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Enhancing Innovation Ecosystems Through University-Led Initiatives: The Case Of NIT/Uniarp

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Abstract:
Background*: This article examines the implementation of the Innovation and Technology Center (NIT)/Uniarp as a strategic initiative to foster a culture of innovation and entrepreneurship in the Alto Vale do Rio do Peixe region. Grounded in the theoretical frameworks of innovation and business ecosystems, the study contextualizes the NIT's conception and development, responding to the regional need for institutional spaces dedicated to nurturing innovation and entrepreneurship.*
Materials and Methods*: Utilizing the action research method, this study provides a temporal analysis spanning from December 2021 to August 2024.*
Results*: The findings highlight that NIT Uniarp directly benefits Uniarp's undergraduate and graduate students (across specialization, master's, and doctoral levels), faculty, administrative staff, research groups, as well as the broader business community and independent entrepreneurs within the local innovation ecosystem.*
Conclusion: *Beyond its applied goals, NIT Uniarp actively seeks to integrate Uniarp's teaching, research, and extension efforts with the evolving needs of the regional community, thereby reinforcing its role as a catalyst for regional development.*
Keywords*: Innovation ecosystems, Entrepreneurship, Innovation, Technology, Universities.*

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I. Introduction

Throughout history, certain business and innovation ecosystems have emerged as undeniably remarkable, such as the semiconductor industry in Silicon Valley and the automotive industry in Detroit (Klepper, 2010). Over the years, recognizing the significant impact of these ecosystems on socioeconomic development (Asefi, Resende, & Amorim, 2020; Oh et al., 2016; Spinosa, Schlemm, & Reis, 2015), numerous ecosystems have been established and consolidated worldwide, including in developing economies. In Brazil, for example, various efforts have been made to foster innovation ecosystems as a strategic option for its socioeconomic development and as a means to become a more aggressive player in the global knowledge economy (Spinosa, Schlemm, & Reis, 2015).

However, these initiatives have fallen short of expectations. Despite recent data showing that Brazil's innovation ecosystem is the most robust in Latin America and the Caribbean, having reached this status in less than 20 years, there remains a significant concentration in the Southern and Southeastern regions. Moreover, within the Brazilian national ecosystem, there are notable disparities among the federal units, with the most significant ecosystems typically thriving in capitals or medium to large cities, leaving other regions, even those with well-established business ecosystems, underserved.

Santa Catarina serves as a case in point. Generally regarded as a reference for innovation ecosystems in Brazil, Florianópolis, for example, boasts the highest density of startups per capita in the country—five startups for every thousand inhabitants. Blumenau (in the Itajaí Valley) and Joinville (in the north) are also among the top ten Brazilian cities with the highest density of scalable, innovative, and technological businesses (ACATE, 2021). However, this is not the case for the Alto Vale do Rio do Peixe region. Despite having a well-established business ecosystem, particularly in manufacturing and agricultural production, the region has only recently begun making modest efforts toward developing its innovation ecosystem. This dependence on technologies from other regions, especially from abroad, undermines its competitiveness.

In response to this challenge, a movement to develop the innovation ecosystem in Caçador was initiated by university leaders in 2017. This effort led to the subsequent founding of the Caçador Innovation Center in 2019, which inspired the establishment of innovation hubs in Videira and Fraiburgo, all located in the

Mid-West region of Santa Catarina (Fontanela, Lavall, & Marocco, 2023). Several years into this movement, despite various initiatives yielding both positive and less favorable results, a significant obstacle to the development of the Caçador ecosystem remained: the lack of an innovative and entrepreneurial culture in the region, which was intrinsically linked to the absence of innovative and entrepreneurial education within local educational institutions.

Motivated by this concern and encouraged by the Santa Catarina State Foundation for Research and Innovation (FAPESC), whose then-president, during a formal visit to the Caçador ecosystem, emphasized the need for greater university involvement and the opportunity to establish a Technological Innovation Center (NIT) in the region, this idea gained traction. The possibility became more tangible with the launch of a public funding call for teaching and innovation laboratories, which eventually led to the establishment of the Innovation and Technology Hub (NIT) at the Universidade Alto Vale do Rio do Peixe (Uniarp). This article presents the experience of establishing the NIT/Uniarp as a means of fostering a culture of innovation and entrepreneurship in the Alto Vale do Rio do Peixe region.

