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Comparative Analysis of Innovation Ecosystems: An Integrative Literature Review

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Abstract: The increasing complexity of contemporary productive systems has positioned innovation ecosystems as a central framework for understanding the generation, diffusion, and application of knowledge across organizational and territorial contexts. These ecosystems are characterized by the interaction of multiple interdependent actors, including universities, firms, governments, and support institutions, whose collaborative dynamics enable systemic value creation and technological advancement. Despite the consolidation of the concept, the literature remains fragmented, with diverse theoretical and methodological approaches that hinder an integrated understanding of the structural and institutional factors shaping ecosystem performance and evolution. In response, this study aimed to comparatively analyze innovation ecosystems, focusing on their structure, governance, relational dynamics, and evolutionary processes, through an integrative literature review. Data were collected from the Web of Science Core Collection using structured descriptors related to innovation ecosystems and comparative analysis, resulting in 130 initial records. After applying inclusion criteria—open access, review articles, and publication between 2021 and 2026—the corpus was reduced to 20 studies, of which 17 were fully incorporated into the final synthesis following analytical screening. The analysis was conducted using thematic content analysis, enabling the identification of five analytical categories: ecosystem structure, governance mechanisms, relational dynamics, evolutionary maturity, and value creation capacity. The findings indicate that innovation ecosystems operate as complex sociotechnical systems whose effectiveness depends on coordinated governance, institutional support, collaborative networks, and adaptive capabilities. Furthermore, ecosystem performance is strongly influenced by structural integration, actor interdependence, and institutional alignment, which collectively enable knowledge circulation and innovation scaling. The study concludes that innovation ecosystems constitute fundamental mechanisms for promoting technological development and systemic competitiveness. As a theoretical contribution, this research advances the integrative understanding of ecosystem structure and dynamics, while practically highlighting the importance of coordinated policies, institutional strengthening, and collaborative governance to support sustainable innovation ecosystem development.

Keywords: *Innovation Ecosystems; Entrepreneurial Ecosystems; Ecosystem Governance; Innovation Networks; Comparative Analysis; Systematic Literature Review; Technological Innovation; Ecosystem Performance; Institutional Collaboration; Innovation Dynamics.*

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I. INTRODUCTION

The increasing complexity of contemporary production systems has driven the concept of innovation ecosystems as a central model for understanding the dynamics of knowledge generation, diffusion, and application in organizational and territorial contexts. These ecosystems are characterized by interactions among multiple interdependent actors, including universities, firms, governments, and support institutions, which collaborate to create value and promote innovation at a systemic level (Ritala & Thomas, 2025; Pilelienė & Jucevičius, 2023). Recent studies indicate that innovation ecosystems have evolved from cluster-based structures into more complex and interconnected arrangements capable of integrating resources, competencies, and knowledge flows, becoming strategic elements for economic competitiveness and technological development (Makarov et al., 2025; Chatti et al., 2024). In this context, innovation ecosystems emerge as fundamental structures for fostering collaboration, accelerating innovation, and responding to digital and economic transformation demands.

Despite the consolidation of the concept, the literature still presents conceptual fragmentation and a diversity of theoretical and methodological approaches, which hinders the development of an integrated understanding of the factors influencing the performance and evolution of these ecosystems. Recent reviews indicate that innovation ecosystems vary significantly in terms of structure, governance, and capacity to generate outcomes, reflecting institutional, technological, and organizational differences across regional and sectoral contexts (Campos-Blázquez et al., 2024; Shen et al., 2025). This heterogeneity highlights the need to consolidate existing knowledge, identify convergent patterns, and understand the key structural elements that sustain the effectiveness of these ecosystems.

In light of this scenario, the present study aims to comparatively analyze innovation ecosystems, focusing on their structures, dynamics, and operational mechanisms, through an integrative literature review. The study seeks to synthesize recent evidence, identify analytical patterns, and contribute to advancing knowledge on the factors influencing the development and consolidation of innovation ecosystems.

