

# Innovation Ecosystems vs. Innovation Systems in Terms of Collaboration and Co-creation of Value

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## Abstract

*In this paper, we explore the relevance of the term “innovation ecosystem” to describe dynamic collaborative networks of people and organizations formed around projects with an innovation objective. We present a survey of literature reviews on ecosystems studies to clarify typical features and interpretations of innovation ecosystems, and we highlight differences in terms of collaboration and value co-creation. We explore ecosystem thinking and illustrate patterns of innovation ecosystems by describing the structure of regional clusters, global value chains and platforms. We offer policy insights on the role of governments in stimulating innovation ecosystems and innovation-conducive environments.*

## 1. Introduction

The concept of innovation ecosystems has emerged in early 2000s to meet the demands of emerging knowledge-based economies, in which the production of innovations and the associated development processes are increasingly non-linear and network-based [1]. This concept has remarkably enriched the idea of innovation systems, coined in the industrial era in the research streams of Freeman, Lundvall, Nelson, and their followers [2–6]. In the 1990s, national or regional innovation systems were seen as static structures regulated by government bodies, with successful performance depending on a critical mass of involved actors and intentional infrastructure [1]. As a departure, innovation ecosystems of the 2000s are considered dynamic and agile collaborative structures that enjoy self-governance as a necessary prerequisite for interactive innovation [7, 8]. This approach is now applied in innovation policies of many developed and developing nations [9].

Meanwhile, some scholars and experts still seriously doubt whether the introduction of the term ‘ecosystem’, adding “eco-“ to “system”, is justified. In particular, some papers argue that though writers on “innovation ecosystems” have added some valuable ideas to the

innovation discussion, appending “eco-” to “innovation systems” adds nothing of substance. Rather, “innovation ecosystem” is a faulty analogy to natural ecosystems [10]. A discussion on this problem of a better terminology opened in the literature quite recently.

Against this background our paper is an attempt to make a contribution to such discussion. With the updated thinking of innovation (for example by the World Economic Forum) [1], we conduct a review of literature published from 2005 to 2016 on ecosystems, concentrating on innovation ecosystems and acknowledging the related terms of business ecosystem, software ecosystem, industrial ecosystem, digital business ecosystem, entrepreneurship ecosystem, and knowledge ecosystem. We aim to clarify typical features of innovation ecosystems as compared to systems and to highlight the advantages of an ecosystemic mode of producing innovations, while picking up interpretations and definitions both from economic and business literature.

## 2. On the definition and the variety of ecosystems in literature

In the updated version of the Global Competitiveness index (GCI), the World Economic Forum draws from findings in the literature, and argues in GCI that innovation now means not only technological innovation but, *in a broader notion, an “ecosystem” (environment) conducive to the generation of ideas and their implementation in the form of new products, services, and processes in the global marketplace* [1]. This approach can be further described with three important details: the wider-scope of innovation, the innovation-conducive environment, and various studies on ecosystems.

Firstly, regarding the scope of innovation, new ideas can be generated by formal scientific R&D; they can also result from non-R&D activities that do not require fixed research costs yet increase the efficiency with which a good or service is produced (such as innovations in managerial and organizational

techniques, personnel, accounting, work practices, etc.) and non-commercial (the latter often treated as “softer”  
 The implementation of such ideas may be commercial innovation.)