II. Theoretical Framework

The concept of a business ecosystem, as defined by Teece (2007), refers to the community of organizations, institutions, and individuals that influence a company and its customers and suppliers. This includes suppliers, regulatory authorities, standard-setting bodies, the judiciary, and educational and research institutions. It is a structure that acknowledges the significant impact that innovation and its supporting infrastructure have on competition (Teece, 2007).

A business ecosystem [...] spans across a variety of industries. Companies co-evolve capabilities around an innovation: they work cooperatively and competitively to support new products, meet customer needs, and eventually incorporate the next round of innovations. Every business ecosystem develops through four distinct stages: birth, expansion, leadership, and self-renewal—or, in the absence of self-renewal, death. [...] While the central hub may shift over time, the role of the leader is valued by the rest of the community. This leadership enables all ecosystem members to invest in a shared future where they anticipate mutual profit (Moore, 1993).

Innovation ecosystems, on the other hand, refer to the set of actors, activities, artifacts, institutions, and relationships—including complementary and substitute products—that are crucial to the innovative performance of an actor or a population of actors (Granstrand & Holgersson, 2020). Interactions within an innovation ecosystem are often organized around a technological platform consisting of shared assets, standards, and interfaces (Dattée, Alexy, & Autio, 2018). However, Pushpananthan & Elmquist (2022) explain that there is research on innovation ecosystems without a technological platform at their core.

The idea of innovation ecosystems emphasizes that a company is not merely part of a whole; rather, it is considered an active agent, meaning it is part of the relationships and general circumstances governing a business ecosystem (Javanmardi, 2022). According to the author (2022), the interactions among companies and the process of collective value creation are too complex to be represented by linear, single-cause effects. The concept of an ecosystem encompasses a wide range of organizations, institutions, and individuals that influence or are influenced by a business.

At this point, it is important to distinguish between an innovation ecosystem and other conceptualizations such as "innovation systems," especially regarding the collaborative and competitive behavior exhibited by their participants (Granstrand & Holgersson, 2020). Innovation systems are often based on geographical boundaries, labeled using constructs such as national or regional innovation systems (Lundvall, 2016). In contrast, innovation ecosystems enable cross-sectoral and cross-regional examinations of innovation activities.

More specifically, when analyzing the concept of Regional Innovation Systems (RIS), it becomes evident that it is the institutional infrastructure that supports innovation within the productive framework of a region (Asheim & Gertler, 2009). It is important to note that the analysis of a geographically-oriented innovation system (such as national systems) is driven by the significance of spatial factors like location and physical proximity in R&D, innovation, and diffusion, giving rise to regional clusters and networks with agglomeration economies. In this context, a region can be emphasized as a meso-level unit of analysis, although there is no explicit definition of what constitutes a region (Granstrand & Holgersson, 2020).

Considering that this study will conduct a geographically-oriented analysis, it is pertinent to incorporate the principles of Regional Innovation Systems (RIS) into the study. The foundation of RISs lies in understanding innovation as a social and interactive process (Scaringella & Radziwon, 2018). According to Cooke (1996), norms, trust, routines, and other informal means of collective learning strongly influence RISs. Within RISs, the actors of the Triple Helix and Quadruple Helix models play a fundamental role. The Triple Helix (TH) model (proposed by Etzkowitz & Leydesdorff, 1995) is based on the interaction between three main actors—university, industry, and government—to explain the dynamics of innovation.

More specifically, the industry, represented by both large and small companies, needs to: (i) develop innovative products or services; (ii) seek interaction with research centers; and (iii) lead change processes. Among its limitations are: (i) limited R&D investment capacity; (ii) insufficient preparedness for research development (Mineiro et al., 2018). The same authors also present that the role of universities is to: (i) generate new knowledge; (ii) seek relationships between government and companies; (iii) identify new research gaps; (iv) lead change processes. Their limitations include: (i) dependence on funding agencies for conducting research; (ii) a limited vision of workforce training and professional development; and (iii) weak ties with society and companies. Finally, the government is responsible for: (i) supporting new organizational structures to promote economic and social development; (ii) having strategic plans focused on innovation and knowledge; (iii) providing benefits to the population through interaction with various political spheres. Government limitations include: (i) excessive bureaucratization; (ii) lack of flexibility for implementing partnership projects; and (iii) the need for professional public management. More recently, beyond the university-industry-government triad, models have integrated civil society—the model known as the Quadruple Helix. This extended model adds the perspectives of media and culture, as well as civil society (Mineiro et al., 2018).

