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Managing Innovation Ecosystems – A Semi-systematic Literature Review

Abstract

Whereas there are several types of innovation cooperation models in the literature, the concept of innovation ecosystems has generated unprecedented attention since the 2010s, from academia to business communities. The aim of this paper is to analyze previous research results regarding innovation ecosystems, and to identify the main elements of innovation ecosystem management from a structural point of view using a semi-systematic literature review analysis. As a result, a conceptual framework of innovation ecosystem management is designed, based on the identified five main components of ecosystem management: participants, structure, management, dynamic capabilities and trust level of ecosystems. Furthermore, the paper aims to give practical guidance on the most frequent challenges of ecosystem management.

Keywords: innovation ecosystem, innovation management, semi-systematic literature review

JEL codes: O32, O36, M12

INTRODUCTION

The complex phenomenon of innovation, closely linked to knowledge-based economy, plays an increasingly important role in sustainable economic development. Although the concept of innovation is originally associated with Schumpeter (1934), the term is very diverse and its meaning is constantly evolving. The international definition of innovation is currently set out in the 2018 edition of the Oslo Manual, which defines innovation and business innovation as "a new or improved product or (business) process (or combination thereof) that differs significantly from the unit's previous products or (business) processes and that has been made available to potential users or has been introduced on the market or brought into use by the firm." (OECD, 2018, 20; 33) However, it is important to note that innovation is both an expensive (especially for product innovation) and an uncertain process, since it may take years to develop a new product or service, and market success cannot be guaranteed in advance.

In order to reduce to some extent, the aforementioned costs and risks of innovation, formal and informal cooperations between market players have become increasingly common since the 1980s (Nalebuff–Brandenburger, 1994). This approach has been described by Chesbrough (2003) as a shift from a closed to an open innovation model. The essence of the open innovation model is that innovation can take place not only

within a company, but also outside of it, with the involvement of several actors, since many tangible and intangible resources that are vital for the innovation process are not created within the company. Given that the exact conceptual framework of business and innovation cooperations is difficult to define, there are several types of cooperation model in the literature (e.g., networks, clusters, ecosystems) (Oh et al., 2016).

Innovation cooperations have become of paramount importance, since the Covid-19 pandemic has highlighted, among others, the relevance of supply safety, global warming, and the interconnectedness of market players. In its latest report, World Economic Forum (WEF) (2020) also identified the fostering of innovation ecosystems as one of the main drivers of economic recovery and promoting socially inclusive entrepreneurial culture after the pandemic. IBM's (2022) recent survey among business managers also indicated as a conclusion that fifteen years ago, companies relied primarily on in-house R&D, but today 80 percent of company executives implement new innovation ideas through some form of innovation cooperation. Overall, it is timely to take a systematic look at the results of previous research in connection with the management of these cooperations.

This paper focuses on innovation ecosystems, since the term is relatively new, but as a "buzzword" the concept has received unprecedented attention from scholars, businessmen to policymakers as well. Ecosystems are derived from the well-researched innovation systems theory (the so called NIS tradition and its sub models); however, the latter denotes a broader and less dynamic concept than ecosystems (Scaringella–Radziwon, 2018; Vasvári et al., 2020).

The research aim of this paper is to analyze previously published research results regarding innovation ecosystems, and to identify the main elements of innovation ecosystem management using a semi-systematic literature review analysis. The article is structured as follows: firstly, the concept of innovation ecosystem is introduced; secondly, the methodology of the systematic literature review is described; thirdly, the main challenges of innovation ecosystem management is synthesized introducing a novel framework; and finally, we proceed to the conclusion and propose further research directions.

1. ECOSYSTEM AS AN ECONOMIC CONCEPT

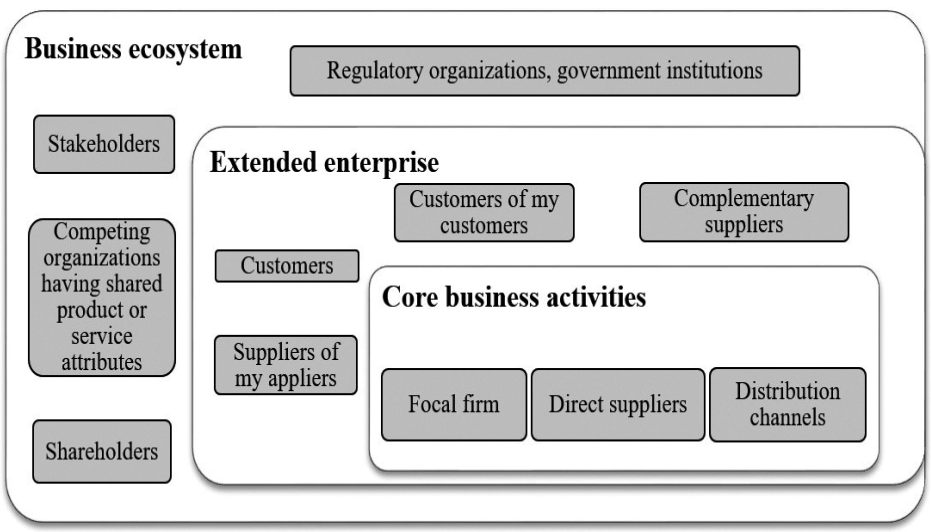
1.1. THE CONCEPTUAL FRAMEWORK OF INNOVATION ECOSYSTEMS