II. MATERIALS AND METHODS

This study is characterized as a qualitative research of a theoretical-analytical nature, structured through an integrative literature review, with the objective of comparatively analyzing the structure, governance, dynamics, and performance of innovation ecosystems in the contemporary period. The integrative review was adopted because it enables the critical synthesis of scientific evidence, the identification of convergent patterns, and the construction of analytical categories capable of explaining the configuration and evolution of innovation ecosystems across different contexts.

Data collection was conducted in the Web of Science Core Collection (WoS), selected due to its editorial rigor, broad multidisciplinary coverage, and relevance for high-impact scientific studies. The search strategy was carried out in the Topic field using structured descriptors in English, combined with Boolean operators and truncations, according to the following search expression: ("innovation ecosystem*" OR "entrepreneurial ecosystem*" OR "innovation network*" OR "business ecosystem*" OR "technological ecosystem*") AND (comparison OR "comparative analysis" OR evaluation OR assessment OR benchmarking) AND (structure OR governance OR performance OR dynamics OR evolution OR development) AND ("systematic review" OR "literature review" OR review). This strategy was designed to capture studies addressing innovation ecosystems from a comparative and integrative perspective, considering their structural dimensions, governance mechanisms, evolutionary processes, and implications for performance and development.

The initial search resulted in 130 potentially relevant records. Subsequently, refinement criteria were applied to delimit a corpus aligned with the investigated phenomenon, including: (i) temporal scope: 2021–2026, to ensure contemporaneity of the evidence; (ii) document type: review articles, ensuring greater theoretical density and synthesis capacity; and (iii) open access, ensuring full availability for complete analysis. After applying these filters, the corpus was reduced to 20 articles, which were exported in RIS format and subjected to preliminary analytical screening.

During the eligibility stage, an analytical reading of the titles, abstracts, and objectives of the studies was conducted based on the following inclusion criteria: direct adherence to the concept of innovation ecosystem or entrepreneurial ecosystem; presence of structural, comparative, evolutionary, or governance analysis; methodological consistency and clear theoretical foundation; and relevance for understanding ecosystem dynamics. As a result of this process, 17 studies were fully incorporated into the final analysis, while three studies were excluded for lacking direct adherence to the investigated phenomenon or sufficient analytical elements for constructing comparative categories.

The selection process followed a structured flow based on the principles of the PRISMA protocol, as described below: records identified in the Web of Science database: 130; records after application of filters: 20; records assessed for eligibility: 20; records excluded after analytical screening: 3; and studies included in the final integrative synthesis: 17.

The analysis of the selected studies was conducted using thematic content analysis with an inductive approach, allowing the identification of recurring patterns, conceptual convergences, and explanatory mechanisms associated with the structure, governance, dynamics, and evolution of innovation ecosystems. From this process, emergent analytical categories were constructed, enabling the development of an integrative synthesis of the state of the art.

Although the study did not fully follow a formal systematic protocol with prior registration, the process was

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conducted in a structured and transparent manner, with explicit definition of the database, descriptors, selection criteria, and full analysis of the included studies. This approach ensures methodological consistency, scientific rigor, and interpretative reliability, allowing the construction of a comprehensive and updated understanding of the configuration and evolution of contemporary innovation ecosystems.

III. LITERATURE REVIEW

Innovation ecosystems represent complex arrangements characterized by the interaction of multiple actors who co-create value through interdependent networks and evolving dynamics. According to Autio et al. (2018), these ecosystems are configured as territorial structures in which social, human, and institutional capital interact to facilitate knowledge circulation and sustain innovation trajectories connected to both local and global contexts. This perspective shifts the focus from the isolated firm to the relational environment that conditions innovation, emphasizing that innovative capacity emerges from the quality of interactions and relational density among actors. In this sense, innovation systems constitute institutional arrangements that shape technological development, being influenced by norms, policies, and organizational structures that condition collective learning (Freeman, 1987; Nascimento et al., 2025). Complementarily, innovation is understood as a cumulative relational process in which interactive learning and cognitive proximity strengthen the adaptive capacity of ecosystems over time (Lundvall, 1992; Nascimento et al., 2025).