Finally, according to Javanmardi (2022), an innovation ecosystem consists of three essential elements: human capital, financial capital, and technological capital. The author suggests that special attention should be given to innovation through policies and significant actions aimed at developing human capital, with one of the key network instances that can strengthen innovation ecosystems being consortia formed by universities and research centers (both internal and external), the public sector, the private sector, and various industries in both the private and public sectors.

III. Material And Methods

This section aims to elucidate the methodological framework that underpins the analysis of the implementation of the NIT/Uniarp. The study employs a qualitative research approach, utilizing the action research method, which Tripp (2005) describes as a form of social research with an empirical basis, designed and conducted in close association with an action or the resolution of a collective problem. Action research seeks to generate both change (action) and understanding (research), particularly of a practical nature (Hahn et al., 2013).

The application of action research is particularly justified in this context, as the Higher Education Institution (HEI) involved in this study established and implemented the teaching and research laboratory at the heart of this investigation. The researchers—who are also the authors of this article—identified challenges within their research environment and, through collaboration with other actors (including professionals from various fields of expertise), developed a systematic solution. This process not only addressed the immediate issues but also generated systematic knowledge about the identified situation (Dionne, 2007, as cited in Hahn et al., 2013).

In addition to action research, the study also incorporated participant observation, as the researchers were actively involved in the processes of designing, implementing, and evaluating the NIT/Uniarp. This participant observation allowed the researchers to gain a deeper understanding of the dynamics at play, enabling them to capture nuanced insights and contextual factors that might have been overlooked by more detached observational methods.

This experiential report covers a temporal analysis that begins in December 2021 and extends until August 2024. The population involved in the study included both the researchers and participants. The researchers, who played a pivotal role in the design and execution of the program, were the authors of this study, supported by other master's and doctoral-level faculty members. The participants comprised faculty and students from Uniarp, as well as other stakeholders directly connected to the innovation and business ecosystem of Caçador/SC.

IV. Results

Presentation of the Innovation and Technology Hub (NIT)

The narrative of the Innovation and Technology Hub (NIT) at Uniarp illustrates the nascent stages of an evolving initiative within the regional innovation ecosystem. Unlike most NITs integrated into Santa Catarina's innovation landscape, Uniarp's NIT remains in its early phases, having only begun its formal structuring in 2021.

Officially established in December 17, 2021, the NIT at Uniarp, under the institutional designation of the Innovation and Technology Hub, embarked on its journey with a strategic intent to foster an innovation-driven culture within the university and the surrounding region. The initial stages, from securing funding and conceptualizing the initiative — led by Professor Dr. Ivanete Schneider Hahn — to developing the architectural and financial plans, involved a comprehensive process that laid the groundwork for its future activities.

The formal launch of the NIT, which included the presentation of its implementation phases, objectives, and strategic goals, was held in May 2022. This event brought together key stakeholders, including representatives from the Rectorate, course coordinators for undergraduate and graduate programs, the Pedagogical Support Center, the Model Office (responsible for designing the NIT space), sector coordinators, researchers, and faculty members. This engagement was a critical step in embedding the principles of innovation into the Pedagogical Projects of Uniarp's academic programs, as well as into research and extension initiatives, thus aligning with the broader strategic objective of fostering an entrepreneurial educational environment (Fontanela et al., 2023).

The official inauguration of the NIT's physical space occurred on October 4, 2022, providing a dedicated environment that includes meeting and coworking spaces designed to support teaching, research, and extension activities. This infrastructure embodies the principles of a business and innovation ecosystem, as described by Teece (2007), where the NIT serves as a hub for the co-evolution of capabilities, fostering innovation through collaboration among various stakeholders.

According to data available on the laboratory's online page (https://uniarp.edu.br/nit/), the NIT/Uniarp is tasked with managing the university's innovation and technology initiatives. Its primary objectives are strategically aligned with the key functions of an innovation ecosystem as identified by Granstrand and Holgersson (2020), including:

- Active engagement in the local, regional, national, and international productive environments;
- Protection of intellectual property and facilitation of technology transfer;
- Support for the creation of enterprises, product development, and the provision of specialized and innovative services;
- Management of shared resources, including laboratories, equipment, and human capital, with third-party access regulated through a formal evaluation process;
- Oversight and active participation in Uniarp's innovation ecosystem and the broader regional ecosystem.

Grounded in the legal framework provided by Law No. 13,243 of 2016, the NIT is also responsible for managing Uniarp's institutional innovation policy and extending these practices to other regional Science and Technology Institutions (STIs). In this capacity, the NIT supports companies, students, faculty, and the regional community in areas such as intellectual property registration, technical training, technology transfer, and the mentoring of nascent entrepreneurial ideas, directing them toward pre-incubation and incubation programs through the Inova Contestado Innovation Center.

