

Innovation Ecosystem as a Multi-Component Concept: Theoretical Review

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Abstract. The article is devoted to the study of the concept of "innovation ecosystem", which is interpreted by the authors as a multi-component. A brief history of the origin of this concept is traced, and various approaches to its understanding are analyzed. Based on a wide range of sources, the author reveals the fundamental aspects of the concept of the innovation ecosystem, reveals their differences from other concepts. Demonstrating the diversity of innovative ecosystems in the economy, the authors determine the factors of their effective development.

1 Introduction

In modern economic theory, there are different concepts of "innovation ecosystem", and how this concept relates to other similar ones. We adhere to the position that the predecessor of the innovation ecosystem is the concept of "business ecosystem". The author of this concept is James Moore [1]; under the business ecosystem, he understood a network of organizations that not only form a system of mutual support, but also jointly evolve around a new innovation. This format of cooperation ensures the competitiveness of each member of the business ecosystem and helps to support a new product, meeting the needs of the client. In essence, Moore is talking about the end of the era of competition between individual companies and the beginning of competition between entire business ecosystems.

Many authors working with the concept of "innovation ecosystem" repeat Moore's postulates, adding an innovative component to them. At the same time, according to Baiyere [2], despite the widespread use of this concept, there is no consensus among researchers on the definition of an innovation ecosystem. Suominen, Seppänen, and Dedeheyir, after conducting a bibliometric analysis of works on this topic written between the early 1990s and 2015, also conclude that there is a conceptual ambiguity in the use of "ecosystem" terms in economics [3]. In turn, Ritala and Almpanopoulou argue that this concept really lacks conceptual and empirical rigor [4].

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2 Theory and approaches

Since the concept of "innovation ecosystem" is multi-component, there are many approaches to its interpretation. Based on the analysis of the literature available to date, we will present in chronological order six approaches to understanding the innovation ecosystem (Table 1).

Table 1. Approaches to innovation ecosystems

Approach	Interpretation of the innovation ecosystem	Feature of the approach
"A system without internal contradictions"	Synthesis of new market proposals from the central firm and other ecosystem participants, which provides a connected new solution for the client (Adner, 2006) [5]	One of the very first interpretations of the innovation ecosystem, which is used as one of the starting points by almost all subsequent researchers
"A system with internal contradictions"	An interdependent structure consisting of a central firm and its environment: suppliers, consumers, various regulators, and firms that produce related products and services. Participants can be active and passive in the field of innovative developments, support or hinder the innovation activities of the central company (Adner, Kapoor, 2010) [6]	There may be contradictions in the goals of the ecosystem participants
"Enabling environment for innovation"	A set of economic agents, relationships, and non-economic components (for example, culture). Such a structure, supported by non-economic components, creates a favorable environment for the emergence of new ideas, the introduction of innovations and their dissemination. A well-developed ecosystem helps its participants to work outside their firms and allows them to transform shared knowledge into innovation (Mercan, Göktas, 2011) [7]	The presence of non-economic components as a favorable environment for innovation
"Organization or platform"	An interconnected network consisting of a central firm or platform and commercial and non-profit organizations centered around it, which interact with each other in order to create and capture new values through innovative activities (Pellikka, Ali-Vehmas, 2016) [8]	At the center of the ecosystem can be not only a firm, but also a platform
"Ecosystem participants plus individual actors"	The complex of relations that exist between individual actors and / or organizations that have a common goal-to ensure innovative and technological development (Oh et al., 2016) [9]	The focus is not only on the participants of the ecosystem, but also on individual actors who have certain values for the ecosystem
"Integration"	An evolving set of actors, activities, artifacts, institutions, relationships, as well as complementary and interchangeable relationships that play a significant role in the innovation activities of the central firm and the entire ecosystem as a whole (Granstrand, Holgersson, 2020) [10]	One of the most recent interpretations of the innovation ecosystem, which emerged as a synthesis of research experience over the past 15 years

Thus, the "innovation ecosystem" has made a certain evolution: from approaches that focus on particulars, to an approach that seeks to integrate all particulars. Accordingly, the integration approach, due to its desire for completeness of coverage, looks the most promising. At the same time, in our opinion, the other approaches also do not lose their

relevance, since the reality of innovative ecosystems is quite broad, and their analysis in accordance with the tasks set can focus on various specific aspects.

