Towards Effective Ecosystems: A Framework for Mapping Knowledge Governance and Management Activities of Innovation Ecosystems Constituent Elements

Gustavo Simas da Silva[a]
Graduate Program in Knowledge Engineering, Management and Media (EGC), Federal University of Santa Catarina (UFSC), Florianópolis, Brazil

Keywords: Innovation Ecosystems, Knowledge Ecosystems, Framework, Knowledge Management, Knowledge Governance.

Abstract: Innovation and knowledge ecosystems are integral parts of today's fast-paced global economy. However, the challenge of effectively governing and managing knowledge within these complex networks remains largely unaddressed. Through a scoping literature review, focusing on existing frameworks, models and best practices related to knowledge management and governance, this paper introduces the ARA (Actors, Resources, Actions) Framework. The framework serve as tool for mapping knowledge management and governance activities in operational, tactical and strategical levels with respect to the constituent elements of innovation ecosystems. A conceptual Entity Relationship Diagram (ERD) is developed, providing a visual representation of the relationships between actors, resources and actions, serving as a referential artifact for ecosystem database modeling. The paper concludes by discussing the practical implications of the ARA Framework for stakeholders and offering insights into future research and the combined utility with other models for innovation and knowledge ecosystems, such as Open Innovation frameworks and the Triple or Quadruple Helix models.

1 INTRODUCTION

Innovation ecosystems (IE) may be interpreted as complex networks of entities that collaborate to create and commercialize new ideas and technologies (Adatto et al, 2023). Within this context, Knowledge Management (KM) and Knowledge Governance (KG) have the role of facilitating the effective creation, sharing, and application of knowledge (Foster et al, 2023). It also involves coordinating the specialist knowledge of ecosystem members to foster collaboration and innovation (Bhatt, 2001; Angrisani, 2023).

Knowledge governance in innovation ecosystems involves the management and direction of innovation efforts within a broader context. It encompasses practices that align actors with roles and responsibilities, leading to value creation and the generation of innovations, technologies, and solutions (Safadi & Watson, 2023). Governance in innovation ecosystems is approached from different theoretical lenses, with a focus on network governance and the orchestration concept (Hoffmann et al, 2022). It also involves addressing major challenges in the management of uncertainty and complexity by linking transformative innovation policy with research perspectives from complex adaptive systems, ecosystems, and adaptive and participatory governance (Könnölä et al, 2021). Also, anticipatory innovation governance, which aims to create an enabling environment for innovation and support anticipatory innovation practices, is another aspect of knowledge governance in innovation ecosystems (Minna & Trina, 2022).

Although the significance of knowledge management and governance in innovation ecosystems is widely acknowledged, the academic and practical literature is yet to present a comprehensive framework that delineates the primary aspects and activities involved. Existing work has primarily focused on the individual components of governance, such as role alignment, value creation, and managing uncertainty, among

[a] https://orcid.org/0000-0003-3485-7910

Simas da Silva, G.
Towards Effective Ecosystems: A Framework for Mapping Knowledge Governance and Management Activities of Innovation Ecosystems Constituent Elements.
DOI: 10.5220/0012251900003598
In *Proceedings of the 15th International Joint Conference on Knowledge Discovery, Knowledge Engineering and Knowledge Management (IC3K 2023) - Volume 3: KMIS*, pages 99-106
ISBN: 978-989-758-671-2; ISSN: 2184-3228

others (Velu, 2015; Tang et al, 2020; de Vasconcelos Gomes et al, 2021; de Freitas Nascimento et al, 2022; Ferreira et al, 2023).

However, these fragmented approaches do not offer an integrated view, leaving a gap in our understanding of how these elements coalesce to govern knowledge effectively within innovation ecosystems. Given this, the current paper aims to address this research problem by proposing a cohesive framework that integrates these disparate aspects. Through a scoping review, the framework will endeavor to identify and align the key constituent elements of innovation and knowledge ecosystems, in order to map knowledge governance and management activities, facilitating a more effective intervention within IE. It seeks to bridge theoretical contributions with practical implementations, also providing actionable insights for researchers, policymakers and industry practitioners alike.

2 THEORETICAL BACKGROUND

The current section offers precise definitions of key terms related to knowledge governance and innovation ecosystems. Establishing this common vocabulary is essential for a focused analysis of the ARA Framework's role in these contexts.