Action Results

The direct beneficiaries of the NIT's infrastructure include Uniarp's undergraduate and graduate students, faculty, technical-administrative staff, research groups, as well as the broader business community, independent entrepreneurs, and other key actors within the local innovation ecosystem. The integration of innovation and entrepreneurship into the curriculum across various programs is a reflection of the NIT's impact, resonating with the concept of innovation ecosystems where educational institutions play a pivotal role in driving collective value creation (Javanmardi, 2022).

In terms of Uniarp's public image, the NIT's activities are promoted through two primary social media platforms—Instagram (https://instagram.com/nituniarp?igshid=OGQ5ZDc2ODk2ZA==) and LinkedIn (https://www.linkedin.com/company/n%C3%BAcleo-de-inova%C3%A7%C3%A3o-tecnol%C3%B3gica-uniarp/)—as well as a dedicated page on the university's website (https://uniarp.edu.br/nit/). These platforms facilitate the dissemination of information and the engagement of a broader audience with the NIT's initiatives.

The successful integration of innovation and entrepreneurship-related courses into the curricula of undergraduate and graduate programs—across specialization, master's, and doctoral levels, both in-person and online—further demonstrates the NIT's influence. This aligns with the broader theoretical framework where innovation ecosystems are characterized by cross-sectoral and interregional collaboration (Granstrand & Holgersson, 2020).

The establishment of an Institutional Innovation Policy at Uniarp, encompassing key structural actions such as engagement in the local productive environment, protection of intellectual property, support for spin-offs and start-ups, infrastructure sharing, and active participation in the regional innovation ecosystem, represents a significant milestone. This policy framework reflects the principles outlined by Cooke (1996), where norms, trust, and collective learning processes are integral to the functioning of Regional Innovation Systems (RIS).

Uniarp's NIT has also positioned itself as a leading actor within the local innovation ecosystem, participating actively in strategic planning, events, and initiatives. A flagship event, the Engineering Innovation Marathon, brought together 80 competitors and over 20 mentors to develop solutions for regional challenges, illustrating the NIT's role in fostering practical, innovation-driven outcomes.

Moreover, the NIT represents the university in various councils, actions, and activities that contribute to the regional innovation and entrepreneurship ecosystem. These include the creation and maintenance of the ON Platform, the development of the Innovation Ecosystem Plan for Caçador, participation in the Innovation Nucleus of the Regional Council of Administration (SC), CRA-SC, the Sectorial Chamber of Innovation of the Santa Catarina Association of Educational Foundations (ACAFE), and the Municipal Innovation Council of Caçador, among others.

Additionally, the NIT supports research groups at the university that focus on innovation and entrepreneurship, such as the Research Group on Social Development, Innovation, and Management. Through these initiatives, the NIT has facilitated the development, funding, and execution of numerous research projects, teaching initiatives (including entrepreneurial education), and technological development projects. The NIT has also hosted various technical and scientific events, including panels and roundtables featuring entrepreneurs and experts in innovation and entrepreneurship.

In conclusion, the NIT is gradually becoming a cornerstone of Uniarp's institutional identity in innovation and entrepreneurship, as well as a key player in the local innovation ecosystem. This evolution aligns with the theoretical frameworks that emphasize the critical role of educational institutions and collaborative networks in fostering innovation and driving regional development.

V. Discussion

The establishment of dedicated spaces for innovation and entrepreneurship within universities plays a crucial role in the socioeconomic development of the regions they inhabit. These spaces not only provide an environment conducive to experimentation and the development of new ideas but also act as catalysts for transforming universities into active agents within the innovation ecosystem. In less developed regions, such as Alto Vale do Rio do Peixe, these spaces are particularly vital as they offer resources and support that may not be readily available in other sectors of the economy. Additionally, by promoting local innovation, universities contribute to talent retention and job creation, thereby preventing the exodus of qualified young professionals to other regions (Granstrand & Holgersson, 2020).

Moreover, the presence of innovation and entrepreneurship centers within universities strengthens the triple helix model of interaction between academia, industry, and government. This model, proposed by Etzkowitz and Leydesdorff (1995), emphasizes that innovation arises from the collaboration among these three sectors. Universities, by providing spaces like the NIT Uniarp, facilitate this interaction, creating an environment where academic research can be directly applied to solve real-world problems faced by local industries. This proximity between academia and the productive sector not only accelerates the innovation process but also ensures that the solutions developed are relevant and readily applicable in the market, benefiting both the local economy and the university, which sees its research efforts translated into tangible impacts (Teece, 2007).