Innovation ecosystems are considered as a type of innovation cooperations in economics and management sciences. The definition of innovation, as was mentioned in the Introduction, can be traced back to Schumpeter; however, the concept of ecosystem as a system of organisms first appeared in the field of ecology. In Tansley's (1935, 306) interpretation, "the fundamental concept appropriate to the biome considered together with all the effective inorganic factors of its environment is the ecosystem". In essence, a biological ecosystem is a complex set of interactions between actors and their envi-

ronment, which are related on a spatial, structural or thematical basis, with its primary purpose being to maintain a state of sustainable equilibrium (Willis, 1997).

The term was later successfully introduced into the field of business and management sciences by Moore with the concept of business ecosystem. In Moore's (1996, 25) interpretation, a business ecosystem is "an economic community supported by a foundation of interacting organizations and individuals – the organisms of the business world. This economic community produces goods and services of value to customers, who are themselves members of the ecosystem." The ecosystem theory was broadened further by Gawer–Cusumano's (2002) business platform theory, which specifically interpreted the concept for big tech companies (Cisco, Microsoft), and also by Chesbrough's (2003) open innovation model. Iansiti and Levien (2004) also pointed out an important feature of business ecosystems: the ecosystem surrounding a company largely determines the company's own performance, so that all actors share in the fate of a given ecosystem, in many cases independently of their own market power. The boundaries and participants of a business ecosystem is shown in Figure 1.

Figure 1 Business ecosystem modelled by Moore



Source: Moore, 1996, 27

The first appearance of innovation ecosystem as a concept can be attributed to Ron Adner. Adner (2006) did not as yet make a clear distinction between business and innovation ecosystems, but later on, several authors began to indicate business and innovation ecosystems as separate concepts, such as Yaghmaie–Vanhaverbeke (2020), Visscher et al. (2021) and Adner (2006).

The main difference between the two types of ecosystems is that while business ecosystems focus on value capture and optimization of the benefits from the cooperation, innovation ecosystems focus primarily on new value co-creation (Valkokari, 2015).

Innovation ecosystems in some cases may lack a solid market demand as Gomes et al. (2018) indicated. A comparison of the two concepts is presented in Table 1.

Table 1 Comparison between business ecosystem and innovation ecosystem

Level of analysis	Business ecosystem	Innovation ecosystem
Related to	Moore (1996)	Adner (2006)
Main focus	Value capture, location of actors, integration	Value co-creation, location of actors, integration, risks distributed across partners and complementors
Main participants, „players"	Focal firm, complementors, suppliers and customers	Companies, complementors, suppliers, higher education institutions, research institutes, customers
Typical coordination mechanisms	In most cases vertically and horizontally comprehensive contractual agreements	In most cases non-contractual agreements, trust driven and open ended partnerships
Industry life cycle	Mainly in mature industry segments (e.g., automotive)	Mainly untapped sectors, niche markets (e.g., space industry)

Source: Gomes et al. (2018, 43) with author's modifications

Based on a comprehensive literature analysis, Granstrand–Holgersson (2020, 105) defined innovation ecosystem as "the evolving set of actors, activities, and artifacts[1], and the institutions and relations, including complementary and substitute relations, that are important for the innovative performance and value co-creation capabilities of an actor or a population of actors." Although, the referred definition is fairly extensive, it is contemporary and formally in line with the notion of different innovation ecosystem concepts; therefore, this interpretation is applied in this research.

1.2. CRITIQUE OF THE CONCEPT OF INNOVATION ECOSYSTEMS

An ecosystem as a concept is often set in parallel to innovation systems theory, which originated from Nelson (1993) and Freeman (1991). The issue is further complicated by the fact that, in addition to business and innovation ecosystems, other ecosystem concepts, such as the entrepreneurial ecosystem (Cavallo et al., 2019; Szerb, 2017), the service ecosystem (Lusch–Nambisan, 2015), and the knowledge ecosystem are also applied in the literature (Nambisan–Baron, 2012). Therefore, a key question is what "eco" really means and what differentiate these new models from innovation systems theory.

