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CHARACTERISTICS OF INNOVATION ECOSYSTEMS' GOVERNANCE: AN INTEGRATIVE LITERATURE REVIEW

MICHELINE GAIA HOFFMANN*, ELISA PEREIRA MURAD*,‡,
DANNYELA DA CUNHA LEMOS*, JOSIVANIA SILVA FARIAS† and
BEATRIZ LANCELLOTTI SANCHES*

*Santa Catarina State University, Brazil
†University of Brasília, Brazil
‡murad.elisa@gmail.com

The research aims to systematise governance characteristics of innovation ecosystems (IE) through an integrative literature review from SciELO, Scopus, and WOS since there is little research discussing governance applied to IE. The following categories emerged from the content analysis: governance approach; actors and roles; the relationship among actors; coordination mechanisms; common objective and value cocreation; goals and evaluation. The results show that governance is approached from different theoretical lenses, with the predominance of literature on network governance. There is also an emphasis on the orchestration concept. Furthermore, results suggest that IE governance is related to practices that align actors with roles and responsibilities oriented to common objectives, leading to value creation. The involvement of actors who collaboratively develop trust and capabilities, share knowledge and information, and generate innovations, technologies, and solutions, stands out. These collaborations may be organic and self-organised or deliberate and orchestrated.

Keywords: Governance; innovation ecosystems; collaboration; orchestration; networks.

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‡ Corresponding author.

Introduction

The concept of innovation ecosystems (IEs) is based on the recognition of innovation as a complex phenomenon that requires interactions and collaboration between different actors with different natures and competence (Dedehayir *et al.*, 2022; Kim *et al.*, 2015; Prokop *et al.*, 2019; Stahl, 2022; Tether, 2002; Tidd and Bessant, 2015). IE is a recent concept inspired by Moore's (1993) business ecosystems and inaugurated in the study by Adner (2006). In the past few years, it has gained space and attention from researchers in strategy, innovation, and entrepreneurship used and interpreted from different perspectives (Cobben *et al.*, 2022; Gomes *et al.*, 2016; Stahl, 2022), reinforcing the relevance of discussing its meaning and definition. The breadth of the concept has increased the debate on its usefulness. For Pushpananthan and Emlquist (2022), this usefulness is related to improving conceptual rigor, reducing ambiguity, and building a synthesised definition leading to an increased consensus among scholars. The challenge around the concept of IE, associated with the ambiguity observed in other elements relevant to the theory and practice addressing this subject, opens many research avenues. This study intends to broaden the understanding of IE governance, a topic little explored in the literature and essential to these collaborative arrangements' operationalisation.

For Granstrand and Holgersson (2020, p. 1), "an innovation ecosystem is the evolving set of actors, activities, and artefacts, 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." Arena *et al.* (2022, p. 432) characterise IE as "structures of interconnected entities, that, thanks to dynamic horisontal relations, support new grounding, exchange, and strengthening of dispersed competences and resources to create innovations and value." Thus, among the myriad of articles that discuss the concept (Cobben *et al.*, 2022), a core idea is the complex relationship among actors oriented to value creation (Adner, 2017; Auria *et al.*, 2016; Gomes *et al.*, 2016; Pushpananthan and Elmquist, 2022; Stahl, 2022).

Collaborative alliances for innovation can be formed by actors such as universities and research institutes, government, companies, suppliers, customers, competitors, consultancies, investors, and others (Faria *et al.*, 2010; Laursen and Salter, 2006; Luoma *et al.*, 2010; Pushpananthan and Elmquist, 2022; Tether, 2002). From the IE perspective, the importance of the triad formed by universities, governments, and businesses lies in creating interactive relationships, forming hybrid organisations that allow exploring the complementarities of the three sets of actors that make up the Triple Helix (Leydesdorff and Etzkowitz, 1996). More recently, civil society gained space in the model, in its social and natural context, with the

recognition of the fourth (Carayannis and Campbell, 2009) and even the fifth helix—i.e., the environment as an essential element in the production of knowledge and innovation (Carayannis and Campbell, 2011).

These are actors with different interests and vocations faced with the challenge of cocreating a value proposition in the context of a collaborative network. Governing this network is challenging, given the diversity of actors involved, the power and information asymmetry, the conflicts of interest, and the different views on achieving common goals. Also, interactions become complex and critical as they combine cooperation and competition (Pushpananthan and Elmquist, 2022). In this context, it is necessary to design a coordination structure to organise collective action and achieve common goals, i.e., there must be an effort in terms of governance (Wegner and Verschoore, 2021; Li *et al*., 2022).

However, it is still uncertain which governance characteristics can help with the challenges faced in innovation ecosystems. The literature offers some clues, conceptualising and characterising types of governance favourable to collaborative processes and the context of networks. However, studies specifically focusing on governance characteristics in innovation ecosystems are scarce.

Collaborative governance has been considered a model representing a response to problems related to integration and trust within and among institutions, where decisions result from a complex process of cooperative adjustment. This process works in multiple directions and levels, focusing on the individual and collective goals to be achieved, and allowing freedom of creation and innovation within the legal and strategic principles of the common good (Freire *et al*., 2017; Rizzati, 2020). This type of governance has been considered promising to increase coordination between the actors involved in favour of innovation (Ansell and Torfing, 2021; Crosby *et al*., 2017; Lopes and Farias, 2022). However, some authors denounce that the degree to which this assumption has been assumed is not accompanied by empirical studies that reveal the characteristics of governance that favour collaborative innovation (Gestel and Grotenbreg, 2021; Lopes and Farias, 2022).

Bressers and Kuks (2003) propose a framework composed of five elements that make up governance to guide studies on the subject: 1—levels; 2—actors in the policy network; 3—perception of the problem and objectives; 4—strategies and instruments; and 5—resources and organisation of implementation. For the author, the model must answer the following questions: Where? Who? What? How? and with what? What he considers "modern" governance has the following characteristics: multi-level, multi-actor, multi-faceted, multi-instrumental, and based on multiple resources. However, this framework does not discuss IE governance.

Wegner and Verschoore (2021) also point out that despite advances in network governance modes, there are still gaps, especially concerning micro-governance,

composed of the functions and practices carried out daily by leaders and which make collaboration happen. However, these authors do not develop the discussion on innovation ecosystems, even though the concept of IE is directly connected to the literature on networks.