Table 1. Literature reviews on the variety of ecosystems, 2005-2016

<i>Review</i>	<i>Review source</i>	<i>Review result</i>
(Peltoniemi, 2005) [11]	Literature review and conceptual analysis of <b>business ecosystem</b> as an organizational population model	Dynamics of conscious choice and limited knowledge of an individual organization and from the interconnected-ness and feedback loops of an organization’s population; differences in cluster and value networks
(Peltoniemi, 2006) [12]		
(Manikas & Hansen, 2013) [13]	90 papers relevant to <b>software ecosystem(s)</b>	The software industry is moving towards software ecosystems with platforms like Google Android and Apple iOS
(Pilinkienė & Mačiulis, 2014) [14]	Literature review of ecosystem analogies: <b>industrial ecosystem, innovation ecosystem, business ecosystem, digital business ecosystem, entrepreneurship ecosystem</b>	Ecosystem analogies have various scopes and objectives having an impact on micro-level, associated with actions of internal actors; (eco)system can be a significant determinant of sustainable economic development
(Gawer, 2014) [15]	Review of management research on technological <b>platforms</b> : industrial economics and engineering design	Platforms operate along an organizational continuum, including firms, supply chains, and industry ecosystems
(Gawer & Cusumano, 2014) [16]	Platform-based ecosystem innovation; review of research on internal and external <b>platforms</b>	A critical issue for managers is to learn to manage the evolution of their industry platforms and accompanying ecosystems and make interrelated technological and business decisions
(Thomas, Autio, & Gann, 2014) [17]	183 publications of <b>platforms</b> in management context	Four streams of platform research identified: organizational capability, product family, market intermediary and technology system
(Kortelainen & Järvi, 2014) [18]	72 empirical articles on <b>ecosystems</b> in a business context	Research on ecosystems is still a long way from the stage of theory testing (i.e., using multivariate statistical methods) or of replication studies across ecosystems
(Valkokari, 2015) [19]	Review of types of <b>business, innovation and knowledge ecosystems</b> and the relationships between them	In order to survive and thrive in an ecosystem, a variety of forms of interaction are required; the interaction between various types of ecosystems is an unexplored area
(Suominen, Seppänen, & Dedehayir, 2016) [20]	4681 publications to look at <b>innovation systems</b> literature, 427 <b>ecosystem</b> research articles	The literature on national, regional and technological innovation systems, as well as literature on corporate competitiveness and the ecosystem approach, has both shared and divergent intellectual roots
(Aarikka-Stenroos, Peltola, Rikkiev, & Saari, 2016) [21]	Systematic content analysis of 157 articles of <b>innovation and business ecosystems</b>	Multidisciplinary perspectives exist on ecosystem phenomenon; research gaps exist, including a gap in policy-making; the business ecosystem stream is dominant

Source: Authors’ elaboration

Secondly, an innovation-conducive environment, comprised of ecosystems and networks, can increase the likelihood that “softer” innovation takes place. This environment encourages collaboration,

connectivity, critical and creative thinking, diversity, and confrontation across different visions and angles. By bringing new products and services to market,

such ecosystems and networks foster productivity though embedded technology, with efficiency gains.

Thirdly, to achieve a complete picture of an innovation-conducive environment one needs to consider both *economic literature* (which focuses more on system incentives to spur idea generation at the aggregate level) and *business literature* (which identifies important factors that generate innovative companies and/or motivate them to innovate).

To this end, and particularly to explore the contemporary perception of innovation ecosystems, we examined relevant scholarly literature in the field of management and economics. We found eleven (11) literature reviews, identified through previous literature reviews themselves. For example, Kortelainen and Järvi [18] acknowledge seven primary reviews, while Valkokari [19] draws from the review by Thomas, Autio and Gann [17]. In addition, participation in scientific conferences allowed us to include other very recent reviews. The range of primary sources covered by reviews during the 2005 to 2016 period is diverse, as some are based on tens of scholarly articles, others are based on 100+ articles, and one even considers close to 5000 publications, as shown in Table 1.

Our overarching survey has highlighted a broad variety of related terms, used simultaneously in literature to describe organizational continua or network interactions. Particularly, there are business ecosystems, software ecosystems, platforms, industrial ecosystems, digital business ecosystems, entrepreneurship ecosystems and knowledge ecosystems; in addition, start-up ecosystem is mentioned [21]. Overall, these entities are seen as vital in sustainable economic development [14].

Our findings confirm that the ecosystem idea is often applied without clear definitions [19] and that there is increased conceptual ambiguity of the terminology [20]. Terms denoting different types of ecosystems are often used interchangeably [21], although some differences between biological and business ecosystems are articulated [11, 12, 14]. It has been noted that research on ecosystems is still a long way from the stage of theory testing [18].

### 3. Synthesis for interpreting innovation ecosystems

In previous writings, we viewed *innovation ecosystems* as networks of sustainable linkages between individuals and organizations, which emerge from a shared vision of desired transformations and provide an economic context (milieu) to catalyze innovation and growth [22]. As applied to the variety

of inter-firm or inter-organizational networks, this definition implies innovation ecosystems are oriented either to the direct co-creation of innovations or to the formation of innovation-supportive milieu [23].