As we have referred to it before, prefix "eco" implies a specific ecological aspect, which relates to the interdependency among different actors, and to the co-creation

[1] Artifacts include products, services, resources, system inputs and outputs (Granstrand–Holgersson, 2020).

and co-evolution process which binds them together over time (Ritala–Almpanopoulou, 2017). While "system" refers to a specific mixture of components and actors that are interdependent, but dependent of other systems. Overall, a system is a more delimited scheme than an ecosystem, where everything is connected to everything, thereby interconnectedness and dynamic changes preserves the overall system (Jackson, 2011). The most distinctive feature of an ecosystem is the capability of the actors to co-evolve without external intervention (Papaioannou et al., 2009).

The innovation systems theory originally emphasized the role of institutional arrangements that facilitated the creation and diffusion of innovation in order to analyze how countries really catch-up to one another (Weber–Truffer, 2017), while Lundvall (1992), instead of analyzing historically different national systems, highlighted the interactive learning process behind outstanding national innovation performances. The innovation systems theory has other different sub models (Varga-Csajkás, 2020) such as the regional innovation system (RIS), the sectoral innovation system (SIS) or the technological innovation system (TIS). However, none of them looked at the innovation process through the lens of the companies (Fagerberg, Sapprasert, 2011; Suominen et al., 2018). Innovation systems theory usually views firms embedded in a sectoral or regional, cluster environment, while ecosystem approaches elaborate the relationship of companies with their functional environment (Gomes et al., 2018). As Ritala and Almpanopoulou (2017) pointed out, the ecosystem concept is rather a market-driven phenomenon and less considered policy issues in the same way as innovation systems. While according to Ferasso et al. (2018) the reason for the shift towards an ecosystemic approach is because innovation systems theory tends not to capture the distinction well between innovation process and structure.

As a conclusion, innovation ecosystem is a rather new concept for describing innovation cooperations, with a clear focus on a firm's perspectives, therefore a novelty of interpretation is revealed. However, since the term is used in so many different ways, no clear definition seems possible (Oh et al., 2016). Thus, it seems that innovation ecosystems theory may not be a"rival" of innovation systems paradigm, rather a complementary concept. Consequently, analyzing the topic with different perspectives may bring us closer to a more coherent and explicit understanding of how innovation ecosystems really work.

1.3. WHAT IS ECOSYSTEM MANAGEMENT?

Innovation management is defined commonly as the mobilization of innovation capacities of an organization, the management of its transformational capabilities and the control of the whole innovation process (Robert, 1998; Edwards-Schachter, 2018). However, innovation ecosystem management as a term is not defined directly in the literature we analyzed; authors usually referred to the concept as a crossover between innovation management and managing external business partners.

Following Adner's (2006) initial concept, ecosystem management can be viewed from the perspective of the organization(s) involved in the ecosystem (ecosystem

strategy), and as a kind of operational framework (ecosystem structure). Ecosystem as a strategy is a set of processes and tools that an organization uses to establish and maintain relationships with other ecosystem participants, while consciously shaping its own position and value creation opportunities in the ecosystem (Klimas–Czakon, 2022). In contrast, the ecosystem as a structure refers to the set of capabilities, processes and tools that maintain coherence and consistency between the organizations participating in the ecosystem (Adner, 2006; Alam, 2022). The two definitions show that the focus is on the autonomous role of organizations in the ecosystem from a strategic perspective, while the focus is on the coherence, cohesiveness and organization system that ensure cooperation between the participants from a structural perspective.

Visscher et al. (2021) described the management of innovation ecosystems as a two-step process from a corporate perspective. In the first, "explorative layer", companies build and maintain relationships with other organizations that may have the necessary knowledge and/or resources that the company potentially needs. In the second, "exploitative layer", companies create new value by connecting different partners that have complementary resources to satisfy market needs (mostly in a form of a product or service innovation). From this point of view, ecosystem management covers both the management of external business partnerships and (partly) outsourcing in-house R&D, while orchestrating the two processes.

Essentially, on the one hand, ecosystem management is more than innovation management, because maintaining close cooperation with partners is the focus of an ecosystem. On the other hand, ecosystem management also has a wider meaning than general external business cooperation management, mostly because an ecosystem encompasses an organizations' inner and outer attitude, goals and the procedure of an ecosystem.