2.1 Definition of Innovation Ecosystems and Knowledge Ecosystems

Innovation ecosystems and knowledge ecosystems are terms that have gained considerable prominence in both academic and practitioner discourses over the past few decades. While they share similarities, they each bring distinct frameworks, objectives, and historical developments to the table.

The term "innovation ecosystem" first gained attention in the early 1990s, rooted in business and management literature by Moore (2016). It conceptualizes an interconnected set of actors—such as startups, corporations, universities, and policymakers—that collaborate to foster innovation. Over time, multiple frameworks have been proposed to analyze innovation ecosystems; prominent among them is the Triple Helix model (Etzkowitz & Leydesdorff, 1995), lately extended to a Quadruple and Quintuple Helix model, which explores the relationship among universities, industry and government (Carayannis & Campbell, 2010).

Knowledge Ecosystems (KE), while sharing some similarities with innovation ecosystems, mainly focus on the flow, management and utilization of knowledge. This term emerged in the early 2000s within the field of information science and technology (Valkorari, 2015). Frameworks like the SECI model (Nonaka & Takeuchi, 2007), which describes the conversion of tacit to explicit knowledge, and the Cynefin (Snowden & Boone, 2007) have played a pivotal role in the mapping and sense making of complex scenarios in the Knowledge Society.

Both innovation and knowledge ecosystems have evolved to accommodate the complex, fast-changing nature of the digital era. The quadruple/quintuple helix model, for instance, expands the triple helix to include civil society and environmental perspectives (Carayannis & Campbell, 2010) and the transition from "stocks" to "flows'"of knowledge reflects the influence of digitization and network theories (Hustad & Teigland, 2008).

With time, innovation and knowledge ecosystems have garnered scholarly attention across social sciences, health sciences, engineering, and other fields, exploring a wide range of perspectives about their aspects. Papaioannou et al (2009) caution against a reductive approach to KE devoid of historical context, while others advocate for their utility in grasping the collaborative and evolutionary aspects of innovation. Mercier-Laurent (2018) and Tejero et al (2020) explore technological enablers like AI-based platforms and knowledge graphs, which offer new avenues for advanced analysis and insights about ecosystems. Tang et al (2020) and Spena (2016) emphasize the efficiency of knowledge networks and specific knowledge practices in facilitating learning and innovation in IE.

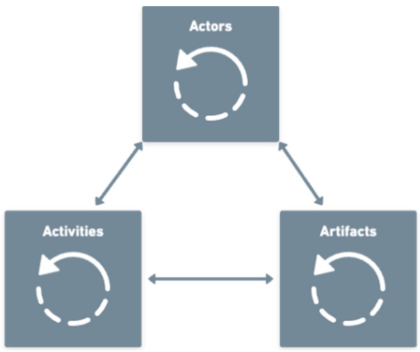

Figure 1: Illustration of IE definition. Source: Adapted from Granstrand and Holgersson (2020).

In essence, the literature collectively highlights the complex nature of KE and IE, suggesting that they serve as collaborative, evolving networks that are supported by a range of technological and managerial practices.

More recently, Granstrand and Holgersson (2020), through an extensive literature review and conceptual analysis, aimed to bring a clear definition of IE, being "the evolving set of actors, activities, and artifacts, and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance of an actor or a population of actors". In their work, innovation ecosystems are composed of three core entities that interact mutually: actors, artifacts and activities. This representation is presented graphically in Figure 1. This conceptualization broadens the scope beyond traditional definitions, which primarily emphasized collaboration and knowledge sharing among actors.

In this updated definition, actors include a diverse range of participants like producers, consumers, and regulators; artifacts extend beyond mere products to include intangible resources and various system inputs like technology and intellectual property; activities in the ecosystem encompass not only collaboration but also competition, knowledge sharing, and social and economic exchanges.

By including these interrelated elements, the authors aim for a more nuanced understanding of how IE function and can be effectively managed. And this clear conceptual definition serve as a basis for the proposed framework.

2.2 Knowledge Governance and Management in Innovation Ecosystems

Although interconnected, Knowledge Management and Knowledge Governance serve different functions within an organization or ecosystem. KM is primarily concerned with the systematic processes for capturing, storing, and sharing information and expertise (Santos & Zattar, 2019). Its focus is operational, aiming to optimize the day-to-day handling of knowledge assets and facilitate their seamless transfer among individuals and departments. In contrast, Knowledge Governance encompasses a broader set of activities that include the formulation of policies, procedures and norms to guide how knowledge is acquired, utilized, and disseminated (Giebels et al, 2016). While KM provides the tools and techniques for effective knowledge flow, KG provides the strategic framework that defines the "why" and "how" of knowledge utilization, addressing issues such as ownership, control, and ethical considerations. Therefore, Knowledge Governance acts as an overarching structure that sets the stage for knowledge management activities, ensuring alignment with organizational objectives and ethical norms.