Spena *et al.* (2017) reinforce this gap, denouncing that IE governance is still a vague topic in the literature. In the same vein, Foguesatto *et al.* (2021) point to understanding governance and forms of governance in different IEs as latent avenues for research in the field. Thus, this article asks: What are the governance characteristics of innovation ecosystems? The study addresses this research question by systematising governance characteristics in IEs based on an integrative literature review.

The research results are expected to clarify the still ambiguous governance characteristics that favour the development of IE (Spena *et al.*, 2017; Foguesatto *et al.*, 2021). They should contribute to mitigating challenges related to integration, collaboration, collective learning, and coordination in a context where the diversity of actors and the horisontality of relationships are necessary, even though they are potential sources of conflict and disarray.

This study contributes to the literature by offering a synthesis matrix of the characteristics of IE governance, emerging from the effort to categorise the literature review findings. Its theoretical relevance is also anchored in Pushpananthan and Elmquist (2022), who argue, as mentioned before, that the IE concept's usefulness depends on a synthesised definition encompassing the elements that form such an ecosystem. Thus, the synthesis matrix is expected to subsidise the construction of theoretical-analytical models for future research, contributing to filling the gap highlighted by Gestel and Grotenbreg (2021) of empirical evidence of governance characteristics in environments where collaborative innovation is developed.

In addition to theoretical advances, the study intends to explain to policymakers key elements of governance to promote the development of IE. It also seeks to support managers who work within the ecosystem to improve their performance and the conditions for engagement in collaborative processes. These managers may be operating in companies interested in taking advantage of the ecosystem's dynamics to establish partnerships to develop new products or services (Gomes *et al.*, 2022). The research can contribute to government agencies' managers, research institutes, technology transfer centres, incubators, and technology parks, who usually work to facilitate interactions within IE.

The next section presents a theoretical framework for IEs, followed by the methodology adopted. The fourth and fifth sections present and discuss the results, offering an overview of the articles researched and the categories elaborated based on the analyses. The last section provides the final considerations, followed by the references.

Governance and Innovation Ecosystems

The IE is considered a promising approach in the literature on innovation, strategic management, and entrepreneurship, which has been discussed under different interpretations (Gomes *et al*., 2016). As this concept is gaining notoriety (Granstrand and Holgersson, 2020), the number of studies analysing collaboration among actors to generate value through IEs has increased, becoming an interdisciplinary topic (Stahl, 2022), published by scientific journals with a comprehensive scope (Foguesatto *et al*., 2021).

As a recent concept, the main discussions started around the 2000s, inspired by the business ecosystem approach proposed by Moore (1993). The author argued that a company is not simply a member of the industry but is part of an ecosystem involving a variety of industries. In business ecosystems, companies develop their capabilities based on innovation, acting cooperatively and competitively to develop new products and innovations. Adner (2006) adopted this understanding and presented the concept of IE as collaborations among companies, so individual offers are combined into a coherent customer-centred solution. Cobben *et al*. (2022) conducted a literature review on ecosystems and identified four main types of IE: business, innovation, entrepreneurial, and knowledge ecosystems. The authors also mentioned the digital and platform ecosystems as a subtype of IE.

Although often related, IE differs from the concepts of innovation systems and innovation networks. Innovation systems deal with interactions in which products and processes are developed from the activities of various actors, mediated by institutions and policies. Innovation networks are related to combining knowledge and learning from organisations to meet market needs (Auria *et al*., 2016).

Thus, IE advances by addressing the complex relationship of interdependent actors involved in value-creating activities (Adner, 2017; Auria *et al*., 2016; Dedehayir *et al*., 2022; Gomes *et al*., 2022; Stahl, 2022), allowing us to understand the new complexities and dynamics of innovative contexts (Auria *et al*., 2016). For Gomes *et al*. (2016), IE refers to the joint creation of value composed of interconnected and interdependent actors, such as companies, customers, suppliers, innovators, and regulatory agents. For the authors, cooperation and competition relations are perpetuated in an ecosystem with a life cycle and immersed in a co-evolution process.

Some authors develop the concept of IE, emphasising a common technological platform (Gomes *et al*., 2022; Pushpananthan and Elmquist, 2022). For example, Gomes *et al*. (2022) highlight that the IE literature has contributed to understanding innovation by proposing a framework that explains the complex partnerships companies establish to capture value, arguing that they do this based on common technology platforms. Technology platforms range from architectures that

facilitate innovation using open interfaces that complementors can easily access, to rules and architectures created to mediate transactions. For the authors, although some technological platforms are limited to a single country, many seek global complementors that offer access to more diverse knowledge. This is particularly relevant for breakthrough innovation. Thus, they introduce the concept of global innovation ecosystems—GIE.

Massa *et al*. (2022) expand the IE perspective by addressing the intersection between business and knowledge ecosystems, adopting the concept developed by Ghazinoory *et al*. (2021) of "innovation ecotone," or "a transitional area populated by a hybrid network of actors in either the knowledge or business ecosystem, which we refer to as technology transfer network (TTN), where the Research Organisations constitutes the center" (Massa *et al*., 2022, p. 1). It is a concept that focuses on the area where new ideas of scientific research lead to innovation.

In addition to being characterised by the presence of interdependent actors, IE involves coordinating interactions among actors through a structure that favours ecosystem participants to have specific roles not defined by formal contracts (Thomas and Autio, 2020). Santos *et al*. (2022) explain that innovation ecosystems can develop spontaneously and be managed deliberately through, what they call, a conscious intervention process. For the authors, each stage of IE life cycle requires different coordination strategies designed according to the networks' complexity and the centralisation of their coordination. For example, the initial stage is characterised by dispersed actors and resources not yet mobilised. Therefore, this stage requires strategies to gather the actors, focusing on aligning and defining common objectives.

Thus, in general, the concept of IE encompasses seeking inter-organisational connection, collaboration, mutual learning, coordination, and alignment. Therefore, at the heart of the concept is the need for governance models with characteristics that help manifest these elements (Agranoff, 2014; Ansell and Torfing, 2021).