As our literature review shows, innovation ecosystems may be treated *both as business networks and as communities meant for innovation*. They may assume different scale and design, functioning as regional innovation hubs, nation-wide innovation communities, local inter-firm networks, very small network-based ad-hoc groups of individuals, or global wide networks [7].

However, neither geography nor industry sector expose the essence of innovation ecosystems as compared to systems. Noticeably, in management studies, one of the primary motivations for addressing the ecosystem concept has been the desire to explore self-organizing properties of natural ecosystems [24]. In studies on innovation dealing with generation and implementation of new ideas, ecosystems are usually considered a means for co-creation and market introduction of inventions [1]. Literature on economic competitiveness incorporates the idea of ecosystems in the context of the broad impact of digital technologies (IT, ICT) on the changing nature of innovation process, especially regarding implications of non-linear innovation for alternative organizational designs. Such thinking is reflected in modern production systems at all levels (firms, clusters, regions, national economies, global economy).

Summarizing the relevant points in literature, as they highlight the origin and properties of innovation ecosystems, we come to the following conclusion. *In the age of non-linear innovation and digital technologies, innovation can be better nurtured within a special, innovation-conducive environment. Such an environment may be seen as an ecosystem meant for co-creation of value through collaboration.*

The concept of *value co-creation* is basically associated with a business strategy focusing on interactive relationships between producers and consumers (the latter are becoming productive workers, or prosumers, who are granted authority by companies to articulate their specific requirements and at times contribute to design considerations). Initially elaborated by the business and market literature, this concept started to gain momentum in the post-2000 period, expanding further in its two dimensions, as both *the idea of value co-production and the idea of value-in-use* [25].

According to an updated definition, as introduced in management studies, particularly by LSE Enterprise [26], co-creation of value is an *active, creative and social process, based on collaboration*

*between producers and users*, which is initiated by the firm to generate value for customers and compete to pass others in the category (i.e., the Nike approach constitutes a full spectrum of customer involvement and competition). While consumers benefit from greater personalization and value, companies build competitive advantage by turning just-in-time knowledge from customers into just-in-time learning for their organizations. Relationships for co-creation may also be established between and among businesses and service organizations. Such collaboration might include global introduction, competitive analytics and tolerance for inefficiency.

The co-creation concept highlights not only the frequency of interaction, but also the quality of relationships between companies and their customers, or among companies, to determine how knowledge is created, shared and transferred [27]. In terms of modern economics literature, this concept can be applied to the architecture of the innovation-led economy based on customized products. In this sense, the co-creation process may imply *the possibility of collaboration between different types of actors across the economy, enabling them to co-produce new goods and values, i.e., innovations*.

In turn, **collaboration**, taken in a broad sense, denotes various forms of interactive communication between networked actors. For example, some experts argue [27] that collaboration is important for both R&D and non-R&D innovation but each type uses different networks. In a more exact definition, collaboration is seen as the most developed form of interactive cooperation. It implies that in order to co-create innovations, *networked actors must rely on a common vision, strategy, common identity, and joint obligations* [28].

To further explain the term of innovation ecosystems and its implications, we have developed additional perspectives.

### **3.1 ‘Innovation ecosystem’ as a metaphor for collaborative innovation networks**

Ecosystems can’t be deliberately established as system-like organizations. Rather they emerge as innovation-conducive environments in the course of collaboration among networked actors. Meanwhile, collaborative networks themselves, tailored to co-creation of value in various forms and ways, can and should be treated as modern agile organizations typical of the 21st century. One of the first descriptions of such dynamic and innovative entities appeared in early 1990s in the “New Society of Organizations” by P. Drucker [29], in which he underlined the ability of such organizations for

continual “creative destruction” and predicted their future global domination.

Later, a more exact term of ‘collaborative innovation networks’ appeared in literature to denote typical organizational forms of production in the age of digital technologies. This term was popularized by Gloor in 2006 [30] and further explored conceptually [31] and empirically [32] by other authors. Such networks may be local, national, transnational or global; they may have different configuration and patterns of collaboration [31]. Their growing proliferation implies that in the 21<sup>st</sup> century, innovative goods, technologies and values will be typically co-created through collaborations of networked entities that form relatively *sustainable ecosystems of actors, linkages and assets* [33].