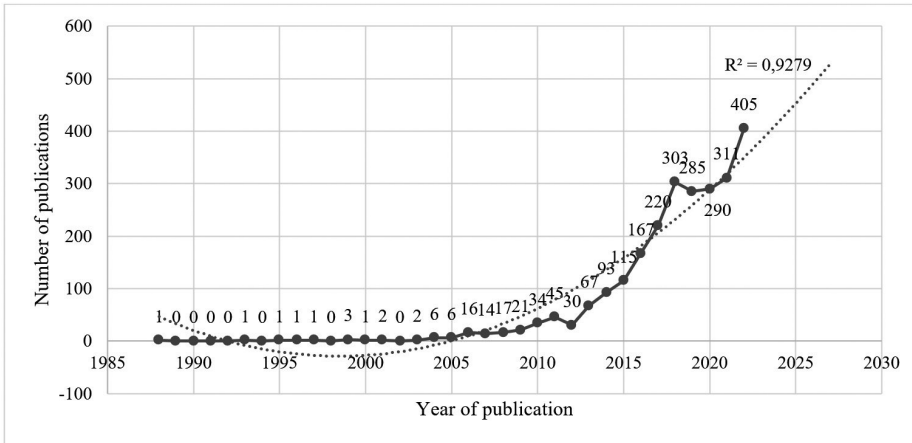
The term of innovation ecosystem management is therefore currently in the "grey zone", because no exact definition is formulated in the existing literature, presumably because there are not yet enough research results to outline its distinctive characteristics. As the content analysis conducted in this research has shed light on some common elements of innovation ecosystem operation and management, this paper aims to contribute to the aforementioned discussion.

2. METHODOLOGY

Literature review is a common applicable methodology in management and business sciences, specifically when a researcher wants to evaluate theory, explore evidence in a certain area or to examine the validity of a certain theory or competing theories from an academic point of view (Saunders et al., 2019).

Innovation ecosystems theory is often subjected to literature reviews (see: Tsujimoto et al., 2018, Scaringella–Radziwon, 2018; Oh et al., 2016; Granstrand–Holgersson 2020; Gomes et al., 2018; Ferasso et al., 2018; Sant'Ana et al., 2019), mostly due to its recent "popularity", yet it is a fuzzy concept, which clearly appears in the constantly rising number of publications on the topic – see Figure 2.

Figure 2 Number of publications with the keyword "innovation ecosystem" in Scopus database between 1989-2022



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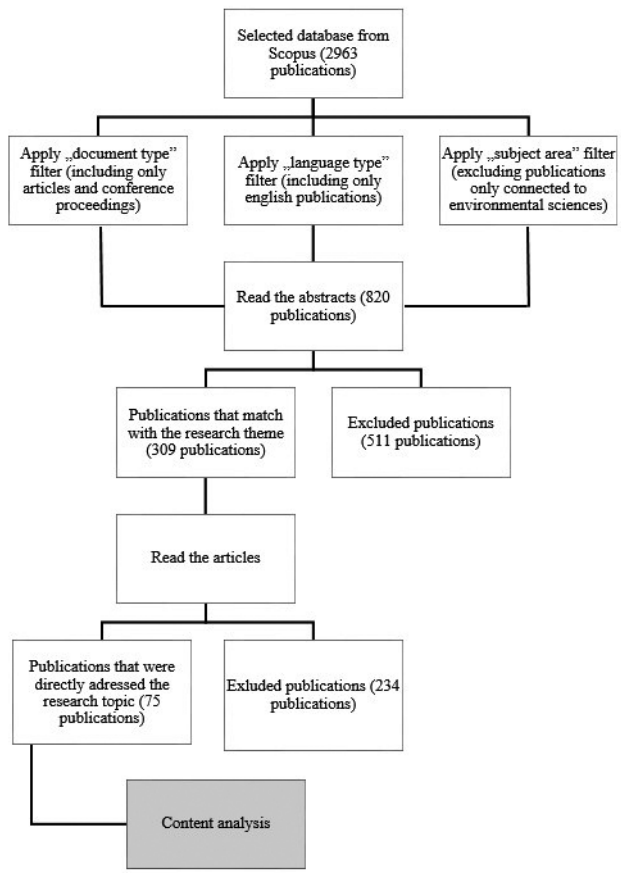
In this research a semi-systematic literature analysis was conducted in order to identify the most common elements of innovation ecosystem management in the existing literature. A semi-systematic literature analysis methodology was chosen above a systemic analysis for two reasons: (1) ecosystem management has been studied by numerous researchers whose publications have been indexed in different databases (Scopus, WoS, Google Scholar etc.), therefore to review every single article that could be relevant to the topic is simply not possible; (2) due to the vague concept of innovation ecosystem, our aim is not to reach a meta-synthesis of ecosystem management, but to identify the most common challenges that have already been revealed by research. The application of a semi-systematic methodology is also motivated by the fact that innovation ecosystem research covers different knowledge fields from ecological to social and economic bases, hence the diverse disciplines of the topic do not allow a delineated, systemic literature review (Paul–Barari, 2022; Fisch–Block, 2018).