Governance is associated with governing inter-organisational relationships through connecting norms jointly created to regulate individual behaviour in collective action (Ostrom, 1990). Lynn *et al*. (2000) stress the ambiguity of definitions around governance. However, like Ostrom (1990), these authors connect the term with means to achieve direction, control, and coordination of total or partially autonomous individuals and/or organisations so they can meet collective objectives and interests. In this sense, governance comprises structures and processes that guide administrative activity.

Bevir (2009) offers a historical review of the term, arguing that governance can be used to describe changes in the role and nature of the state, reflecting the 1980s and 1990s reforms in the public sector. For the author, the term can have a more general application, referring to standards of rules or regulating activity. The evolution

of the concept undergoes several influences, some of which are directly associated with networks. Similarly, Wegner and Verschoor (2021) and Wang and Ran (2021) portray governance as networks. This has implications for coordination and inter-organisational interaction, as networks constitute governance structures distinct from bureaucracy for coordinating activities and allocating resources.

Agranoff (2014) considers that, although bureaucracy will probably not submit to collaborative structures, it will probably become more relational. In the context of innovation, the fact that learning processes transcend organisational boundaries makes such a challenge urgent. Networked value production requires governance characteristics distinct from hierarchy, formalism, and legality. It requires shared governance comprising a collegiate body that seeks bottom-up inputs, promotes participation and learning, seeks consensus, and decides together. Ansell and Torfing (2014) highlight the necessary presence of synergy, learning, and commitment.

On the other hand, as Santos, Zen and Bittencourt (2022) remind us, this approach does not rule out the presence of a central intervention for conducting the development of IE. The IE literature emphasises the presence of an orchestrator, although this role is not specifically attributed to a focal company (Cobben *et al.*, 2022). In this sense, the governance arrangement is shaped according to the characteristics of each ecosystem. In the case of IE, a leadership role, almost directive, is attributed to an orchestrator who is usually a company. In the knowledge and entrepreneurial ecosystems, on the other hand, it is common to observe a facilitating or supporting actor, such as a university, a research organisation, the government, or even an independent management organisation playing a leadership role (Cobben *et al.* 2022).

Similarly, Gomes *et al.* (2022) highlight the importance of rules and participation mechanisms in the ecosystem. The authors argue that governance in this context is oriented to how focal companies influence other actors to engage. However, the authors denounce that important questions related to this topic remain unanswered.

In this context, this work seeks to systematise the current literature regarding governance characteristics in innovation ecosystems.

Methodological Procedures

This research comprises an integrative literature review following the review process presented by Botelho *et al.* (2011). This method enables the analysis and synthesis of scientific knowledge on a given topic and identifies research opportunities and gaps.

This process involves identifying the topic and the research question; the establishment of inclusion and exclusion criteria; identification of pre-selected

and selected studies; categorisation of selected studies; the analysis and interpretation of results; and finally, the review and synthesis of knowledge (Botelho *et al*., 2011).

After delineating the research question, searches were conducted in the scientific databases SciELO, Scopus, and Web of Science, chosen because of the scope and diversity of their publications. The searches were carried out using the descriptors (*governance*) AND ("*innovation ecosystem*" OR "*ecosystem of innovation*"), and the filters: article-type document, in English and Portuguese, without delimitation of area and period. A total of 145 articles were obtained, of which 39 were duplicates. Thus, the final sample contained 106 articles.

Pre-selection was carried out after screening the titles, abstracts, and keywords, considering the following inclusion criteria: (i) IE context; (ii) interaction between different ecosystem actors; and (iii) IE governance. Thus, we sought to gather articles that addressed IE and their governance. The research portfolio included articles presenting aspects of governance focused on the relationship among actors to co-create value.

The following excluding criteria were applied: (i) articles focused only on one actor; (ii) articles that did not discuss IE; and (iii) articles that did not address IE governance and the relationship among different actors. These criteria were adopted based on the assumption that the perspective of only one actor is not enough to discuss IE governance.

Based on these criteria, 39 articles were selected to be fully read. This analysis verified compliance with the criteria, leading to a final research portfolio with 15 articles. Figure 1 shows the selection process.

Data analysis was carried out using content analysis, according to Bardin's (1977) guidelines, involving a categorisation process to classify and regroup the elements of the articles according to the research objective. The categorisation was conducted after the analysis.

Microsoft Excel was used as a support tool. Given the number of articles that made up the final portfolio (reflecting the lack of studies in the area), it was decided not to use content analysis software. Spreadsheets were used to systematise data and organise codes related to the theme.

Thus, elements were grouped according to each governance-related characteristic (Bardin, 1977). For this grouping, common aspects were identified, originating the study categories, which are presented and conceptualised in the synthesis matrix at the end of the fifth section.

The following section presents and describes the portfolio. The subsequent section discusses the categories that emerged from the analysis. In addition, it presents a synthesis matrix with the concepts formulated for each category, listing the authors used as references.
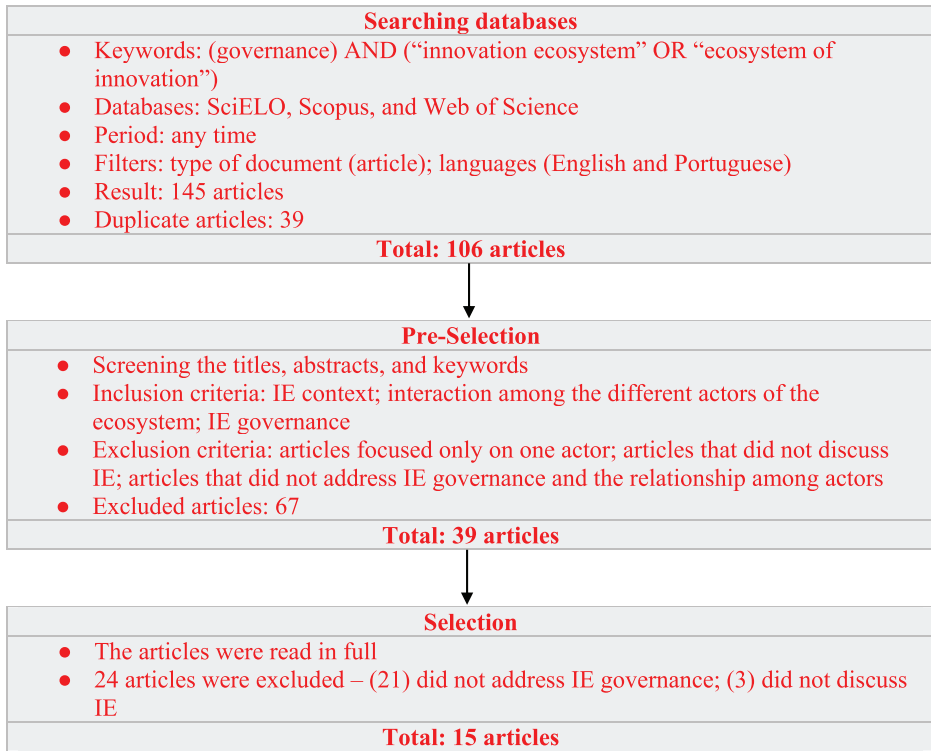
Searching databases
• Keywords: (governance) AND ("innovation ecosystem" OR "ecosystem of innovation")
• Databases: SciELO, Scopus, and Web of Science
• Period: any time
• Filters: type of document (article); languages (English and Portuguese)
• Result: 145 articles
• Duplicate articles: 39
Total: 106 articles

