

INNOVATION ECOSYSTEMS

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ONLINE ABSTRACT: Innovation ecosystems are collectives of diverse, yet complementary, actors collaborating to generate system-level outcomes. Despite growing research interest, the role of “innovation” within innovation ecosystems remains unclear. We first distinguish innovation ecosystems from other innovation-oriented collectives such as alliances and networks, distinguish the various types of ecosystems that innovation scholars engage with, and then identify the role of innovation within different ecosystem streams. We also highlight the distinct approaches of innovation-as-outcome, innovation-as-process, and innovation-as-context as alternative ways to study innovation ecosystems, thus offering a comprehensive ecosystem framework for innovation scholars and practitioners.

Keywords: Innovation ecosystem, Business ecosystem, Platform ecosystem, Entrepreneurial ecosystem, Innovation process

OUTLINE OF THE TOPIC

The term “innovation ecosystem” is increasingly used by management scholars and business practitioners to describe collectives of heterogeneous, yet interdependent, actors who jointly (co)create a system-level output. However, despite sizable scholarly work, the role of “innovation” within an innovation ecosystem is not always clear. In this chapter, we first briefly review the key characteristics of the concept and then discuss different ecosystem conceptualizations, describing applications of each. We conclude with three approaches to innovation within ecosystems: innovation-as-outcome, innovation-as-process, and innovation-as-context.

CONCEPTUAL OVERVIEW AND DISCUSSION

In biology, an ecosystem is a biotic community and related physical environment with systemic interdependence between actors. More recently, the term has been adopted by innovation management scholars interested in a systemic view of innovation and actor interdependencies. Thomas and Autio suggest innovation ecosystems have three differentiating characteristics: they comprise *heterogeneous, yet interdependent* actors who jointly (co)create a *system-level outcome*.

Differentiating Characteristics of Innovation Ecosystems

Heterogeneous actors. Ecosystems are composed of heterogeneous actors that are hierarchically independent but who have specific ecosystem roles. The heterogeneity of actors often means that there is no clear ecosystem boundary as this varies by system-level outcome. This heterogeneity also means that ecosystems differ from industries as they are broader, including at times suppliers, distributors, outsourcing firms, producers of complementary products or services, technology providers, financiers, analysts, competitors, customers, as well as non-market actors, such as universities, public research institutions, and governmental organizations.

Interdependence. Ecosystem actors are linked through a variety of interdependencies depending on their role. Technological interdependence occurs when actors co-specialize, often around a specific resource, shared platform, or modular architecture. Economic interdependence arises when the value that each actor receives from participating in the ecosystem is dependent on the simultaneous availability of offerings by others, often expressed through the notion of complementarity. Cognitive interdependence develops when ecosystem actors align with other actors their understanding of the purpose and norms of the ecosystem to ensure ecosystem coherence.

System-level outcome. The system-level outcome (or outcomes) refers to something greater than any single actor can deliver alone. While a system-level outcome also characterizes supply chains and interorganizational (such as alliance) networks, those are often governed through bilateral formal contracts and tighter coupling. Ecosystems, instead, involve looser contractual structures, and from an innovation management perspective, lead to emergent outcomes that can include, for instance, an ecosystem value proposition, innovative business models, or new knowledge production.

Overview of Different Types of Ecosystems from an Innovation Perspective

Initially, management scholars viewed innovation ecosystems as groups of firms that combine their complementary offerings into a new coherent offering, resulting in new types of interdependency risks and opportunities. Scholars focusing more distinctly on innovation initially considered the innovation ecosystem as the loosely connected set of complementary partners and other collaborators around an innovating focal firm. Others viewed innovation ecosystems as broader innovation domains, where different organizations co-evolve their capabilities around a set of technologies, knowledge, and skills, and collaborate and compete in developing new products and services. Over time, these and other ecosystem approaches have been given a variety of labels—not only “innovation ecosystems”—as discussed below.

Innovation ecosystems. Recently the literature around the “innovation ecosystem” has started to consolidate around the idea of collective generation of a system-level output targeted to create value for a specific audience. In his review of this “structural” stream, Adner defined an innovation ecosystem as: “. . . the alignment structure of the multilateral set of partners that need to interact in order for a focal value proposition to materialize.” Here, the ecosystem scope is (comparatively) narrow and non-location-specific, with the analytic interest on the focal firm and the supporting set of components (upstream) and complements (downstream) and their technological and economic dependencies that deliver the ecosystem value proposition. Examples of scholars investigating such ecosystems include focal firms in the semiconductor lithography equipment industry and the photovoltaic solar panel industry. The “innovation” here relates to the varying input combinations from differing upstream components and downstream complementors, that together create both variety and complementarity resulting in new or improved (i.e., to different degrees innovative) ecosystem value propositions.

