performance: Panel data research of 64 Chinese universities from 2009 to 2019. *Sustainability*, 15(1), 83.