Pre-Selection
• Screening the titles, abstracts, and keywords
• Inclusion criteria: IE context; interaction among the different actors of the ecosystem; IE governance
• Exclusion criteria: articles focused only on one actor; articles that did not discuss IE; articles that did not address IE governance and the relationship among actors
• Excluded articles: 67
Total: 39 articles

Selection
• The articles were read in full
• 24 articles were excluded – (21) did not address IE governance; (3) did not discuss IE
Total: 15 articles

Fig. 1.   Articles inclusion and exclusion criteria.

Source: Research data.

Integrative Review Portfolio: Presentation and Description

The literature review allowed us to identify the different interpretations regarding IE governance, given different contexts and stages of maturity, ranging from those linked to a specific industry to a comprehensive perspective, which encompasses different actors at national and global levels.

Table 1 shows the articles reviewed, in order of year of publication, from which it was possible to develop an analysis to understand the characteristics of IE governance.

The reviewed articles confirm that IE is a recent discussion, as the largest number of publications is concentrated in 2021, with an increase from 2017 onward. Both theoretical and theoretical-empirical were present in the portfolio, with a prevalence of literature reviews and case studies with a qualitative approach. Amid the different theoretical lenses when approaching governance, it is possible to identify that most of the works are based on the literature on network governance.

Table 1.   Articles reviewed.

Authors	Title	Year	Country	Journal	Quotes	Type of study
Leten, Vanhaverbeke, Roijakkers, Clerix, and Helleputte	IP models to orchestrate innovation ecosystems: IMEC, a Public Research Institute in Nano-Electronics	2013	Belgium	California Management Review	64	Theoretical–empirical
Spena, Tregua, and Bifulco	Searching through the jungle of innovation conceptualisations: system, network, and ecosystem perspectives	2017	Italy	Journal of Service Theory and Practice	17	Theoretical
Cobben and Roijakkers	The dynamics of trust and control in innovation ecosystems	2019	Netherlands	International Journal of Innovation	5	Theoretical–empirical
Grobbelaar	Developing a local innovation ecosystem through a university coordinated innovation platform: The University of Fort Hare	2018	South Africa	Development Southern Africa	8	Theoretical–empirical
Camboim, Zawislak, and Pufal	Driving elements to make cities smarter: Evidence from European projects	2019	Brazil	Technological Forecasting & Social Change	47	Theoretical–empirical
Leceta and Könnölä	Fostering entrepreneurial innovation ecosystems: Lessons learned from the European Institute of Innovation and Technology	2021	Spain	Innovation: The European Journal of Social Science Research	3	Theoretical–empirical
Cappellano and Makkonen	Cross-border regional innovation ecosystems: The role of nonprofit organisations in cross-border cooperation at the US-Mexico border	2020	Finland	GeoJournal	12	Theoretical–empirical
Liu, Ma, Huang, and Tang	Collaborative governance for responsible innovation in the context of sharing economy: Studies on the shared bicycle sector in China	2020	China	Journal of Open Innovation: Technology, Market and Complexity	4	Theoretical–empirical
Roig, Wang, and Sánchez	Barcelona's science diplomacy: Towards an ecosystem-driven internationalisation strategy	2020	Spain	Humanities & Social Sciences Communications	1	Theoretical–empirical

Author	Title	Year	Country	Journal		Type
Arena, Azzoni, and Piantoni	Uncovering value creation in innovation ecosystems: Paths towards shared value	2022	Italy	European Journal of Innovation Management	0	Theoretical
Autio	Orchestrating ecosystems: A multi-layered framework	2021	UK	Innovation: Organisation & Management	6	Theoretical
Chen, Jin, Su, and Yue	The roles of captains in megaproject innovation ecosystems: The case of the Hong Kong-Zhuhai-Macau Bridge	2021	China	Engineering, Construction and Architectural Management	4	Theoretical–empirical
Gifford, McKelvey, and Saemundsson	The Evolution of knowledge-intensive innovation ecosystems: co-evolving entrepreneurial activity and innovation policy in the West Swedish maritime system	2021	Sweden	Industry and Innovation	5	Theoretical–empirical
Könnölä, Eloranta, Turunen, and Salo	Transformative governance of innovation ecosystems	2021	Finland	Technological Forecasting & Social Change	0	Theoretical–empirical
Duarte, Reis, Fleury, Vasques, Filho, Koria, and Ramos	Innovation Ecosystem framework directed to Sustainable Development Goal #17 partnerships implementation	2021	Brazil	Sustainable Development	3	Theoretical

Source: Research data.

Six of the fifteen articles highlighted the importance of the presence and role of a leader in the ecosystem, often connected to the concept of ecosystem orchestrator (Autio, 2021; Chen *et al*., 2021; Cobben and Roijakkers, 2019; Grobbelaar, 2018; Könnölä *et al*., 2021; Leten *et al*., 2013). Another set of articles addresses the characteristics of self-organisation from a bottom-up perspective (Camboim *et al*., 2019; Cappellano and Makkonen, 2020; Duarte *et al*., 2021; Gifford *et al*., 2021; Leceta and Könnölä, 2021; Liu *et al*., 2020; Roig *et al*., 2020). Spena *et al*. (2017) and Arena *et al*. (2022) work on top-down and bottom-up approaches, as well as power distribution, from a self-organised ecosystem. However, these articles focus on the concept of IE rather than governance.