Governance and orchestration emerge as central elements for the functioning of these ecosystems, as coordination among institutional actors becomes necessary to align resources, objectives, and capabilities. According to Etzkowitz and Leydesdorff (2000), the Triple Helix model establishes a relational structure based on the interaction between university, industry, and government, promoting hybrid configurations that expand knowledge production and diffusion. This model demonstrates that innovation results not only from internal capabilities but also from the ability to articulate different institutional spheres. Furthermore, ecosystem governance depends on dynamic capabilities that allow organizations to reconfigure competencies in response to environmental changes, reinforcing the importance of institutional flexibility and adaptive coordination (Teece et al., 1997; Nascimento et al., 2025). In this context, actors perform complementary roles, where universities act as knowledge-generation hubs, firms mobilize productive resources, and governments provide policies and support instruments, forming collaborative systems oriented toward value creation (Araújo, 2015).

At the regional and university levels, innovation ecosystems play a strategic role in promoting scientific and technological development, particularly through institutional structures such as Technology Transfer Offices (TTOs). According to Alves et al. (2024), universities function as ecosystem hubs by integrating research activities, technology transfer, and interaction with industry, strengthening intellectual property protection and fostering academic startups. This dynamic reflects the evolution of the Triple Helix model toward broader approaches such as the Quintuple Helix, which incorporates civil society and the environment as essential dimensions for sustainable innovation (Carayannis & Campbell, 2012; Nascimento et al., 2025). In this sense, innovation ecosystems are understood as multilevel systems in which institutional, territorial, and organizational factors influence their structure and performance. Given this complexity, comparative analysis becomes essential to identify structural variations, institutional asymmetries, and mechanisms that condition innovative performance across different contexts, contributing to the improvement of ecosystem development policies and strategies (González-Moreno et al., 2020; Nascimento et al., 2025).

IV. DISCUSSION AND RESULTS

The integrative analysis of the 18 selected studies allowed the identification of convergent patterns that highlight the systemic, relational, and evolutionary nature of innovation ecosystems. Based on the synthesis of findings, five main analytical categories emerged: (i) ecosystem structure and architecture, (ii) governance and coordination mechanisms, (iii) relational dynamics and actor roles, (iv) ecosystem evolution and maturity, and (v) ecosystems as mechanisms for value creation and performance. These categories reflect complementary dimensions that explain how ecosystems are configured, coordinated, developed, and sustained over time. Collectively, the results demonstrate that innovation ecosystems are not merely aggregations of organizations but dynamic systems grounded in structural interdependence, institutional coordination, and collective value creation.

- *Category 1 — Structure and Architecture of Innovation Ecosystems*

According to Hoffmann et al. (2022), the structure of innovation ecosystems consists of organizational and relational arrangements that articulate multiple actors around shared objectives, with governance and orchestration serving as central elements for aligning interests and coordinating actions. The authors emphasize that ecosystem architecture involves not only the presence of actors but also the definition of roles, coordination mechanisms, and knowledge flows, enabling the systemic creation and diffusion of innovation. This perspective reinforces that ecosystem structure results from organizational and institutional processes that enable collaboration and value co-creation.

This structural perspective is expanded by the Innovation Reef model, which proposes an ecosystem configuration based on cooperation and value sharing as foundations for sustainable development, particularly in regional contexts with limited resources (Lima et al., 2024). The authors demonstrate that ecosystem structure depends on the density and stability of relationships among actors, with cooperation acting as a determinant factor for value retention and the consolidation of regional innovation capabilities. This model repositions the ecosystem as an architecture

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oriented not only toward competitiveness but also toward systemic sustainability and territorial development.

Complementarily, Taratori et al. (2021) highlight that the structure of urban innovation ecosystems is configured through interactions among government, universities, firms, society, and the environment, consistent with Triple, Quadruple, and Quintuple Helix models. Their findings demonstrate that integration among these actors enables the development of innovative solutions to complex challenges such as urbanization and sustainability, evidencing that ecosystem architecture depends on the articulation of multiple institutional levels. This approach confirms that ecosystems function as multilevel systems in which different actors perform complementary roles.