Since innovativeness of networks can be revealed only through their collaboration activities, we can consider them innovation ecosystems and use this term as a metaphor for denoting their specific organizational and functional features, as compared to systems. *Ecosystems are tailored to interactive co-creation of values, while systems are not*.

Taken as a metaphor of collaborative networks, the term ‘innovation ecosystem’ provides a highly useful image to draw a difference between the rigid hierarchical design of economic systems in the age of linear development and their dynamic network-based architecture in the 21<sup>st</sup> century. Hence, this term helps to highlight the newly emerging economic milieu, in which innovative goods and values are created at the level of networks capable of shaping an effective ecosystem. “Eco” stands to emphasize the non-linear nature of innovation and the crucial role of collaboration in producing innovations to achieve sustainable development in non-linear environments.

The ability of collaborative networks to adapt themselves to a non-linear environment implies they assume certain features of *complex adaptive systems* - agility, self-organization, self-governance, and synergy effects [34]. When it comes to such ecosystems as innovation clusters, cluster literature (originated by Porter and followers) directly interprets them as complex dynamic systems, noting their unique synergy effects [35–37].

Also important, collaborative networks that form an ecosystem of actors and linkages to co-create innovations are designed as temporary projects, around a common project idea. For this reason, the emanating network economy is also called a project economy [38], as an alternative to a traditional economy, in which interactions are not necessarily collaborative and long-term systems are intended. Collaborative networks and their ecosystems are distinguished by different design, functional purpose

and pattern of collaboration. These differences can be easily seen when comparing *regional innovation clusters, global value chains and digital platforms*.

**3.1.1. Innovation clusters as formalized innovation ecosystems.** Innovation clusters are geographically localized agglomerations of collaborating firms and organizations, which enjoy a highly developed pattern of collaboration, associated with a triple-helix model, i.e. an interactive pairwise collaboration between three types of networked institutional actors, namely companies, research centers and authorities [39]. As follows from cluster literature [37], innovation clusters constitute a special variety of innovation ecosystems, in which triple-helix interactions enable unique economic effects of innovation synergy, or *co-creation of innovative goods and services on a continual basis*. According to this literature, among the various kinds of collaborative networks only innovation clusters can provide a sustainable rise in productivity based on a continual innovation [40]. Initial systemic findings [41] confirm that successful innovation clusters can function as poles of growth for a given region.

Open innovation clusters are considered the most convenient ecosystem model both for continuous co-creation of innovations and for disseminating them across an economy. These ecosystems are shaped by collaborative partners of various profiles, who are free to join and leave the open cluster network [40]. According to observations [42–44], mature clusters have a sophisticated ecosystem of functional linkages, formed both by deeply embedded actors and by flagship firms that have already expanded beyond the cluster's bounds and are reinvesting money in their business projects

By virtue of the coordinating work of cluster organizations, a co-located group of companies is able to transform itself into a self-governed and self-sustainable network that can achieve innovation synergy. Due to their relationships developed as ecosystems, entities in agile innovation clusters can combine and rapidly recombine their shared assets in varied and novel configurations and, in this way, can flexibly start new venture business projects to meet the rapidly changing market demands. Their “design” is evolved through a combination of market forces, organizational efforts of triple helix actors [45], and value transactions [46].

**3.1.2. Global value chains as innovation ecosystems of cross-cluster collaboration.** Regional innovation clusters are seeking to develop their specializations in ways that enable them to become geographically localized network nodes of global

value chains (GVCs). The latter are the result of globalization, when traded goods and services are no longer produced or consumed within a single country but instead, through dispersion of the production processes and marketing, across several countries. GVCs are now horizontally crossing countries and territories, with value added flows circulating between their cluster nodes. Meanwhile, GVCs themselves constitute a special kind of collaborative networks, and therefore, a kind of ecosystem to co-create value.

GVCs emerged in the late industrial era due to outsourcing business practices. Initially, they were governed by hierarchic multinationals that were building vertical systems of actors under their control, while looking for expansion in size at local, not yet globalized markets. Nowadays, multinationals tend to become more horizontally dispersed and network-based [47].