The literature review identified the emphasis given to the issue of ecosystem orchestration. It refers to leadership performance (Chen *et al*., 2021) when establishing an architecture of stakeholder roles and stimulating interactions to create value (Autio, 2021). This theme is addressed by Leten *et al*. (2013), Cobben and Roijakkers (2019), Grobbelaar (2018), Autio (2021), Chen *et al*. (2021), and Könnölä *et al*. (2021).

Leten *et al*. (2013) present the orchestrator role in developing and managing an innovation ecosystem in the nanoelectronic technologies sector. The authors addressed the relationship between an orchestrator (a public research institute) and universities and companies in a government-funded program. The institute established contracts and rules for partners interested in the program, establishing interactions that favoured sharing knowledge and technologies. The orchestrator allowed the partners to enjoy the benefits of the research program together, taking into account their needs and contributions. Thus, research was carried out collaboratively.

Cobben and Roijakkers (2019) identify the need to discuss IE governance mechanisms. From the study of four cases in which the focal entity orchestrates the IE, the authors analysed how they use the mechanisms to align partners to achieve successful innovations, understanding it as a way to mitigate risks of opportunistic behaviour. The use of control and trust mechanisms is discussed. Control mechanisms concern the use of formal norms, rules, procedures, and policies, and trust mechanisms are based on the positive expectation of the ecosystem partners.

This orchestration can also occur through platforms, as in the study by Grobbelaar (2018). The author presents the role of a university in establishing a platform to create an innovation ecosystem oriented toward the development of communities, aligning research with local challenges, and engaging different actors in the process.

For Autio (2021), although interest in orchestration has grown, few studies focus on the actions companies must take to orchestrate an ecosystem throughout the life cycle. Thus, the author suggests that effective orchestration involves activities in four layers: technological, economic, institutional, and behavioural, and points out

that the architectures developed vary according to the ecosystem approach (bottom-up or top-down) and its life cycle stage.

Chen *et al.* (2021) contribute to the discussion about the actions of leaders in IE orchestration. The authors explore the approach of ecosystem captains, i.e., leaders and central actors—individuals, organisations, or collective groups—who manage IE in the context of megaprojects. They started from an existing gap in which the governance discussion focused on projects, requiring a focus on the perspective of innovation ecosystems.

Konnolla *et al.* (2021) address orchestration from a transformative governance perspective, which seeks to improve ecosystem adaptability and resilience, orchestrating change based on diversity, connectivity, poly-centricity, redundancy, and directionality in IE.

The authors who advocate the bottom-up approach and the distribution of power in the ecosystem refer to the mobilisation of different actors in integrated and decentralised management focused on achieving specific goals (Camboim *et al.*, 2019). The contribution of authors such as Camboim *et al.* (2019), Leceta and Könnölä (2021), Cappellano and Makkonen (2020), Liu *et al.* (2020), Roig *et al.* (2020), Gifford *et al.* (2021), and Duarte *et al.* (2021) follows this perspective.

Camboim *et al.* (2019) address smart cities from an urban innovation ecosystem perspective, highlighting the importance of a participatory governance model based on deliberate interaction and collaboration of different actors, providing greater integration and active participation. This contributes to forming environments favourable to creativity and innovation in a sustainable way.

Leceta and Könnölä (2021) examine an experience that integrates higher education institutions, research, and companies in innovation cocreation activities, in a bottom-up approach, through collaborative projects. Considering the triple helix model (Leydesdorff and Etzkowitz, 1996), the government does not stand out. In the research by Cappellano and Makkonen (2020), there is also no emphasis on government participation, shedding light on the role of other actors as leaders in the ecosystem and the cocreation of value in a collaborative and self-governing structure. The role played by non-governmental organisations (NGOs) is emphasised. According to Carayannis and Campbell (2009), NGOs are the fourth helix responsible for transferring knowledge and stimulating innovation in a cross-border context.

Liu *et al.* (2020) discuss the sharing economy approach through technological platforms where stakeholders such as government, industry, and civil society work in a collaborative governance perspective, with the public interest as a common objective. Regarding the public-private partnerships, Roig *et al.* (2020) present a case involving universities, companies, and public institutions, together with stakeholders in elaborating transparent and efficient public policies that benefit the knowledge and innovation ecosystem of a city, meeting the needs of society.

Gifford *et al*. (2021) present a conceptual framework for IE, combining top-down and bottom-up approaches. The top-down approach is linked to formulating public policies, and the bottom-up approach to the performance of entrepreneurs in a knowledge-intensive entrepreneurial perspective aligned with sustainability objectives. Thus, several actors are involved through collective action, and public policies stimulate entrepreneurs.

Duarte *et al*. (2021) address the issue of sustainable development and the relationship between IE and the UN Sustainable Development Goals (SDGs). In this context, the relationship among actors in sharing resources and knowledge to mobilise the implementation of the SDGs is highlighted. Through digital platforms, interactions between different actors and multisectoral partnerships are favoured based on innovative, collaborative approaches and rules regarding ecosystem management.

The articles show the different perspectives regarding platforms, understanding that leaders can establish IE around these arrangements (Grobbelaar, 2018), which may or may not be digital (Autio, 2021). Other issues emerged in addition to the platforms, such as the actors' activities aimed at sustainable development (Duarte *et al*., 2021; Gifford *et al*., 2021); smart cities (Camboim *et al*., 2019); knowledge-intensive entrepreneurship, and actions to solve social and environmental problems (Gifford *et al*., 2021). These different scenarios form the background where governance plays an important role in the development of ecosystems.

After observing the essence of each article reviewed, the following section presents a categorisation focused on identifying IE governance characteristics. The characteristics are presented separately and culminate in a synthesis matrix containing the identified categories and the respective concepts.