For the analysis the Scopus database was used, as this database contains the largest number of publications in the social sciences research area, including economics, business and management. In order to extract all the relevant papers, different search criteria were considered for the following keywords: "innovation ecosystem management" OR "innovation ecosystem case study". The search resulted in 2963 studies; however, to meet our original research focus, the following filters were applied on the results. As for the "document type", only papers/articles and reviews that have already been published were further analyzed. Books, chapters and reviews were excluded because journals are the most common platforms of contemporary knowledge sharing and publishing significant research results; in addition, articles and conference proceedings indexed in Scopus are always peer reviewed. Moreover, we also filtered for "language", as due to obvious reasons only publications written in English were included. As a final step, publications related to the environmental science "subject area" were excluded, because after reviewing the

results, we concluded that they were mainly connected to the ecological aspects of ecosystems, hence those were not in line with our research scope.

After reading the abstracts, 511 publications were excluded; then, after reading through the papers 234 publications were also eliminated, as, despite connecting to the concept of ecosystem management, they did not encompass the problem directly. The filtering left overall 75 publications in the final sample between 2006 and 2022. Then a content analysis was performed. Figure 3 presents the process of the semi-systematic review.

Figure 3 Process of the semi-systematic literature review



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The analyzed publications were mostly case studies, using qualitative methods, specifically surveys and semi-structured interviews with ecosystem participants. The aims of the papers were mainly to identify the best practices of ecosystem operation and to highlight some internal and external hindering factors of the specific cases. After reading the papers, specific attributes that connected to the organization or/and management of ecosystems were marked, then the different features were organ-

ized into a thematic system by logical consideration. The elements identified by the content analysis are presented in Table 2.

We identified as "keywords" those management elements that the articles associated with the better and/or more efficient functioning of the ecosystems. Elements were considered as "indicated" in the article, when the analyzed paper contained the given keyword. Keywords were changed throughout the analysis, as we omitted those that were not included in at least 10% (min. 8 paper) of the articles. After the elements were highlighted, we created a specific thematic system, so the elements with similar context could be connected following a logical linkage. Hereby, it is also important to highlight that the results of the paper could possibly have been arranged in a different thematic system; however, as the research focus of this paper was to identify the main factors of successful innovation management, this objective was considered during the analysis. At the same time, different interpretation may be fruitful as well to understand the topic more broadly.

Table 2 Elements and thematic categorization of the results

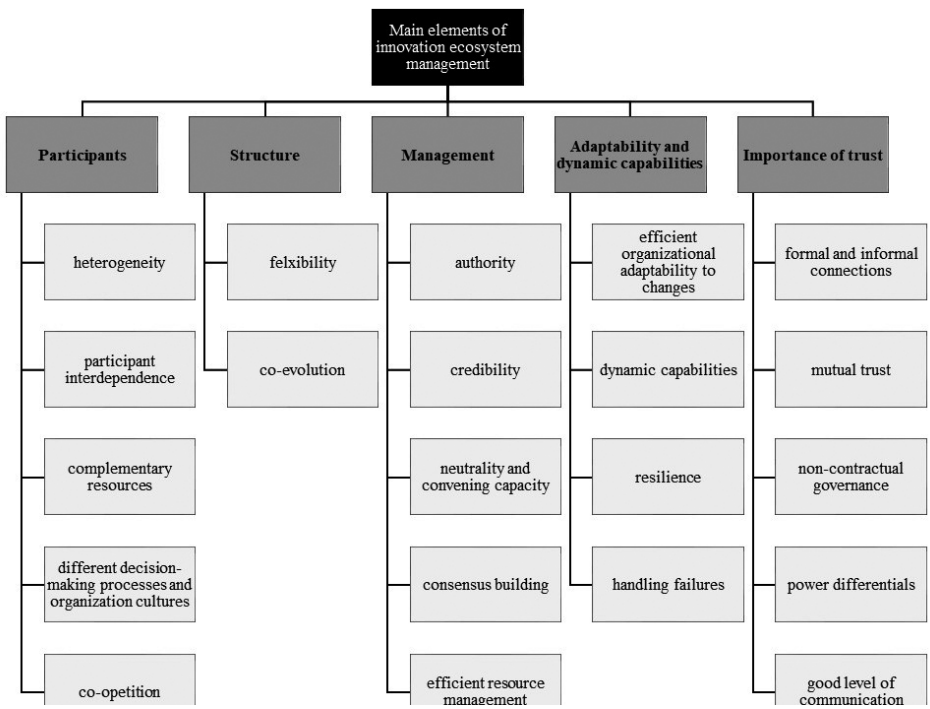
Indicated elements	Number of related articles	Thematic categorization
heterogeneity	15	Participants
participant interdependence	21	
complementary resources	14	
different decision-making processes and working cultures	13	
co-opetition	12	
flexibility	27	Structure
co-evolution	21	
authority	11	Management
credibility	12	
neutrality and convening capacity	13	
consensus building	9	
efficient resource management	7	
efficient organizational adaptability to changes	16	Adaptability and dynamic capabilities
dynamic capabilities	7	
resilience	8	
handling failures	7	
formal and informal connections	11	Importance of trust
mutual trust	11	
non-contractual governance	14	
power differentials	7	
direct communication	9	