One can see a GVC as a *horizontally dispersed ecosystem for value co-creation*, formed by a network of legally independent and functionally interdependent actors that are collaborating across countries and territories within a common project. The participating actors create initial and intermediary products (knowledge, technologies, goods, services) that move along the chain in an upstream way, generating flows of a consecutively added value, until the final product is co-created and delivered to external customers, embedding productivity into a dynamic cluster ecosystem.

**3.1.3. Platforms as ecosystems for value co-creation.** Digital platforms are oftentimes regarded as technological systems, as a technical artifact, “as the extensible code-based system that provides core functionality shaped by the modules that interoperate with it, and the interfaces through which they interoperate” [48, p. 677]. Increasingly they are also seen as management and economic concepts, creating value by providing products and services that enable two or more different types of customers to find each other and exchange value [49]. Importantly, the overall value of platform requires players, such as developers who build tools, to operationalize the exchange [50]. Conceptualization of platforms has been developed separately by two streams of academic literature – industrial economics and engineering design.

The *industrial economics perspective* associates platforms with a new, network type of markets (two-sided or multi-sided), focusing on how platforms create value by coordinating transactions between two or more groups of consumers who would not have been able to connect without the platform. This

literature highlights that platforms generate a virtuous cycle of indirect, or cross-group network effects (the value that consumers and the platform owner can capture increases with increasing customer bases), which dynamically reinforces incumbents' early-gained advantages.

*The engineering design perspective* views platforms as purposefully designed modular architectures organized around a 'core' (the platform leader) and a 'periphery of users' (which complement the platform leader), providing a respective technological interface between these two sides. This literature posits that platforms can network and coordinate users not just in the role of consumers but first of all in the role of suppliers and innovators, thus helping firms to achieve the economy of scope effects and facilitate innovation [51].

The literature on platforms distinguishes three broad types of platforms, namely *platforms within firms* (like Sony Walkman's platform servicing constituent sub-units of one firm in consumer electronics), *platforms across supply chains*, including GVCs (like Boeing's platform for the GVC in aerospace manufacturing, or Renault-Nissan's platform for the GVC in automotive manufacturing), and *industry-wide platforms* (like Facebook's platform across the sector of social networking) [52]. Industry-wide platforms are considered as generators of the most open ecosystems. They are defined as technological building blocks (technologies, products, or services), which act as a foundation for organized array of interdependent firms (sometimes called an industry "ecosystem") to develop a set of inter-related products, technologies and services [15].

On top of this, there exists a special class of *platforms for joint action*, tailored to overcome coordination problems and to directly support collaboration in the process of the project realization [52]. These platforms enable cluster participants to better exploit potential linkages among existing capabilities and to make better decisions on investing into new capabilities, taking into account the externalities of such actions across the cluster [53]. These platforms aim to provide innovation synergy effects that lead to individual and aggregate 'competitiveness upgrading' across the cluster [37].

Insights from different research streams move us closer to understanding platforms from *the perspective of value co-creation*. Platforms can form or promote the emergence of ecosystems enabling the co-production of innovations [25]. Much of this ability concerns the value-in-use dimension of the value co-creation concept, i.e., using and transferring value. Cluster platforms for joint action enable networked actors (producers, suppliers, customers) to

exchange their knowledge, transfer value and reshuffle their resources for the purpose of direct co-production of innovations [45].

Overall, digital platforms are redesigning traditional industrial landscapes towards ecosystemic perspective. Literatures on platforms and ecosystems have started to merge and have introduced the term '*platform ecosystem*' (for example Basole & Karla 54). Scholars are examining platform roles in ecosystems that generate large populations of networked users, who carry different functions and interact in a wide variety of ways to co-create value. This makes it reasonable to associate platforms with innovation ecosystems rather than with technological systems. And as studies on platforms suggest (McKinsey Global Institute, 2015 55), the digital sector provides several widely recognized examples of platforms and their associated platform leaders, such as Apple, Facebook, or Google (which became Alphabet) with each of these leaders playing an orchestrating role within a network of firms and individual innovators that have come to be collectively referred to as the platform's "innovation ecosystem" [56].