Regarding Innovation Ecosystems, Carayannis and Campbell (2011) argue that the intricacies of KM in IE necessitate a dedicated system for knowledge production. Their framework emphasizes that the central challenge is not merely the transfer of knowledge among organizational actors but also its translation into actionable innovation—whether in products, services, or novel solutions. This sentiment underscores the vital role of KG in forging symbiotic relationships among diverse ecosystem participants, ranging from academia to industry. Furthermore, Carayannis (2014) suggests that such governance is facilitated by the multi-organizational presence of individuals, like academics, who can act as conduits for knowledge between research settings and practical applications.

Santos and Zattar (2019) delineate paths to effectively implement KM within IE, indicating several key strategies which must be adopted. First, acquiring relevant information is critical to reducing systemic uncertainty and enhancing the ecosystem's capacity for knowledge absorption. Second, breaking down complex bodies of knowledge into manageable units can simplify the learning process and facilitate its dissemination. Structuring circulating knowledge also aids in diminishing ambiguity, providing a clearer pathway for decision-making. Establishing a robust knowledge production system is pivotal not only for governing these complex knowledge flows but also for augmenting the intellectual capital that undergirds the ecosystem's development. The collaborative integration of diverse stakeholders—ranging from research centers and universities to entrepreneurs and established corporations—fuels a dynamic knowledge flow. This multi-agent interaction not only enriches the ecosystem's intellectual repository but also serves as a cornerstone for its long-term success and adaptability.

Also, in support of KM and KG, knowledge engineering serves as the bedrock for designing, developing and managing the content, practices and relationships that facilitate innovation. The primary purpose here is to construct formal knowledge representations, typically using ontologies or semantic web technologies, to enable more efficient discovery, sharing and recombination of innovative ideas and technologies (O'Leary, 1998). Activities might include knowledge extraction from multiple sources, building intelligent systems capable of problem-solving, and creating advanced algorithms to analyze patterns in data to predict future innovations. The implications are profound: well-executed knowledge engineering can significantly amplify the collective intelligence of an innovation ecosystem, thereby accelerating the pace of innovation and reducing redundancies (Kendal & Creen, 2007; Mercier-Laurent, 2020; Tejero et al, 2020). However, it's crucial that this engineering be conducted with an eye to ethical considerations and the broader impacts on the ecosystem's stakeholders, including the potential for unequal access to benefits (de Kreuk et al., 2009; Bryan & Gezelius, 2017; Stahl, 2022) and in accordance with KG strategies.

3 THE ARA FRAMEWORK

Rooted in the foundational work by Granstrand and Holgerssson (2020), who initially conceptualized the relationships among Actors, Artifacts and Activities within IE, the Actors-Resources-Actions (ARA) framework adapts and expands on these original constructs, aligning the structure more closely with the specific requirements of KG and KM. Through this engineering, the ARA framework aims to offer a closer approach to KG and KM, accommodating the complexities and demands of IE and KE constituent elements.

Figure 2: ARA Framework with indicated KG and KM activities. Source: the authors.

The framework, with indicated KG and KM demands for each aspect in Figure 2, serve as a tool for orchestrating the various elements in IE, spanning operational, tactical and strategic layers —layers original from military doctrine but adapted for use in business management and other fields (McNair & Vangermeersch, 2020). On the operational end, it encapsulates foundational activities such as mapping actors and profiling their skills and motivations, creating a comprehensive inventory of resources and laying down the essential technology infrastructure.

These activities set the stage for tactical interventions, where talent management comes into play, roles and accountabilities are clearly defined, and intellectual property (IP) is safeguarded. Capacity building through a network of mentors and careful actor-resource matching ensures optimal utilization of available assets. The tactical layer also involves asset valuation, making sure that all resources, whether tangible or intangible, are appropriately valued for actions, whenever necessary.

These tactical considerations prepare the ground for strategic maneuvers in the ecosystem, including meticulous action-resource matching and long-term governance of innovation and knowledge. It is, also, at this level that actions such as cultural facilitation and knowledge curation may be concentrated, aiming to sustain an ecosystem that is not only innovative but also resilient.