Source: Own editing

3. RESULTS – ELEMENTS OF ECOSYSTEM MANAGEMENT

As a result of the content analysis, five thematic elements were identified that previous researches considered of paramount importance for successful ecosystem operation. The designed model is presented in figure 4. In this chapter, these elements are described briefly, providing practical insights on possible solutions for these structural challenges.

Figure 4 Identified elements and features of innovation ecosystem management



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3.1. PARTICIPANTS OF THE ECOSYSTEM

As cooperation is the basis of ecosystems, defining the partners is a fundamental issue for all participants before starting a new or entering an operating ecosystem. This is particularly important given that innovation ecosystems are characterized by a heterogeneous set of participants (Talmar et al., 2018). This also implies the possibility that members of the ecosystem may be competitors, so the participants need to be able to delimit their competitive and cooperative relationships in such a way that one does

not exclude the other (Adner, 2006). Competitors generally participate in the same ecosystem when the innovation goal is specific and objective. In this case, the parties primarily share the costs and risks associated with innovation, as they recognize that bringing a given novelty to the market requires extensive technological development and its wider application over time (e.g., close cooperation between electric cars and tech companies) (Visscher et al., 2021).

Ecosystems are also characterized by a diversity of decision-making processes and organizational cultures, which, although a key driver of learning and innovation, (Nieto–Santamaría, 2007), forces cooperation between incompatible organizations which usually leads to hindering tensions. Therefore, it is fundamental of well-functioning ecosystems that participants have different but complementary resources and skills, as the combination of these underpins the ecosystem's potential for innovation (Ruuska–Tegiland, 2009). When selecting ecosystem participants and before accepting new participants, it is therefore worth considering the future potential of a possible partner, rather than past achievements, which may be untapped in the present (Dodgson, 2007).

3.2. DESIGN OF THE ECOSYSTEM STRUCTURE

Essentially, the development of innovation ecosystems requires, on the one hand, that participants have different but high quality (or unique) financial, physical and/or human resources and competences, and on the other hand, that they clearly identify the common interests underlying the cooperation; in other words, the cross-section of self-interests (Bacon et al., 2019). This, however, only lays the foundations of an ecosystem, but professional ecosystem management is essential for the long-term and successful operation. If market players do not properly structure the ecosystem's organization, there is a high risk that resources may be frittered away, which in the long run will lead to the disintegration of the ecosystem, as the participants will realize less and less benefit from maintaining the cooperation (Ritala–Almpanopoulou, 2017).

Based on the operational structure of ecosystems, Jacobides et al. (2018) distinguish between open and closed ecosystem systems – similar to Chesbrough's (2003) models of innovation. An open ecosystem is particularly characterized by trust-based relationships and long-term commitment, while a closed ecosystem, on the other hand, is mainly based on contractual relationships, with better more specified goals. In an open ecosystem, the rules of the game are thus established "de facto" by common agreement, whereas in a closed ecosystem, the rules of the game are established "de jure", usually in writing, and set out the framework within which the ecosystem operates. This also implies that closed ecosystems are more difficult to adapt to external-internal changes and have higher entry costs for external actors, whereas open ecosystem systems are less able to coordinate among many actors (Ketonen-Oksi–Valkokari, 2019).

Overall, therefore, the operational structure of ecosystems is not bound in the classical sense. Whether an ecosystem takes on a closed or an open structure depends primar-

ily on the purpose for which the ecosystem is created and the basic characteristics of the industries involved, although empirical researches (e.g.: Jacobides et al., 2013) confirm that the two structures are dynamically interchangeable.