### **3.2 Transition of economies to ecosystem organizational design**

Although the word 'ecosystem' derives linguistically from biological ecology, the use of this term in the context of innovation is not about connotations with Darwin's natural order. Rather it reflects the growing organizational complexity of economic systems, which denotes the formation of a new, more sophisticated social order, based on network coordination [27].

The shift of the technological paradigm [57] associated with non-linear innovation and proliferation of digital technologies is occurring hand in hand with a concomitant shift in the paradigm of social interactions. While industrial economies of mass production rested on a combination of market and hierarchic patterns of coordination, the emerging innovation-intensive economies (also called post-industrial systems, or knowledge-based economies) rely on a more sophisticated, network pattern of social coordination, constituting a functional hybrid between rigid hierarchies and atomistic markets [58, 59]. As applied to these changes, the term 'innovation ecosystem' can be used to denote the ongoing organizational transformation of economies into network-based production systems. This change is accompanied by a deconstruction of hierarchies both at micro- and macro-levels of social activity. In a growing number of countries private firms and

public bodies are meeting the challenge of restructuring, transforming themselves from vertically built entities into more flexible and horizontally oriented [47, 60].

The newly emerging design of economies can be called ecosystemic, to emphasize the crucial role of networking and dynamic connectivity between actors (including interpersonal linkages) to work within the dispersed non-linear space. As a result, an innovation-conducive context is emerging. This context implies an inclusive institutional environment in the terms of Acemoglu and Robinson [61], or the idea of building ‘commons’ in terms of Ostrom [62], or simpler, the culture of win-win games in economic and political markets to meet challenges of the global competition.

As rigid vertical hierarchies, typical of the industrial era, are being replaced by agile horizontal networks, the traditional patterns of governance are giving way to collective decision-making, in which investment priorities, lines of business activity and conventions are defined through interactive consensus-building among networked actors. This non-hierarchic model of governance, associated with proliferation of platform-based communication, is often called *collaborative governance* [63].

Collaborative governance in its various patterns is now emerging for region-wide or national-wide innovation ecosystems that are gradually evolving within countries and territories under government support. Collaboratively governed ecosystems provide an alternative to the former, “linear” innovation systems of regional or national scale, which governments have tried to develop not through promoting collaboration and connectivity but through initiatives that concentrated on the individual roles of actors, or the establishment of innovative infrastructure or structures as such [64].

### **3.3 The new mission of governments in the age of ecosystems. Policy implications.**

The global trend in the transformation of the hierarchical systems of the past into network-based and self-supportive ecosystems of the post-industrial era doesn’t mean that the governments are becoming less active. On the contrary, governments’ best interests require even more proactive now than in the late industrial epoch, associated with liberalization of markets. However, the functional purpose and the manner of government interventions into markets are drastically changing.

In the industrial age, various national governments, especially in developing economies, took the upper hand in defining strategic priorities for

the private sector, which was associated with a classical model of industrial policy. During times when modernization in many developing economies had been driven by their market-oriented transition, direct state interventions into industrial structures have been replaced by mild indirect initiatives aimed at building a better institutional environment.

The situation has changed in recent years, when all types of economies (developed, developing and those in transition) have been faced with a common need to accelerate their transition to knowledge-based systems and adapt themselves to the non-linear world. At the organizational level, this challenge is concerned with promotion of a network-based and ecosystem-oriented transformation. As a result, since 2010s, a *new model of industrial policy* has emerged in many developed and developing countries, one which seeks to upgrade their industrial structure and enhance competitiveness through a collaborative organizational environment for a continual innovation [65].

The new industrial policy is not limited to manufacturing or to material goods. Rather it's about acceleration of the ecosystem-oriented restructuring in the whole industrial (economic) landscape, implying that under this new design the market forces will self-discover the most innovative business projects and re-direct resources into those projects and industries [66]. Under this policy, national governments don't seek to build specialized innovation clusters in "priority" industries, but instead help localities create platforms and infrastructures for networking and collaboration.

Though modern industrial policy is aimed at generating macro-level structural shifts, it is based on removing barriers at the micro-level, in order to cultivate organizational and social transformations through inter-firm and inter-organizational networking. The ecosystem approach implies that network linkages interconnect the micro- and macro levels of economies, corresponding to the core idea of Porter’s Diamond model of competitiveness [40].