With a keen focus on aligning actions with resources and actors, the ARA framework aims to create a self-sustaining loop of continuous improvement and value creation, thereby ensuring the ecosystem's long-term viability and impact.

3.1 Actors

Actors in innovation ecosystems refer to the diverse human or non-human entities that participate in the ecosystem, including companies, educational organizations, policy makers and third-party actors.

Here, the Triple/Quadruple/Quintuple Helix models (Carayannis & Campbell, 2010) may come into play in order to categorize into a more specified ontology the different existing actors within the IE.

Matt et al. (2021) emphasize the role of three ecosystem actors - companies, educational organizations, and regional policy makers - in enabling and fostering the adoption of new industry standards. These actors bring different assets to the ecosystem, such as technological expertise, research capabilities and policy support.

Also, the innovation ecosystem can be viewed as a multilevel structure formed by different layers of actors. Beliaeva et al. (2019) propose a four-layer structure, including the focal company, a community of innovation, an innovation habitat, and an innovation ecosystem. Each layer represents different types of actors and their relationships within the ecosystem. The diversity of actors within the ecosystem is paramount for its support of digital entrepreneurship and innovation. The more diverse the actors and their assets, the more prolific the ecosystem becomes.

3.2 Resources

Resources in IE refer to the assets, capabilities, and knowledge that actors bring to the ecosystem. The resources (tangible or intangible) brought by actors in IE contribute to the overall ecosystemic innovation potential. These resources may include financial capital, human skills, intellectual property, and technological capabilities. The diversification and quality of these resources can significantly affect the ecosystem's overall ability to innovate and adapt. For example, intangible resources like social capital and tacit knowledge can be just as critical as financial resources in promoting ecosystemic collaboration and co-creation (Adner, 2017).

3.3 Actions

Actions in innovation ecosystems refer to the activities, interactions and interventions undertaken by actors to drive innovation and ecosystem development. The actions of actors in innovation ecosystems can range from R&D activities to training, networking, startups incubation and acceleration programs, policy interventions and other innovative initiatives. To foster the adoption of emerging economic approaches, such as "Industry 4.0" or "5.0", it's crucial not only to focus on R&D activities but also to engage in interorganizational actions like training and networking that involve all ecosystem actors. Further, the development and success of innovation ecosystems hinge on the effective alignment and coordination between various participating entities in integrated actions (Matt et al., 2021; Santos et al., 2021).

3.4 Conceptual ERD

A conceptual Entity-Relationship Diagram (ERD) was developed to visually represent the possible relationships between the Actors, Resources and Actions entities, serving as a graphical foundation for database modeling in alignment with the ARA framework, as presented in Figure 3. The attributes in the ERD are merely suggestions and can be expanded or refined as per the specific requirements. An ERD is a conceptual blueprint that graphically depicts the structure of a database, illustrating how entities are related to one another (Frantiska, 2017). It outlines how different entities (such as tables) relate to each other, specifying relationships through primary keys (PK) and foreign keys (FK). A primary key is a unique identifier within a table, ensuring that each record is distinct. A foreign key, on the other hand, is a field in one table that matches the primary key in another table, establishing a linkage between them. The use of PKs and FKs helps maintain data integrity and enables complex queries and operations.

In this design, an actor can engage in multiple actions, and reciprocally, an action can involve numerous actors (many-to-many relationship). This ability to accommodate multiplicity reflects the real-world complexity of innovation and knowledge ecosystems, where collaborative actions often involve multiple stakeholders. The relational structure extends to actions and resources as well, allowing an action to be associated with multiple resources and vice versa. This is particularly important for understanding how diverse resources—be they tangible or intangible—can be leveraged across various initiatives within an innovation ecosystem. Moreover, a resource can be linked to multiple actors and vice versa, which enables the model to capture scenarios of commons (Hess & Ostrom, 2007), resource sharing, co-ownership or even competition among various entities.

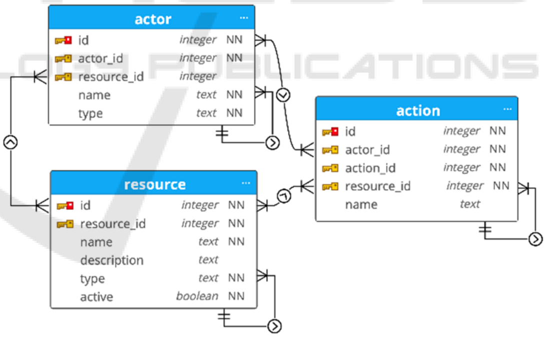

Figure 3: ARA conceptual ERD. Source: the authors.