3.3. MANAGEMENT OF THE ECOSYSTEM

The leading, intermediary actor is most commonly referred to in the literature as a "boundary spanner", "gatekeeper" or "knowledge broker" (Tushman–Scanlan, 1981; Tamtik, 2018).

The role of the ecosystem leader or manager, is twofold, as in traditional project management. On the one hand, it is responsible for seeking consensus between the different interests of the participants, and on the other hand, it is responsible for coordinating between partners to achieve the ecosystem's common goals and the optimal utilization of resources (Champenois–Etzkowitz, 2018).

The manager can be a person or an organization; moreover, they may be a member of the cooperation or a person outside of it. However, an important criterion for the leader is that they must be neutral, politically independent and have close links with the representatives of all participants (Tamtik, 2018; Ferdinand–Meyer, 2017). When selecting the manager, it is important that the person or organization is credible to all participants in the ecosystem, i.e., has the appropriate professional qualifications and practical experience (Johnson, 2008). In addition, it is essential that the manager should seek to build consensus rather than compromise. Since if the leader is too 'diplomatic', i.e., tries to take account of individual interests at the expense of common goals, it will in the long run undermine the cooperation (Frølund–Ziethen, 2016).

We may conclude that although there are some general guidelines in the literature on the selection of the ecosystem leader or manager, in fact, in every ecosystem, the goals of the partners must be adapted to the method of the ecosystem management.

In short, the ecosystem leader is the person who is perceived as such by the partners on the basis on his credibility and competence. The credible person or organization that acts as the 'conductor' of the ecosystem is therefore more important than a steady organizational structure.

3.4. ADAPTABILITY AND DYNAMIC CAPABILITIES

As we have already mentioned in the Introduction, innovation activity involves many uncertainties. Failure is not always a failure of cooperation between the participants, as both the macro and micro economic environment can change very rapidly. Thus, participants are affected by changes both external and internal to the ecosystem, and asymmetric shocks can also occur, where particular ecosystem members are affected disproportionately – for example the Covid-19 pandemic (Pyka–Nelson 2018).

In order for an ecosystem to be resilient to the above-mentioned changes and crises, it is crucial to build adaptability – as it is highlighted in the very recent literature, e.g., Khurana–Dutta, (2021); Morais et al. (2022); Fukuda (2020).

In Mason's (2007) interpretation adaptability is the set of attitudes, knowledge and skills that enable an organization to operate in an uncertain environment. Adaptive capacity is determined primarily by the degree of behavioral uncertainty within the organization and its ability to envisage environmental change.

A conceptual area of adaptability that has been specifically analyzed from an innovation perspective is dynamic capabilities by Teece (2007). Closely related to the concept of adaptability, dynamic capabilities are those skills and capabilities consciously managed and developed by the organization to reorganize its existing resources (physical, intellectual, financial) in order to influence the external environment or to adapt to changes occurring inside and outside the organization. A comparison of the two concepts shows that while adaptation is more of a passive process, dynamic capabilities enable organizations to actively influence and foresee the changes to some extent.

Based on the literature analysis, the adaptability and resilience of the ecosystem became highly relevant just in recent years – which is most likely closely connected to the effect of the Covid-19 pandemic on the economy. As the current economic situation is more uncertain and vague in general, solid cooperations between market players are becoming more valuable. Therefore, the dynamic adaptability of an ecosystem is essential to ensure the operation of the cooperation in a period of increased uncertainty (Boyer et al., 2021). Moreover, if an ecosystem does not develop a certain level of dynamic capabilities during the operation, then the cooperation may lack real commitment by some of the partners, which could result in participants prioritizing their own interest over value co-creation goals (Sahasranamam–Soundararajan, 2022).

3.5. THE IMPORTANCE OF TRUST

In order for an ecosystem to function effectively and thus, as an organization, to be able to adapt dynamically to the external and internal changes mentioned before, trust between partners is essential. As Cobben–Roijakkers (2018) put it, trust is a prerequisite for ecosystem development, while trust is the basis for its operation. Based on the study by Castaldo et al. (2010, 666), trust can be defined as follows: "trust is a positive expectation of the future reliability and capabilities of an organization or person, which is not negatively influenced by uncertain environmental influences".

In ecosystem cooperation, the concept of trust is twofold. On the one hand, it implies "good will", i.e., the assumption that it is in the interest of the other partners to operate and develop the ecosystem in the most efficient way. On the other hand, competence-based trust covers the confidence in the competence and expertise of the other participants in the ecosystem. In summary, ecosystem actors must have both confidences that their partners will deliver and confidence that they have the resources to do so (Cobben–Roijakkers, 2018).