Characteristics of Innovation Ecosystems' Governance: Approaching Cutting-Edge Research

Governance can be understood by observing the leadership performance—an IE orchestrator (Leten *et al*., 2013; Cobben and Roijakkers, 2019; Grobbelaar, 2018; Autio, 2021; Chen *et al*., 2021; Könnölä *et al*., 2021) or leadership based on self-organisation, with power distributed among stakeholders (Cappellano and Makkonen, 2020). Two approaches stood out during the literature review: top-down (Grobbelaar, 2018), from a stricter to a less hierarchical form of control that enables cocreation, for example (Leceta and Könnölä, 2021); and bottom-up, represented by decentralised management that favours the participation of different actors (Camboim *et al*., 2019). In the bottom-up approach, the ecosystem value

proposition is negotiated. The top-down approach tends to be externally oriented (Autio, 2021) by a focal entity, for example (Duarte *et al*., 2021).

The IE may adopt both approaches (Camboim *et al*., 2019; Gifford *et al*., 2021). In cases where there are risks linked to uncontrolled collaborations (Arena *et al*., 2022) and opportunistic behaviour (Cobben and Roijakkers, 2019) or a less structured and uncertain market context (Autio, 2021), a top-down approach is appropriate. The bottom-up approach is important when multilateral conversations between participants are needed to develop ecosystem architecture (Autio, 2021) and greater resilience (Arena *et al*., 2022). Therefore, the "**governance approach**" is identified as a category.

In a different perspective from the contributions from the integrative review portfolio, Kinder *et al*. (2022) associate the top-down approach with the concept of networks, arguing that ecosystems give rise to new forms of governance, from the bottom up, without a central direction. According to the authors, such an approach provides deeper trust and learning. In contrast, the top-down, formal, and rational-ist approach to governance limits the development of these attributes, which can result in a lower value stream than possible. However, these authors discuss the concepts of ecosystems and networks applied to the context of public services and not the innovation context. They seek to contribute to the research gap that distin-guishes the governance of ecosystems and networks of public services. Although the concept of an ecosystem in this work is applied to another context, the discus-sion brought by Kinder *et al*. (2022) brings to light the fact that the articles in the integrative review portfolio do not distinguish ecosystems from networks. As this is not the purpose of this article, there remains an opportunity for future research.

A striking feature of innovation ecosystems is the presence of different actors with different roles and functions. The actors observed in the articles reviewed are companies, universities, public authorities, nonprofits, society, entrepreneurs, investors, startups, incubators, accelerators, coworking (Duarte *et al*., 2021), and science parks (Leceta and Könnölä, 2021). The functions vary, and their interfaces may generate new ones (Könnölä *et al*., 2021). Therefore, each actor can play sev-eral roles and participate in different projects simultaneously (Duarte *et al*., 2021), given their own goals and those of the ecosystem (Chen *et al*., 2021). In this sense, the category "**actors and roles**" was created.

The government, for example, can act as a facilitator by developing public pol-icies that favour IE and funding for initiatives (Camboim *et al*., 2019; Cappellano and Makkonen, 2020; Gifford *et al*., 2021; Leten *et al*., 2013; Liu *et al*., 2020). Relevant policies emerge as institutional support for the ecosystem, as is the case, for example, of innovation policies (Grobbelaar, 2018). The government can

also favour community engagement, involving it in decision-making processes (Camboim *et al*., 2019).

Like the government, the private sector can provide financial resources for the ecosystem (Camboim *et al*., 2019; Cappellano and Makkonen, 2020) and contribute by cocreating knowledge and technologies (Duarte *et al*., 2021) through exchanges with other actors, resulting in innovative, collaborative projects (Leten *et al*., 2013; Roig *et al*., 2020) and entrepreneurial initiatives (Gifford *et al*., 2021).

On the other hand, universities provide the flow (Chen *et al*., 2021) and the exchange of knowledge and learning, developing research and projects in interaction with the community, providing spaces for engagement, collective experimentation, teaching, and capability development workshops (Grobbelaar, 2018).

Chen *et al*. (2021) cite financial institutions, public authorities, and nonprofits as IE support entities. The latter provides solutions and ideas for improving environmental and social problems (Chen *et al*., 2021) regarding an ecosystem that also aims for sustainable development (Duarte *et al*., 2021; Gifford *et al*., 2021).

In this context, the figure of the orchestrator stands out, which can be an individual, an organisation, or a collective group (Chen *et al*., 2021) performing orchestration activities based on the development of a technological, economic, institutional, and behavioural architecture, with a focus on creating value (Autio, 2021). The role includes defining rules, elaborated through consultations with stakeholders (Grobbelaar, 2018), carrying out the selection of IE participants, and orchestrating resources (Chen *et al*., 2021) based on the existing resources and knowledge in the ecosystem (Grobbelaar, 2018). As there is no formal and hierarchical authority in the ecosystem, nor a contractual obligation between the parties, participants must be persuaded to provide voluntary inputs consistent with the ecosystem's value proposition, a role assigned by Autio (2021) to the orchestrator. In general, there are different types of orchestrators. One example is the case addressed by Leten *et al*. (2013), where there was a participation fee and concern about promoting benefits to partners.

Thus, an IE has different interdependent actors (Autio, 2021; Cappellano and Makkonen, 2020; Chen *et al*., 2021; Gifford *et al*., 2021; Grobbelaar, 2018), nurturing a sense of collective value (Cobben and Roijakkers, 2019) and responsibility (Cobben and Roijakkers, 2019; Grobbelaar, 2018; Liu *et al*., 2020; Spena *et al*., 2017), commitment (Cobben and Roijakkers, 2019; Roig *et al*., 2020), engagement (Grobbelaar, 2018; Duarte *et al*., 2021), creativity (Cappellano and Makkonen, 2020; Camboim *et al*., 2019), and generating voluntary contributions (Autio, 2021).

In this context, reaching a mutual understanding of actors' roles and responsibilities is crucial, favouring efficient decision-making (Roig *et al*., 2020) through

collective actions (Gifford *et al*., 2021; Grobbelaar, 2018). Concerning the relationship among actors, IE is marked by collaboration and competitiveness (Cappellano and Makkonen, 2020; Leceta and Könnölä, 2021), especially cooperation (Gifford *et al*., 2021; Duarte *et al*., 2021; Leten *et al*., 2013; Liu *et al*., 2020), from formal and informal exchanges (Liu *et al*., 2020).