The framework also incorporates self-referencing hierarchies within each of the three entities. For instance, an actor at an institutional level could function as a parent entity that envelopes several individual-level actors, thus representing an organizational hierarchy. The same principle applies to resources, where a high-level resource like an infrastructure could encompass other, more specialized resources. As for actions, a macro-level action could serve as an umbrella for multiple, interconnected sub-actions. This hierarchical representation is critical for modeling the often nested structures encountered in IE, thereby enhancing the granularity and depth of knowledge governance studies.

4 CONCLUSIONS AND PERSPECTIVES

Effective knowledge management in innovation ecosystems hinges on a synergistic blend of various actions, such as knowledge creation, validation, and dissemination, necessitating shifts in organizational culture and technology adoption (Bhatt, 2001; Spena et al, 2016). Central to the ecosystems are diverse actors—ranging from firms and educational institutions to individuals—who not only facilitate the knowledge and other tangible or intangible resources flow but also take on specialized roles, like universities serving as regional innovation leaders (Pucci et al., 2018; Yalcin, 2022). Knowledge frameworks aid in the streamlined flow of knowledge among these actors, enhancing both exploration and exploitation stages of innovation (Secundo et al., 2018). Lead firms, equipped with both open and closed action strategies, are vital in this milieu for managing knowledge and accelerating the rate of innovation, thus stimulating the entire ecosystem (Velu, 2015).

The proposed framework's principal limitation is its generic nature, which might overlook specific, nuanced attributes of particular ecosystems or sectors. Also, the framework is built to be more oriented towards business relationships and may require adaptations to fully capture the intricacies of social, environmental or public policy dynamics. Furthermore, the framework may be less effective in rapidly changing environments where the identification of stable actors, resources or actions becomes challenging.

The Dynamic Capabilities (Teece et al, 1997) and the concept of Absorptive Capacity (Camisón & Forés, 2010) offer lenses through which an organization's ability to adapt, learn, and innovate can be understood. These theories can guide the Actions and Actors elements in the ARA Framework, helping to pinpoint where capacity building or training may be needed to maximize the potential for innovation. Social paradigms like Communities of Practice (Wenger, 1998) and Social Network Analysis offer social and relational perspectives. They particularly inform the Actors element, illustrating how tacit knowledge and social capital flow within and between organizations and can be mapped for more effective KG.

Future research can focus on customizing the ARA framework for specific ecosystem types, such as platform ecosystems, local or regional innovation hubs, and smart city initiatives. Investigating how the ARA framework interacts with other innovation and knowledge ecosystem frameworks can also provide valuable insights. For example, connecting the ARA model with frameworks of Open Innovation (Enkel et al, 2011), Triple or Quadruple Helix (Schütz et al, 2019) and Sustainability models (Liu & Stephens, 2019) could offer a more comprehensive view of ecosystem dynamics. Empirical studies are encouraged to test these integrations across diverse sectors.

The current scenario indication is that innovative frameworks for knowledge governance have the potential to serve as catalysts in the evolution of a Knowledge Society that continually adapts, learns and thrives, fostering sustainable, innovative and knowledge-rich ecosystems.

REFERENCES

Adatto, L., Aouinaït, C., Le, S. T. K., & Mongo, M. (2023). Innovation Ecosystems in the New Economic Era (No. emse-04099899).

Adner, R. (2017). Ecosystem as structure: An actionable construct for strategy. Journal of management, 43(1), 39-58.

Angrisani, M., Cannavacciuolo, L., & Rippa, P. (2023). Framing the main patterns of an academic innovation ecosystem. Evidence from a knowledge-intensive case study. International Journal of Entrepreneurial Behavior & Research, 29(11), 109-131.

Beliaeva, T., Ferasso, M., Kraus, S., & Damke, E. J. (2019). Dynamics of digital entrepreneurship and the innovation ecosystem: A multilevel perspective. International Journal of Entrepreneurial Behavior & Research, 26(2), 266-284.

Bhatt, G. D. (2001). Knowledge management in organizations: examining the interaction between technologies, techniques, and people. Journal of knowledge management, 5(1), 68-75.