As Granovetter (1973) points out in his paper, cooperations are made up of strong and weak ties. Strong ties are characterized by the fact that the parties generally communicate through formal, often contractual, channels, and that information sharing is limited to the bare essentials. Weak ties, on the other hand, are characterized by

an informal, often long-lasting, familiarity between the partners, which facilitates the exchange of available information and personal opinions in a kind of joint reflection.

It is essential that strong and weak ties are not contradictory but complementary factors of trust. In their research, Blomqvist–Levy (2006) highlighted that strong ties tend to be fragmenting (separation between "us and them"), thus drawing clear boundaries of cooperation, while weak ties are integrating, because they allow cooperation between organizations and individuals who would otherwise not connect.

As innovation is an uncertain process, it is clear that both strong and weak ties are key factors in ecosystems; however, too much trust may weaken the "commitment to deliver" (Giest, 2019). Thus, healthy rivalry is essential in ecosystems, avoiding sharp personal differences (Russell et al., 2015). As Jones et al. (2020) concluded, informal relationships between partners usually prevent task conflicts to escalate to personal level.

Overall, the key is to maintain a healthy balance between formal and informal relationships (Chesbrough et al., 2014). For example, good personal relations between partners should not lead to an abuse of power, in extreme cases, corruption, but should benefit the ecosystem as a whole (de Clercq et al., 2009).

4. CONCLUSIONS

Innovation ecosystems are receiving wide recognition among scholars, businessmen and policymakers as well, although the exact meaning of the term even today is not completely outlined. The main distinctive feature of innovation ecosystems from other innovation-oriented cooperations is that the aim of innovation ecosystem collaboration is new value creation within a versatile and dynamically changing ecosystemic organization. Moreover, in ecosystems the focus is on the connections between participants, whereas in the classical innovation systems theory the focus is more on the institutional environment and knowledge creation (Weber–Truffer, 2017).

As ecosystems are diverse phenomenon, both related to the inner and outer aspects of innovation management, innovation ecosystem management is yet a relatively less researched topic. However, in the currently highly uncertain economic environment as a result of Covid-19 and international conflicts, efficient cooperations between market players are vital for companies' survival. Hence, the paper identified the most frequent managerial and organizational elements of innovation ecosystems through a semi-structured literature review on the Scopus database.

Although several bibliometric analyses have already been performed on the topic of innovation ecosystems, only a few focused on management elements and challenges. Since, during the filtering no specific innovation ecosystem management framework could be identified, based on the marked features, a framework of the main elements of ecosystem management was created. The results are summarized in Figure 4.

As the analyzed publications were not connected in any identifiable way, it is concluded that ecosystems have common managerial and organizational elements and features irrespectively of the related industry, the number of partners, the origin of the ecosystem or the applied research method. Hence, the main finding of the

paper is that ecosystem management is a currently evolving research field of ecosystemic cooperations which has already formulated a common knowledge-base, and an emerging interest for more efficient solutions for common managerial challenges has begun to be outlined.

Practical implications may be summarized as well from the theoretical results. As for corporate partners the managerial framework leads to the conclusion that one of the driving forces of cooperation should be the sharing of resources, knowledge, risks, and to reduce the cost of innovation. This dynamic ensures that participants are able to create more value in the ecosystem than they would be able to outside the cooperation. It also indicates that ecosystems should be formulated on the (potential) partners' own-perceived interest. Previous relations between market players serve as a foundation of ecosystemic cooperations, because trust-based relationships (or weak ties) influence both the selection of partners and the cohesion of the cooperation. As for policy makers, the results may redirect attention to the essence of long-term thinking; mostly because economic resilience is a value that cannot be imitated easily. Thus, the main role of government in ecosystem building is promoting the beneficial aspects of business relations, and to strategically support grassroots or bottom-up initiatives.

The results of the study are based on a semi-structured literature review; therefore it is important for the research to have solid limitations. Firstly, as literature reviews do not cover every publication on the analyzed field, no universal conclusions may be drawn from a single review. Secondly, as the analyzed papers applied different methodology, the comparison between results is limited. Thirdly, as ecosystem management is not yet an outlined research field, the results should be further reinforced with subsequent research.

As for the further research directions, if enough empirical evidence were available, the created framework could be specified for a given industry segment or for a specific type of participant (e.g., university, SME etc.). Otherwise, further ecosystem case studies – specifically from the CEE region – could also enrich our current knowledge on how innovation ecosystems really work and how the cooperation between different actors could be improved and orchestrated efficiently.

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