For collective action to occur, it is necessary to encourage collaboration and establish meeting places, partnerships between universities and industries, and activities to integrate the actors involved in the ecosystem (Gifford *et al*., 2021). From the interaction among them and the generated connectivity (Könnölä *et al*., 2021), there is the exchange and sharing of knowledge and information (Cappellano and Makkonen, 2020; Grobbelaar, 2018; Roig *et al*., 2020), tangible and intangibles resources (Grobbelaar, 2018), capacity building (Chen *et al*., 2021), learning (Gifford *et al*., 2021; Könnölä *et al*., 2021), and building trust between the parties, something widely discussed in the literature. These characteristics make up the third category, "**relationship among actors**."

Thus, actors communicate and dialogue with each other (Liu *et al*., 2020; Roig *et al*., 2020), and several encounters are facilitated through events, meetings, and congresses (Chen *et al*., 2021; Leceta and Könnölä, 2021). From a cocreation perspective, win-win relationships are developed (Liu *et al*., 2020), where decision-making is carried out collaboratively (Camboim *et al*., 2019; Duarte *et al*., 2021). Instruments to support strategies for achieving results are configured in this value cocreation process through internal mechanisms (Arena *et al*., 2022). In this sense, functions and practices performed by one or more leaders or organisations to achieve common goals stand out, which Wegner and Verschoore (2021) characterise as "micro governance." Practices aimed at establishing agreements, such as contracts, are common; the arrangements are supported by decision-making processes and commitments made face-to-face or mediated by technology (Wegner and Verschoore, 2021).

Management practices (Leceta and Könnölä, 2021) and formal and informal mechanisms (Arena *et al*., 2022) encourage participation, information exchange, and collective problem-solving (Duarte *et al*., 2021). Therefore, actions are coordinated to ensure directionality (Könnölä *et al*., 2021). These actions and practices, aimed at aligning the actors, comprise the category "**coordination mechanisms**."

Likewise, there is a concern about aligning actors, focusing on achieving a common objective through a direction and a purpose (Könnölä *et al*., 2021), and favouring the sharing of a common vision among ecosystem participants (Duarte *et al*., 2021). The alignment of interests focused on the implementation of the IE strategy (Roig *et al*., 2020) and the generation of value (Autio, 2021; Cappellano and Makkonen, 2020; Chen *et al*., 2021; Duarte *et al*., 2021; Grobbelaar, 2018; Leceta and Könnölä, 2021) is reinforced. The value of the ecosystem is generated

by the participants' complementary outputs, which take place independently and voluntarily (Autio, 2021). Thus, the value associated with the ecosystem level is cocreated and cannot be achieved by individual actors (Duarte *et al*., 2021). The category "**common objective and value cocreation**" is thus constituted.

A joint value proposition is linked (Duarte *et al*., 2021; Könnölä *et al*., 2021), and long-term goals are shared among IE actors (Könnölä *et al*., 2021). Thus, strategic objectives (Leceta and Könnölä, 2021) and goals are developed through engagement and a participatory approach among stakeholders (Grobbelaar, 2018). These goals must be monitored and followed up (Chen *et al*., 2021; Leceta and Könnölä, 2021) through indicators and metrics (Leceta and Könnölä, 2021), forming the "**goals and evaluation**" category.

These aspects constitute the innovation ecosystem's governance characteristics, which are systematised in Table 2.

Table 2. Synthesis matrix: Characteristics of innovation ecosystems' governance.

Categories	Concept	Authors
Governance approach	Top-down and/or bottom-up governance approach. In certain cases, there is a focal entity, leadership, an orchestrator, or a platform. In other cases, governance can be characterised by the decentralised perspective of power and self-organisation to distribute power among the parties. Both approaches can simultaneously give the ecosystem directionality, control, adaptability, and creativity.	Autio (2021), Arena *et al*. (2022), Camboim *et al*. (2019), Cappellano and Makkonen (2020), Chen *et al*. (2021), Cobben and Roijakkers (2019), Duarte *et al*. (2021), Gifford *et al*. (2021), Grobbelaar (2018), Könnölä *et al*. (2021), Leceta and Könnölä (2021), Leten *et al*. (2013), Liu *et al*. (2020) and Spena *et al*. (2017).
Actors and roles	Presence of diverse and interdependent actors: government, companies, universities, society, research institutes, nonprofits, startups, entrepreneurs, incubators, science and technology parks, accelerators, and coworking spaces. The actors' diversity and heterogeneity and the polycentricity and redundancy of the roles and functions they perform provide adaptability and creativity to IEs	Autio (2021), Camboim *et al*. (2019), Cappellano and Makkonen (2020), Chen *et al*. (2021), Cobben and Roijakkers (2019), Duarte *et al*. (2021), Gifford *et al*. (2021), Grobbelaar (2018), Könnölä *et al*. (2021), Leceta and Könnölä (2021), Leten *et al*. (2013), Liu *et al*. (2020), Roig *et al*. (2020) and Spena *et al*. (2017).

Table 2.   (*Continued*)