Bryden, J., & Gezelius, S. S. (2017). Innovation as if people mattered: The ethics of innovation for sustainable development. Innovation and development, 7(1), 101-118.

Camisón, C., & Forés, B. (2010). Knowledge absorptive capacity: New insights for its conceptualization and measurement. Journal of Business Research, 63(7), 707-715.

Carayannis, E. G. (2014). Strategic knowledge arbitrage and serendipity (SKARSE™) in action. Journal of the Knowledge Economy, 5, 203-211.

Carayannis, E. G., & Campbell, D. F. (2010). Triple Helix, Quadruple Helix and Quintuple Helix and how do knowledge, innovation and the environment relate to each other?: a proposed framework for a trans-disciplinary analysis of sustainable development and social ecology. International Journal of Social Ecology and Sustainable Development (IJSESD), 1(1), 41-69.

Carayannis, E. G., & Campbell, D. F. (2011). Open innovation diplomacy and a 21st century fractal research, education and innovation (FREIE) ecosystem: building on the quadruple and quintuple helix innovation concepts and the "mode 3" knowledge production system. Journal of the Knowledge Economy, 2, 327-372.

de Freitas Nascimento, S., Lima, M. C., & Gondim, I. J. C. (2022). Level of collaboration and knowledge transfer among actors of the innovation ecosystem: the proposition of an analytical model. International Journal of Innovation: IJI Journal, 10(3), 434-460.

de Kreuk, M., van de Poel, I., Zwart, S. D., & van Loosdrecht, M. C. (2010). Ethics in innovation: Cooperation and tension (pp. 215-226). Springer Netherlands.

de Vasconcelos Gomes, L. A., de Faria, A. M., Borini, F. M., Chaparro, X. A. F., Dos Santos, M. G., & Amaral, G. S. G. (2021). Dispersed knowledge management in ecosystems. Journal of Knowledge Management, 25(4), 796-825.

Dos Santos, D. A. G., Zen, A., & Bittencourt, B. A. (2021). From governance to choreography: coordination of innovation ecosystems. Innovation & Management Review, 19(1), 26-38.

Enkel, E., Bell, J., & Hogenkamp, H. (2011). Open innovation maturity framework. International Journal of Innovation Management, 15(06), 1161-1189.

Etzkowitz, H., & Leydesdorff, L. (1995). The Triple Helix--University-industry-government relations: A laboratory for knowledge based economic development. *EASST review*, *14*(1), 14-19.

Ferreira, J. J., Fernandes, C. I., Veiga, P. M., & Dooley, L. (2023). The effects of entrepreneurial ecosystems, knowledge management capabilities, and knowledge spillovers on international open innovation. R&D Management, 53(2), 322-338.

Foster, L., Wiewiora, A., & Donnet, T. (2023). Integrating Knowledge Management and Governance for Innovation Outcomes: A New Framework for Managing Innovation in a Project Environment. Journal of the Knowledge Economy, 1-28.

Frantiska, J. (2018). Entity-relationship diagrams. Visualization Tools for Learning Environment Development, 21-30.

Giebels, D., van Buuren, A., & Edelenbos, J. (2016). Knowledge governance for ecosystem-based management: Understanding its context-dependency. Environmental Science & Policy, 55, 424-435.

Granstrand, O., & Holgersson, M. (2020). Innovation ecosystems: A conceptual review and a new definition. Technovation, 90, 102098.

Hess, C., & Ostrom, E. (2007). Introduction: An overview of the knowledge commons. In Understanding Knowledge as a Commons: From Theory to Practice (pp. 3-26). MIT Press.

Hoffmann, M. G., Murad, E. P., Lemos, D. D. C., Farias, J. S., & Sanches, B. L. (2022). Characteristics of Innovation Ecosystem's Governance: an Integrative Literature Review. International Journal of Innovation Management, 26(08), 2250062.

Hustad, E., & Teigland, R. (2008). Implementing social networking media and web 2.0 in multinationals: Implications for knowledge management. In Proceedings of the 9th European conference on knowledge management (Vol. 323331).

Kendal, S. L., & Creen, M. (2007). An introduction to knowledge engineering (pp. 1-25). Springer London.

Könnölä, T., Eloranta, V., Turunen, T., & Salo, A. (2021). Transformative governance of innovation ecosystems. Technological Forecasting and Social Change, 173, 121106.