The structural dimension is also evident in technological ecosystems associated with sensor systems and the Internet of Things, where the integration of technological infrastructure, devices, and applications defines the ecosystem's capacity to generate innovation (Ridwan et al., 2025). The authors show that technological structure constitutes an essential component for enabling the autonomy and functionality of innovative systems, highlighting that ecosystem architecture includes material and technological elements. This reinforces that innovation ecosystems depend on the interaction between physical, technological, and institutional infrastructures.

In the context of global health, the African vaccine ecosystem illustrates how ecosystem structure is strongly conditioned by institutional capacity, productive infrastructure, and coordination among national and international actors (Okesanya et al., 2026). The authors demonstrate that the absence of local infrastructure limits ecosystem autonomy, emphasizing the importance of structural strengthening to sustain innovation and technological independence. This finding reinforces that ecosystem architecture represents a critical factor for the development of sustainable innovation capabilities.

- *Category 2 — Governance, Coordination, and Ecosystem Orchestration*

According to Shi et al. (2023), innovation ecosystem governance depends on institutional frameworks that guide coordination among actors and establish standards and operational guidelines. Their findings demonstrate that regulatory systems play a central role in ecosystem consolidation by establishing norms, promoting collaboration, and strengthening institutional capabilities. This highlights governance as a fundamental mechanism for ensuring ecosystem stability and functionality.

This dimension is reinforced by mission-oriented innovation policies, which align investments, strategic priorities, and institutional efforts around specific objectives (Al-Jayyousi et al., 2023). The authors demonstrate that mission-driven governance strengthens ecosystem coordination by promoting integration between public and private actors. This finding confirms that strategic governance contributes to directing ecosystem development and enhancing its effectiveness.

In the pharmaceutical sector, regulatory governance has proven critical for ecosystem consolidation, accelerating technological development and strengthening international competitiveness (Tan et al., 2025). The authors show that regulatory reforms and institutional investments expand ecosystem innovation capacity, highlighting the central role of institutions in ecosystem coordination. This reinforces governance as a structural determinant of systemic innovation.

Governance also manifests through organizational mechanisms such as corporate accelerators, which connect startups, corporations, and investors, facilitating knowledge and resource circulation (Heshmati et al., 2024). These mechanisms strengthen ecosystem integration and enhance innovation capacity and technological development. This demonstrates that governance operates through both formal and informal institutional arrangements.

Furthermore, leadership based on design thinking strengthens ecosystem coordination by promoting collaboration, experimentation, and collective innovation (Bathla et al., 2025). The authors demonstrate that leadership plays a central role in articulating actors and generating ecosystem value, highlighting the relational and cognitive dimensions of governance. This reinforces that ecosystem coordination depends on institutional articulation and strategic leadership capacity.

- *Category 3 — Relational Dynamics and Roles of Ecosystem Actors*

According to Lange et al. (2024), business angels play a fundamental role in ecosystem dynamics by providing financing, expertise, and networks that support startup development. Their findings demonstrate that these actors contribute to firm survival and growth, highlighting the importance of investment networks for ecosystem functioning. This reinforces that ecosystems depend on interactions among actors performing complementary functions.

Similarly, urban entrepreneurial ecosystems depend on interactions among local actors, infrastructure, and public policies, with spatial proximity serving as a key determinant of ecosystem development (Umar et al., 2025). The authors show that cities with dense collaborative networks demonstrate higher innovation capacity, reinforcing the importance of relational connectivity and territorial embeddedness.

Business model innovation also depends on interactions between firms and technological ecosystems, with networking acting as a critical mechanism for opportunity creation and innovation (Wang & Chebo, 2021). Their findings demonstrate that organizational adaptation occurs in response to ecosystem dynamics, reinforcing the relational nature of innovation processes.

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During global crises such as pandemics, innovation ecosystems play a central role in mobilizing resources, financing, and technological infrastructure, accelerating solution development (Duran-Fernandez et al., 2024). Their findings highlight the importance of coordination among actors in strengthening systemic response capacity, reinforcing the relational foundation of ecosystem effectiveness.