3 The difference from other concepts

The main feature of ecosystems, which many say the authors, is the co-evolution of its members throughout their interaction [1, 17, 14].

From earlier concepts, such as technology and science parks, science cities, technopolises, and innovation clusters, ecosystems differ in that they are more systematic (the importance of the relationships between participants is emphasized), digitalized (information and communication technologies occupy a key position), create innovations in accordance with the "open innovation" paradigm, have a greater emphasis on role differentiation, and are more influenced by market forces [9].

The concept of an innovation ecosystem differs from other designs built around networks in that it focuses not only on producers, but also on consumers, as well as producers and consumers of complementary goods and services [13].

Platforms, open innovations, and ecosystems differ in the nature of the relationships between their participants. In the first case, the central organization, being a platform, does not directly interact with the actors, it only creates conditions for their direct interaction. The latter include the central firm and the actors (users, designers, innovators, etc.) with whom the central firm interacts directly to create an innovative product. The peculiarity of the ecosystem structure: between its participants there can be relations both in direct interaction, and only for the purpose of helping to establish connections with other participants of the ecosystem. However, these structures are not mutually exclusive [18].

4 Fundamentals of the concept

Based on our knowledge of the subject, we can identify the following fundamental aspects of the innovation ecosystem concept:

1. *The central entity around which the innovation ecosystem* can be a firm, a digital platform [8, 11, 12], a business unit, or a structural unit. The central entity is responsible for management, depending on the specifics of the ecosystem, controls access to the platform or the right to use its brand and benefit from it; is responsible for stability and creating joint results [13]. Often in the literature on ecosystems, the term "orchestrator" can be found, denoting the central subject of the ecosystem [12]. In addition to the actual orchestrator, the presence of potential orchestrators in the ecosystem is also allowed [14] (Radziwon, Bogers, 2019).

2. *Various economic agents that are or are not members of the innovation ecosystem.* The results of the activities of the central entity and the innovation ecosystem are determined by the nature of the activities of all economic agents included in the ecosystem [6]. The number of ecosystem participants is determined by the degree of openness of the ecosystem [15]. At the same time, agents that are not related to a particular ecosystem can also influence its activities. For example, these can be subjects that are part of the ecosystem's immediate environment, or contextualizing subjects [15].

3. *Links between members of the innovation ecosystem.* The location of the members of the innovation ecosystem and the connections between them are essential for the successful functioning of the entire structure [6]. Ecosystem participants can share knowledge, values, etc. [4]

4. *Additional resources received by the participants of the innovation ecosystem.* Members of the innovation ecosystem can use various resources of the central entity to

improve their financial performance. However, the ecosystem allows the central entity to expand its own capabilities by attracting the resources of other ecosystem participants [16]. For example, it can be knowledge [8].

5. *The overall goal of the participants of the innovation ecosystem* is a defining element for the entire system, it is called the ecosystem value proposition [17, 12].

6. *Jointly created values*. The innovation ecosystem allows its participants to create values together that they could not create alone [5, 8, 12].

7. *The interdependence of ecosystem members*. The performance of any of the key ecosystem members influences and determines the success/failure of its value proposition and each ecosystem member individually [17, 14, 12].

8. *The embeddedness of members in an ecosystem* means that a particular member has the ability to benefit personally from the value created with the participation of other members of the ecosystem [17]. In particular, for small organizations, participation in the ecosystem is a chance to be competitive on the world stage [15].

9. *Innovation ecosystem strategy*. The innovation ecosystem should correspond to the innovation strategy and vice versa [5]. The strategy of the central actor should be developed in the context of the ecosystem and take into account the interests of all its members [16, 12]. Thus, the ability of a central firm to successfully commercialize a new product will depend on its own strategy and how it manages the strategy of the entire ecosystem [8].

10. *Ecosystem boundaries* can be open or closed [4]. If the boundaries are permeable, the limits of the ecosystem are difficult to determine [13]. At the same time, economic agents can be members of several ecosystems at once [16]. Borders are also defined by geographical coverage: local, regional, national, or global [4].

11. *The dynamism of the ecosystem*. The innovation ecosystem is an ever-changing structure, driven by new needs and transformed by new circumstances [7]. The presence of dynamism in the ecosystem provides opportunities for creating and capturing value. Three types of dynamic capabilities are critical: 1. Innovative capabilities help firms develop innovations; 2. scanning capabilities help detect opportunities and threats; and 3. integration capabilities contribute to the orchestration of the entire system [11].