Categories	Concept	Authors
Relationship among actors	Relationships of collaboration and competition in which prevails value cocreation and coproduction of knowledge, technologies, and innovation. Through interactions and connections, there is the mobilisation and sharing of resources and the establishment of dialogue and communication among the parties.	Autio (2021), Camboim *et al.* (2019), Cappellano and Makkonen (2020), Chen *et al.* (2021), Cobben and Roijakkers (2019), Duarte *et al.* (2021), Gifford *et al.* (2021), Grobbelaar (2018), Könnölä *et al.* (2021), Leceta and Könnölä (2021), Leten *et al.* (2013), Liu *et al.* (2020), Roig *et al.* (2020) and Spena *et al.* (2017).
Coordination mechanism	Mechanisms are adopted to promote actors' participation, interactions, coordination, and alignment, to gain directionality. A more formal approach can be developed based on defining rules, goals, and control mechanisms. The informal approach is based on socialisation and open communication processes oriented toward learning and trust	Autio (2021), Arena *et al.* (2022), Camboim *et al.* (2019), Cappellano and Makkonen (2020), Chen *et al.* (2021), Cobben and Roijakkers (2019), Duarte *et al.* (2021), Gifford *et al.* (2021), Grobbelaar (2018), Könnölä *et al.* (2021), Leceta and Könnölä (2021), Leten *et al.* (2013), Liu *et al.* (2020), Roig *et al.* (2020) and Spena *et al.* (2017).
Common objective and value cocreation	Actors share vision and objectives based on a common value proposition that offers directionality	Camboim *et al.* (2019), Cappellano and Makkonen (2020), Chen *et al.* (2021), Cobben and Roijakkers (2019), Duarte *et al.* (2021), Gifford *et al.* (2021), Könnölä *et al.* (2021), Leceta and Könnölä (2021), Leten *et al.* (2013), Liu *et al.* (2020), Roig *et al.* (2020) and Spena *et al.* (2017).
Goals and evaluation	Jointly elaborating strategic objectives and goals, monitoring and measuring results through indicators and metrics. Goals and evaluation contribute to improving adaptability and offer directionality	Arena *et al.* (2022), Camboim *et al.* (2019), Chen *et al.* (2021), Cobben and Roijakkers (2019), Duarte *et al.* (2021), Gifford *et al.* (2021), Grobbelaar (2018), Leceta and Könnölä (2021) and Liu *et al.* (2020).

Source: Elaborated by the authors.

Thus, the IE governance characteristics, which include an approach that varies according to the ecosystem context, involve diverse actors, established relationships, and actions and practices aimed at the alignment of actors, with a view to objectives and goals to be achieved and evaluated.

Final Considerations

This study aimed to systematise governance characteristics of innovation ecosystems (IE) through an integrative literature review. It builds on the complexity of relationships among diverse and interdependent actors who exchange and share tangible and intangible resources resulting in innovation, technological development, and value creation, and on the assumption that this complexity requires an effort in terms of governance.

Although it is essential for developing an IE, governance is little discussed in the literature on IE. There is no clarity on which governance characteristics can favour the challenges present in these ecosystems. Although the literature presents some possibilities, conceptualising and characterising types of governance favourable to collaborative processes and networks, few studies focus specifically on the characteristics of IE governance.

Intending to contribute to fulfil the knowledge gap, the research made it possible to systematise IE governance characteristics through the identification of six categories: governance approach, actors and roles, relationship among actors, coordination mechanisms, common objective and value co-creation, and goals and evaluation. The results are presented as a synthesis matrix and synthesis that seeks to advance the discussion around the ambiguity of the concept of IE governance (Pushpananthan and Emlquist, 2022), pointed out in recent studies as a research avenue to be explored (Cobben *et al*., 2022). In addition, this study contributes to the evolving field of IE, considering that until now, articles that discuss governance are based on the literature on networks. The results of the integrative review show the scarcity of research that addresses governance in the context of IE.

The results also suggest that the concept of IE governance is related to actions and practices aimed at aligning the actors of an IE, who have roles and responsibilities toward a common objective that will create value. The involvement of various actors stands out, including companies, universities, public authorities, society, nonprofits, and other organisations, which collaboratively develop trust and capabilities, share knowledge and information, generating innovations, technologies, and solutions for the identified problems. This flow can occur in an organic and self-organised way (bottom-up) or in a deliberate and orchestrated way (top-down).

The systematisation and conceptualisation of the IE governance characteristics also have practical implications. In addition to being a reference for scholars in designing theoretical-analytical models for empirical research, this study subsidizes policymakers and practitioners to build guidelines for public policies and management processes related to the dynamics of IE interactions, collaboration, and coordination. The results presented here may support insights into how to improve IE governance mechanisms.

Also, this research may constitute a reference to educating orchestrators and training different actors who work in IE. This potential contribution follows Cobben *et al*. (2022), who denounce the need to develop educational programs preparing orchestrators and other actors to engage in ecosystems instead of focusing on teaching internally focused management practices and theories.

As for limitations, this research broadly addresses the concept of IE, disregarding the particularities of the stages in the ecosystem's life cycle, as discussed by Pushpananthan and Elmquist (2022), who shed light on the emergence of a new IE. For the authors, the IE literature has been predominantly dedicated to studying existing ecosystems, and only a few empirical works explore their emergence. Another research that discusses the stages of the ecosystems' life cycle is Santos *et al*. (2022), who focused on the actors' coordination strategies throughout the ecosystem's evolution. In this sense, a future research agenda could explore governance characteristics considering the peculiarities of the different stages since, according to the authors, each stage of the life cycle requires different coordination strategies, given the complexity of networks and the centralisation of their coordination.

Another limitation is that the study does not go into the specificities of different types of IE, such as in the case of IE organised around a focal company based on a specific technology platform (Pushpananthan and Emlquist, 2022). Gomes *et al*. (2022), for example, highlight the peculiarities of the Global Innovation Ecosystems—GIE, arguing that dealing with global uncertainties based on interactions in an ecosystem is not an automatic process and requires a set of rules and mechanisms to address the challenges involved. The authors consider that alignment between actors, their roles, activities, connections, and strategies are not the same in traditional and global innovation ecosystems, arguing that the latter requires specific governance approaches. Therefore, the findings in this research may be limited since governance challenges related to particular types of IE or perspectives of intersection between different ecosystems (Massa *et al*., 2022) are not considered.

Future studies should consider the limitations pointed out above. Another suggestion for future research is to develop the categories identified during this integrative literature review, considering how they interrelate. This suggestion follows the concerns by Li *et al*. (2022) about the scarcity of studies exploring how governance mechanisms interrelate for value cocreation.

Another issue for future empirical research is seeking practical evidence of the categories developed in this study, finding new categories to increase knowledge on IE governance. Also, all studies obtained in the integrative literature review adopted a qualitative approach, suggesting that there is room for quantitative studies to contribute to understanding governance characteristics in different innovation ecosystems.

Based on the discussion proposed by Kinder *et al*. (2022), further studies should deepen the differences between the concepts of (a) innovation ecosystems and innovation networks and (b) innovation ecosystems and national/regional innovation systems since these differences may influence governance. Finally, we suggest pursuing perspectives correlated to governance in studies on IE such as the network brokerage approach discussed by Massa *et al*. (2022).

Acknowledgements

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