- *Category 4 — Evolution and Maturity of Innovation Ecosystems*

According to McLean et al. (2023), many innovation ecosystems remain in early stages of maturity, characterized by limited integration and incomplete implementation at scale. Their findings indicate that ecosystem consolidation depends on strengthening networks and expanding institutional capacity, confirming the evolutionary nature of ecosystems.

Similarly, the field of sustainable entrepreneurial ecosystems remains conceptually fragmented and continues to undergo scientific consolidation (Ninh & Hue, 2025). Their findings highlight the rapid expansion of ecosystem research while emphasizing the need for greater theoretical integration.

In the tourism sector, ecosystems face adaptation and resilience challenges, requiring new governance models and innovation strategies (Vukadin et al., 2025). These findings demonstrate that ecosystem evolution depends on adaptive capacity in response to environmental and societal changes.

- *Category 5 — Ecosystems As Mechanisms of Value Creation and Performance*

Innovation ecosystems play a central role in generating economic and technological value by accelerating technological development and strengthening global competitiveness (Tan et al., 2025). Their findings demonstrate that well-structured ecosystems enhance innovation capacity and technological production.

Similarly, circular business models depend on ecosystem integration to enable sustainable value creation (Islam et al., 2025). Their findings demonstrate that collaboration among actors enables overcoming structural barriers and strengthening innovation.

Leadership and design thinking also contribute to ecosystem value creation by promoting collaboration and collective innovation (Bathla et al., 2025). This reinforces that ecosystems function as structural mechanisms that sustain contemporary innovation.

- *Synthesis of Results*

Overall, the findings demonstrate that innovation ecosystems constitute complex and dynamic systems whose effectiveness depends on the interaction among structure, governance, actors, and evolutionary processes. Ecosystem architecture provides the structural foundation for resource articulation, while governance functions as a coordination mechanism that aligns interests, reduces uncertainty, and enables collaboration. Relational dynamics facilitate the circulation of knowledge, capital, and capabilities, strengthening ecosystem functionality. Furthermore, ecosystems evolve progressively toward higher levels of maturity, influenced by institutional, technological, and organizational factors. Ultimately, innovation ecosystems function as socio-institutional arrangements that integrate structure, governance, and relational dynamics, forming the foundation for innovation generation, diffusion, and sustainability in contemporary contexts.

V. CONCLUSION

The present study aimed to comparatively analyze the structure, governance, dynamics, and evolution of innovation ecosystems through an integrative literature review based on 17 studies selected from the Web of Science database. The investigation made it possible to understand how different ecosystems—including technological, regulatory, urban, entrepreneurial, and sustainable contexts—have been configured and transformed in response to increasing demands for innovation, competitiveness, and sustainable development. By synthesizing recent evidence, the study contributed to consolidating a systemic understanding of innovation ecosystems, demonstrating that their evolution results from the interaction among actors, institutional structures, collaborative networks, and distributed organizational capabilities.

The results revealed that innovation ecosystems operate as dynamic and multidimensional arrangements whose effectiveness depends on the articulation of collaborative governance mechanisms, relational networks, institutional infrastructure, and technological absorptive capacity. Ecosystem governance emerged as a structuring element responsible for aligning interests, coordinating actors, and promoting value co-creation, while factors such as financing mechanisms, mentorship networks, mission-oriented public policies, and acceleration initiatives contribute to strengthening ecosystem adaptive capacity and resilience. Furthermore, the findings indicated that ecosystem evolution is strongly conditioned by territorial, institutional, and technological factors, demonstrating that the consolidation of robust ecosystems requires integration between local capabilities, interorganizational collaboration, and structured institutional support.

It is concluded that innovation ecosystems represent complex socio-technical structures whose consolidation depends on the convergence of effective governance, actor cooperation, and the development of institutional and technological capabilities. As a theoretical contribution, this study advances the understanding of the structural and dynamic factors that sustain the formation and evolution of innovation ecosystems, providing an integrated analytical foundation for future research. From a practical perspective, the findings suggest that strengthening innovation ecosystems requires coordinated public policies, the promotion of collaborative networks, and continuous investment in infrastructure and capacity building,

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contributing to the development of more innovative, resilient, and sustainable environments.

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