12. *Benefits from the ecosystem*. Increase profitability, reduce time to market, improve innovation opportunities and training, and expand market access [8].

5 Factors of effective development

As the concept of the innovation ecosystem has evolved, researchers have formulated several different approaches to understanding the groups of factors that determine its effective development; within each group, we identify a determining factor (Table 2).

Table 2. Factors that determine the effective development of the innovation ecosystem

The determining factor	Description of a group of factors
Innovative	Continuous transformation of technologies and resources into new products with lower costs, adaptation to a changing environment and the creation of new niches [16]
Strategic	Developing processes, working with partners and potential followers, creating an innovative strategy that takes into account the risks inherent in the ecosystem [5]
Infrastructure	The state of cluster development, cooperation between universities and industry, the presence of a culture of innovation [7]
Human	The presence of talented people; the concentration of researchers, entrepreneurs, and various institutions; the presence of a culture of entrepreneurship, access to capital, and a supportive regulatory environment [9]

The identification of the innovation factor as a determining factor is related to the essence of the concept and phenomenon of "innovation ecosystem", one of the main goals of which was the emergence of an alternative approach that promotes the introduction of innovative products and services to the market. However, sustainable development and successful innovation in the long term is impossible without strategic management; hence the allocation of the strategic factor. To create innovations in the context of innovation ecosystems, a special infrastructure is also important, which, among other things, contributes to the emergence of a synergistic effect (the infrastructure factor). The ecosystem approach also imposes new requirements on people, whether they are representatives of production, public administration, science or civil society (the human factor). In our opinion, at the present stage of studying innovative ecosystems, it is advisable to accumulate the formulated approaches into a general logic, which will allow us to approach a more complete and comprehensive study of such a multi-component phenomenon as the innovation ecosystem.

6 Conclusion

Today, the concept of "innovation ecosystem" successfully overcomes the stage of formation, and we see how actively its basic principles are formulated, with which many scientists who adhere to different approaches agree, and other conceptual components, as well as their operationalization. And if initially we were talking about approaches related to particulars, now there are also integration approaches, which, in our opinion, are more promising (despite the fact that particulars are also important and relevant). Gradually, the concept of "innovation ecosystem" becomes really multi-component.

Since this concept is initiated and constructed on the basis of the real experience of modern companies, regions and states, it begins to acquire practical significance. The diverse sources used by us allow us to argue that the emergence of the concept of "innovation ecosystem" marks a transition to a new paradigm in management, which has its own philosophy and requires different behavior in both strategic and operational management. For theorists, this paradigm accumulates the latest achievements in management as a science, becoming the basis for subsequent research; for practitioners, it simplifies the introduction of modern managerial knowledge into practice, since they deal with one complex concept, and not a dozen disparate ones.

At the same time, one can also find criticism of innovative ecosystems both in a practical and theoretical way. In the first case, criticism is built around the fact that trying to put innovative ecosystems into practice can be a costly failure, since along with new opportunities, they also generate additional risks [5], which can negate the potential benefits [9]. In the second case, this concept is used inconsistently, which calls into question its contribution to science and, consequently, the possibility of transferring theoretical research related to innovative ecosystems to practice [4]. In our opinion, this criticism should not be taken as a signal of the failure of the concept and concept, but as a fan of opportunities for further research that will dispel the existing doubts.

In general, the concept of "innovation ecosystem" is the starting point for many different approaches designed to solve specific practical problems in certain conditions, including in a relatively narrow segment: for example, the transfer of innovation ecosystems to the scale of cities, regions and countries (innovation ecosystem at the city level, regional innovation ecosystem, national innovation ecosystem); the ecosystem of science, technology and innovation as the basis for the Japanese implementation of "Strategy 5.0"; innovations in the circular ecosystem, etc. In the present studies focus on specific aspects of the innovation ecosystem (e.g., knowledge transfer, communication, and

configuration) and some of its participants (the position of universities, Central firms, small and medium enterprises, etc.).

In the future we plan to conduct studies that the synthesis will be implemented at a qualitatively new level, we mean a parallel examination of the innovation ecosystem from the standpoint of several/many of their members or aspects.

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