Liu, Z., & Stephens, V. (2019). Exploring innovation ecosystem from the perspective of sustainability: Towards a conceptual framework. Journal of Open Innovation: Technology, Market, and Complexity, 5(3), 48.

Matt, D. T., Molinaro, M., Orzes, G., & Pedrini, G. (2021). The role of innovation ecosystems in Industry 4.0 adoption. Journal of Manufacturing Technology Management, 32(9), 369-395.

McNair, C. J., & Vangermeersch, R. (2020). Total capacity management: Optimizing at the operational, tactical, and strategic levels. CRC Press.

Mercier-Laurent, E. (2020). Platform for knowledge society and innovation ecosystems. In Artificial Intelligence for Knowledge Management: 6th IFIP WG 12.6 International Workshop, AI4KM 2018, Held at IJCAI 2018, Stockholm, Sweden, July 15, 2018, Revised and Extended Selected Papers 6 (pp. 34-47). Springer International Publishing.

Minna, T., & Taina, T. (2022). Anticipatory Innovation Governance Model and Regional Innovation Ecosystems Supporting Sustainable Development. AHFE international.

Moore, J. F. (2006). Business ecosystems and the view from the firm. The antitrust bulletin, 51(1), 31-75.

Nonaka, I., & Takeuchi, H. (2007). The knowledge-creating company. Harvard business review, 85(7/8), 162.

O'Leary, D. E. (1998). Using AI in knowledge management: Knowledge bases and ontologies. IEEE Intelligent Systems and Their Applications, 13(3), 34-39.

Papaioannou, T., Wield, D., & Chataway, J. (2009). Knowledge ecologies and ecosystems? An empirically grounded reflection on recent developments in innovation systems theory. Environment and Planning C: Government and Policy, 27(2), 319-339.

Pucci, T., Runfola, A., Guercini, S., & Zanni, L. (2018). The role of actors in interactions between "innovation ecosystems": drivers and implications. *IMP Journal*, *12*(2), 333-345.
Safadi, H., & Watson, R. T. (2023). Knowledge monopolies and the innovation divide: A governance perspective. Information and Organization, 33(2), 100466.
Santos, M. L. B., & Zattar, I. C. (2019). The importance of knowledge management for the functioning of innovation ecosystems. Journal on Innovation and Sustainability, 10(1), 48-56.
Schütz, F., Heidingsfelder, M. L., & Schraudner, M. (2019). Co-shaping the future in quadruple helix innovation systems: uncovering public preferences toward participatory research and innovation. She Ji: The Journal of Design, Economics, and Innovation, 5(2), 128-146.
Secundo, G., Toma, A., Schiuma, G., & Passiante, G. (2019). Knowledge transfer in open innovation: A classification framework for healthcare ecosystems. Business Process Management Journal, 25(1), 144-163.
Snowden, D. J., & Boone, M. E. (2007). A leader's framework for decision making. *Harvard business review*, *85*(11), 68.
Spena, T. R., Trequa, M., & Bifulco, F. (2016). Knowledge practices for an emerging innovation ecosystem. International Journal of Innovation and Technology Management, 13(05), 1640013.
Stahl, B. C. (2022). Responsible innovation ecosystems: Ethical implications of the application of the ecosystem concept to artificial intelligence. International Journal of Information Management, 62, 102441.
Tang, H., Ma, Z., Xiao, J., & Xiao, L. (2020). Toward a more efficient knowledge network in innovation ecosystems: A simulated study on knowledge management. Sustainability, 12(16), 6328.
Teece, D. J., Pisano, G., & Shuen, A. (1997). Dynamic capabilities and strategic management. Strategic management journal, 18(7), 509-533.
Tejero, A., Rodriguez-Doncel, V., & Pau, I. (2020). Knowledge graphs for innovation ecosystems. arXiv preprint arXiv:2001.08615.
Valkokari, K. (2015). Business, innovation, and knowledge ecosystems: How they differ and how to survive and thrive within them. Technology innovation management review, 5(8).
Velu, C. (2015). Knowledge management capabilities of lead firms in innovation ecosystems. AMS review, 5, 123-141.
Wenger, E. (1998). Communities of practice: Learning as a social system. Systems thinker, 9(5), 2-3.
Yalcin, E. (2022, November). Universities of Applied Sciences 'Leadership Role in Regional Innovation Ecosystems. In European Conference on Management Leadership and Governance (Vol. 18, No. 1, pp. 439-446).