Business ecosystems. When the research emphasis is on the broader economic context which a focal firm must monitor and react to, innovation scholars have also used the moniker “business ecosystem”. These ecosystems comprise a community of actors with an analytic focus mostly on economic and cognitive interdependencies and tend to be characterized by role fluidity and emergent ecosystem value offerings. Business ecosystems are location-independent and can have a broad scope—for instance, Teece considers them to include “the community of organizations, institutions, and individuals that impact the enterprise and the enterprise’s customers and supplies . . . including complementors, suppliers, regulatory authorities, standard-setting bodies, the judiciary, and educational and research institutions.” Thus, for innovation scholars, business ecosystems are the (co-)evolving complementary and competitive relationships between actors and activities within an innovation-driven context.

Platform and technology ecosystems. Innovation scholars at times use ecosystems to emphasize the role of technological dependencies and connectivity across different technical interfaces and standards (i.e., a “technology ecosystem”), and specifically platforms (i.e., a “platform ecosystem”). Such ecosystems feature a network of location-independent complementors who create complements that enhance the system-level offering provided via a common interface or a platform. For this reason, many of the empirical examples include platforms and technologies such as gaming consoles and mobile phones. The analytic focus is often on technological interdependencies, especially the coordination and maintenance of the necessary platform capabilities and standards to ensure interoperability and connectivity. The key is addressing a fundamental tension between the need for flexibility and variety and the need for integrity and standardization. Innovation often happens in the “periphery”, while the platform owner controls the “core”. The complementary actors—such as app developers or content providers—continuously innovate valuable complements offered via the platform.

Entrepreneurial ecosystems. Innovation management scholars use entrepreneurial ecosystems when they focus on the economic and cognitive interdependencies behind entrepreneurial opportunities and business model innovation within a specific locality. Empirical examples have included Silicon Valley, “Silicon Fen” in Cambridgeshire UK, as well as the Aalto University region in Finland. As Autio and colleagues argue, although resembling concepts previously explored by economic geographers and innovation researchers—such as “clusters,” “knowledge clusters,” “industrial districts,” “innovative milieus,” and “regional and national systems of innovation”—entrepreneurial ecosystems are distinct due to their emphasis on entrepreneurial agents and business model innovation, as opposed to product, service, or technological innovation. This is reflected in actors such as new venture accelerators, coworking spaces, makerspaces, start-up academies, university-

entrepreneurship programs, crowdfunding, angel investors, business angels, and venture capital, all of which enable business model experimentation and knowledge spillovers.

Knowledge ecosystems and open innovation ecosystems. Knowledge ecosystems are used by innovation management scholars when research-based knowledge and associated applications constitute the system-level output, echoing the “systems of innovation” tradition. Such ecosystems focus on mostly cognitive interdependencies and the processes of joint knowledge search, creation, sharing, and transfer—all processes that incorporate the front end of the innovation process. Knowledge ecosystems primarily occur at a regional level of analysis and in pre-competitive settings and consist of universities, public research institutions, bridging and brokering organizations, and for-profit firms collaborating to create new knowledge. Open innovation ecosystems—as explained by Thomas and Ritala in another chapter of this encyclopedia—also include a strong focus on inter-organizational knowledge flows, but also more broadly describe how a focal firm can utilize collaborative innovation with heterogeneous stakeholders across the whole spectrum of R&D&I.

APPLICATION

Extant scholarship has provided many empirical examples of the application of each type of ecosystem that helps to understand the scope and nature of innovation activities in ecosystems.

For innovation ecosystems, Adner and Kapoor, in what is considered a seminal paper investigating a semiconductor lithography equipment ecosystem, demonstrated the important role of technological interdependencies in innovation ecosystems. In particular, they found how greater upstream innovation challenges in components enhance the benefits that accrue to technology leaders, while greater downstream innovation challenges in complements erode these benefits. Many other studies have demonstrated later on how innovation ecosystem orchestrators can leverage technological, economic, and cognitive interdependences to facilitate joint innovation goals in ecosystems. By developing a variety of value creation and

capture mechanisms ecosystem orchestrators can ensure that each actors' individual innovation goals and incentives are met while being aligned with the broader technological trajectory. At the same time, ecosystem orchestrators need to be mindful of co-innovation risks and other challenges arising from the complex innovation interdependences.

For business ecosystems, Snihur and colleagues investigated the emergence of Salesforce as a new CRM (Customer Relationship Management) industry entrant and identified the phenomenon of a 'disruptor's gambit'. Specifically, a new disruptive company reveals its intentions early on through effective framing of its innovation to build cognitive interdependence in the emerging ecosystem, followed by rapid adaptation of its business model to enable technological and economic interdependencies that satisfy changing business ecosystem needs.

For technology and platform ecosystems, a well-known study by Wareham and colleagues investigates how platform ecosystems are governed to ensure that emergent innovation meets evolving market demand. For an enterprise software ecosystem, they show how technological, economic, and cognitive interdependencies exhibit three tensions that need to be resolved by platform governance: a tension between standardization and variety, a tension between control and autonomy, and a tension between collective and individual identity.

In a study on an entrepreneurial ecosystem located in Seattle, Thompson and colleagues found that the initial activities of distributed, disparate individuals and groups can rather suddenly coalesce into more coordinated, integrated, and durable patterns of social interaction. They demonstrated how via interaction patterns entrepreneurial ecosystems can create the methods, resources, and legitimacy required to support social entrepreneurs in developing their business model innovations. Thus, the study shows how innovation can grow emergently from grassroots movements into collective entrepreneurial efforts as the system-level outcome.