## **4. Concluding findings**

The term “innovation ecosystem” symbolizes the newly emerging, network mode of arranging business activity and economic governance, which enables companies and territories to master innovation-led growth and benefit from rapid technological changes. This mode requires horizontal and inclusive economic thinking, as well as enabling certain organizational continua, relevant for interactive innovation and dispersed patterns of production.

Innovation ecosystems can't be referred to as subjects of decision and action. Rather they are special organizational spaces, tailored to co-creation of values through collaboration. More exactly, they constitute a sophisticated milieu of actors, assets and linkages, generated by collaborative activities of networks. Such networks of various forms, sizes and profiles can play the role of modern-type organizations meant for a collective decision-making and collective action, and innovation ecosystems should be seen as the native environment of such networks. However, since collaborative networks and their ecosystems are functionally inseparable (in terms of interactive co-creation of value), both terms may be perceived and used interchangeably. This admission corresponds to findings in literature on complexity, viewing collaborative networks as complex adaptive systems that are inseparable from their changing environment by definition [66].

A multifaceted variety of ecosystem models, meant for various functional purposes, is now emerging and developing. Irrespective of their dispersed titles in different research streams, most of them can be referred to the class of innovation ecosystems, since the modern non-linear pattern of economic activity and economic growth is inherently connected with innovation. Our exploration of this variety through comparison of three different cases (platforms, clusters and value chains) suggests that all ecosystem models are complementary and predetermine each other in terms of design, pattern of collaboration and functionality.

Digital platforms, while coordinating broad groups of networked actors that interact in different functional combinations (consumers-consumers, consumers-producers, producers-producers), can be easily seen as universal tools to generate various kinds of ecosystems at various levels of social and economic activity. Platform-generated or platform-enhanced ecosystems have their own platforms tailored either to co-usage or to co-production of innovations, or both. Regional clusters of triple-helix design can form advanced and convenient ecosystems to co-create innovations continuously, allowing clusters to serve as multi-faceted tools for upgrading industrial structures of modern economies. Meanwhile, collaboration between clusters of different geographical locations leads to the evolvement of GVCs and global production networks that can shape more powerful ecosystems, able to co-create innovations continuously across the world.

Collaborative networks and hence innovation ecosystems may evolve and proliferate in the future across all sectors and levels of modern economies, be they region-wide, country-wide, or global-wide.

Plainly speaking, networks and their ecosystems shape the modern mode of production, making economies both more cohesive to meet the challenges of high uncertainty, and more innovative to become globally competitive and self-sustainable. Overall, innovation ecosystems concern the social, organizational and cultural shifts that facilitate the formation of the knowledge-based economy.

Social and economic ecosystems are surely not the same as natural ones. But both types are populations able to self-organize and self-develop in a similar, agile manner of complex adaptive systems, associated with inter-relationship of elements, as well as with the ability to adapt *in* and evolve *with* a changing environment [66], with mutual respect. In particular, the ecosystems can obtain new sources for growth and achieve dynamic sustainability through internal, self-correcting structural changes – rather than through top-down intervention of any centralized bodies, or from an external intervention, as typical for traditional systems.

All this supports the rationale for using the term 'ecosystem' far beyond a mere metaphor to systems, to highlight both *the network-based organizational design and the collaborative organizational culture of the emerging innovation-led economies*. Because of its relevance for the contemporary reality, it is no surprise that this term is widely popular in management studies and economics communities, as shown in our literature review.

Nevertheless, returning to publications that argue in favor of the classical term 'innovation systems', we admit that this option may still be regarded as a problem of academic taste in introducing contemporary realities. Some researchers may find it convenient to consider ecosystems as a new generation of systems and may respond by describing their growing complexity and ever changing features in the era of non-linear innovation. Others may prefer to call them ecosystems from the outset and underline the key role of collaborative interactions and value co-creation, including the historically new enabling role of government interventions.

In our view, the idea of ecosystems provides a much better image for effective policymaking across countries. It offers instructive insights on the framing and implementation of further research on innovation. Additionally, it acquires an especially important practical notion for the post-Soviet and other transition economies (in contrast to the situation in US and other technologically advanced nations), in which innovation systems are often perceived as special infrastructure projects realized by governments, and not as the result of networking and collaborative dialogue developed across the society.



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