Another crucial aspect of creating these spaces is the promotion of a culture of innovation and entrepreneurship within the university. Organizational culture is a key determinant of the success of innovation initiatives, and the introduction of dedicated entrepreneurship spaces can transform the mindset of both students and faculty. With access to resources and support for developing innovative projects, students are encouraged to adopt a more proactive approach, identifying opportunities and developing creative solutions to contemporary challenges. Similarly, faculty and researchers are motivated to integrate innovation into their pedagogical and research activities, promoting an education that not only imparts knowledge but also empowers students to become agents of change (Javanmardi, 2022).

Finally, institutionalizing these innovation spaces within universities also contributes to the sustainability and growth of the regional innovation ecosystem. By establishing itself as a hub of innovation, the university can attract strategic partnerships, investments, and talent, consolidating its position as a leader in regional development. Moreover, by aligning these initiatives with the university's institutional mission, as seen with the NIT Uniarp, it ensures that innovation efforts are in harmony with the needs and aspirations of the local community. This not only reinforces the university's role as a development agent but also ensures that innovation initiatives have a lasting and positive impact on the region (Asheim & Gertler, 2009; Scaringella & Radziwon, 2018).

VI. Conclusion

The activities of the NIT are justified by the pressing need to create environments that foster innovation and entrepreneurship, particularly within traditional university settings and especially in less developed regions like the Alto Vale do Rio do Peixe. These efforts are crucial for the development of such communities. Entrepreneurship plays a pivotal role in regional development, not only through the establishment of new businesses that generate jobs and income but also by strengthening existing institutions.

Furthermore, despite the existence of two established Innovation Centers in the Alto Vale do Rio do Peixe region, the NIT Uniarp serves as a bridge between the activities of undergraduate and graduate programs and these Innovation Centers. By enhancing the physical infrastructure of the NIT, Uniarp commits to being an active agent in the regional innovation ecosystem. Moreover, through the NIT, students and faculty at Uniarp can engage with demands from the region's productive sector, contributing significantly to the management of the institution's service provision and extension activities.

The NIT also functions as a collaboration hub between companies and the formation of industrial networks, which are essential for the innovation process across micro, small, medium, and large enterprises. Even large companies face limitations in product development that require diverse technological bases, and only through collaboration via industrial networks can increasingly complex technological products be developed. Additionally, the flexibility, interdisciplinarity, and exchange of ideas between the administrative levels of companies and the laboratories of educational institutions are crucial.

Specifically, the establishment of the NIT has provided the following benefits:

- Improvement in the research conditions and technology transfer from all research groups at Uniarp, as well as from all Science and Technology Institutions (STIs) in the Alto Vale do Rio do Peixe region;
- Promotion of interinstitutional relationships through collaborative research agreements, intellectual property (IP), and/or national and international technology transfer (TT);
- Fostering of interinstitutional relations within environments, networks, incubators, and innovation centers;
- Addressing and guiding the demands presented by the business sector, government, and society in the practice of innovation;
- Encouragement of existing entrepreneurship and innovation initiatives within the STI and the ecosystem;
- Support and promotion of the integration of Science, Technology, and Innovation (ST&I) from the STIs with the regional society;
- Facilitation of the integration of researchers, professors, students, professionals, entrepreneurs, and public agents within the Alto Vale do Rio do Peixe region.

In addition to these applied objectives, the NIT seeks to align Uniarp's teaching, research, and extension activities with the needs of the regional community, thereby fulfilling its institutional mission.

This study, while providing valuable insights into the development and impact of the NIT, is not without its limitations. One significant limitation is the focus on a single case study within a specific regional context, which may limit the generalizability of the findings to other regions or institutions. Additionally, the study relies heavily on qualitative data and subjective interpretations, which, while rich in detail, may introduce biases and limit the ability to quantify the broader impact of the innovation center. Future research could benefit from a comparative analysis involving multiple innovation centers across different regions, allowing for a more robust understanding of how such initiatives function in diverse contexts. Moreover, incorporating quantitative methods, such as surveys and econometric analysis, could provide more empirical evidence of the economic and social impacts of innovation centers. Longitudinal studies could also be valuable, tracking the development of these centers over time to assess their sustainability and long-term effects on regional innovation ecosystems.

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