As an application of knowledge ecosystems, Järvi and colleagues studied the Strategic Centers for Science, Technology, and Innovation in Finland, and provided insight into the systemic nature of knowledge ecosystems. In particular, they identified two forms of organizing within knowledge ecosystems: prefigurative organization where participants are searching for a knowledge domain, and partial organization where participants search for knowledge within an identified knowledge domain. Examples of the application of open innovation ecosystems are further detailed in the chapter by Thomas and Ritala in this encyclopedia.

CRITICAL SUMMARY

While there are different ecosystem constructs that innovation management scholars can apply, paradoxically there is limited focus on “innovation”. We suggest that this is because the focus of many of the studies have not been on innovation, particularly the innovation process, *per se*. To “bring innovation back”, we propose three approaches to appreciate the role of innovation in innovation ecosystems: innovation-as-outcome, innovation-as-process, and innovation-as-context. The first two approaches follow the classic distinction between the innovation process and outcomes, and the third takes a higher-level view of the innovation context. While not mutually exclusive, these approaches can be seen in outcome-oriented operationalizations such as “innovation performance”, in process-oriented constructs such as “innovation activities”, and in innovation-enabling contexts and domains.

Innovation-as-outcome. Different ecosystem constructs have distinctive implications as to what exactly is “innovative” in the system-level outcomes. For instance, for innovation, platform, and technology ecosystems the innovation-as-outcome materializes in the form of a new or improved value proposition which is based on the (varyingly innovative) inputs of the ecosystem actors. For business ecosystems, the innovation-as-outcome is less clear, although analytically it is usually the result of interactions amongst the different actors. In contrast, for

entrepreneurial ecosystems, the innovation-as-outcome are the innovative business models and the new ventures that embody them. For knowledge and open innovation ecosystems, the outcome is new knowledge (in itself, a precondition for innovation).

Innovation-as-process. Innovation ecosystems have a strong process connotation, as they are often seen as co-evolving, interdependent, and adaptive systems. The process(es) of coordination (and relatedly, governance) are probably the most studied aspect of innovation ecosystems, regardless of the literature stream. These key processes (for all ecosystem constructs) are driven by role definitions and balancing of tensions between the technological, economic, and cognitive alignment structures that reflect actor interdependencies.

In innovation, platform, and technology ecosystem research, innovation-as-process considers how ecosystem actors work together to deliver the ecosystem value proposition. One approach has been to consider how ecosystem actors coordinate, align, and communicate with each other in the process of developing different complementary innovations that increase the value of the overall offering. Another approach has considered “generativity”, the emergent and uncoordinated process which leads to value creation via novelty of both individual innovative inputs and combinatorial innovation (especially prevalent in platform and technology ecosystems). For business ecosystems, innovation-as-process has usually been considered in terms of competitive and cooperative processes, such as disruption, framing, and legitimation. In entrepreneurial ecosystems, innovation-as-process can be seen in the increasing body of research into governance dynamics and processes. Knowledge ecosystem scholarship directly considers the process of joint knowledge search and creation, while open innovation ecosystem approaches examine how new ideas, innovations, and technologies are developed in collaborative and competitive processes.

Innovation-as-context. Innovation-as-context refers to the shared infrastructures, artifacts, resources, affordances, and other factors within the broader environment that promote

innovation within an ecosystem. For innovation-as-context, “innovation” arises within the emerging, co-evolving, and often non-linear ecosystem dynamics. The innovation-as-context—or perhaps better expressed, the ecosystem for innovation—the lens is most prominent for scholars studying business, knowledge, open innovation, and entrepreneurial ecosystems, as studies in these streams focus on populations of organizations rather than specific technological configurations, which is more typical of research into innovation, platform and technological ecosystems.

A feature of the innovation-as-context approach is that innovation is an emergent property of a complex adaptive system, rather than a process that can be specified, or an ecosystem-level outcome that can be identified. For business ecosystems, the innovation-as-context returns to the original Moore’s ecosystem metaphor from the 1990s that considered competitive and collaborative interdependencies within a particular context. Thus, for business ecosystems, the innovation-as-context view echoes some of the classic strategic context literature. For entrepreneurial and knowledge ecosystems, the innovation-as-context view focuses attention on how the various actors within the ecosystem interact in a particular locality. In this sense, the innovation-as-context view bears great resemblance to the classic innovation system or entrepreneurial milieu literature. In doing so, innovation-as-context reveals some of the intellectual roots of contemporary innovation ecosystem scholarship.

In summary, innovation ecosystems remain to be a fruitful area of inquiry and are a useful means of investigating networked and systemic innovation phenomena. We reviewed the fundamentals of innovation ecosystems and provided an example of how each type of ecosystem has been applied in management scholarship. Further, by demonstrating how innovation occurs in ecosystems as an outcome, process, or emergent property of its context, we hope the chapter helps scholars place their research into the appropriate ecosystem stream to facilitate the cumulateness and coherence of this exciting topic.

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