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# Innovation ecosystems: Theory, evidence, practice, and implications

Nowadays, the concept of innovation ecosystems is attracting much attention. Today, most companies inhabit ecosystems which are loose networks of suppliers, distributors, and outsourcers, product or service providers, technology providers, and other organizations (Iansiti and Levien, 2004a,b; Su et al., 2018). The actions of a company will affect the health of its innovation ecosystem which in turn will ultimately affect the performance of the company itself. Leading examples tend to come from high technology companies in developed economies such as Apple, Google, Microsoft, and Amazon in United States, while some other leading examples tend to come from high technology companies in emerging economies such as Haier, Alibaba, Tencent, and Xiaomi in China.

In 1993, American economist James F. Moore proposed the new strategic concept of "business ecosystems" in his *Harvard Business Review* article "Predators and Prey: A new ecology of competition". Moore held that networks among companies need to be analyzed from a higher conceptual level rather than from the view point of individual firms. A business ecosystem, like its biological counterpart gradually moves from a random collection of elements to a more structured community (Moore, 1993). Moore also defined four distinct stages of business ecosystems in both cooperative and competitive challenges: birth, expansion, leadership, and self-renewal of the business ecosystem (Moore, 1996).

In 2004, Iansiti and Levien proposed "match your strategy with your environment" to assess the health of ecosystems. Four strategies are defined by two dimensions of "level of turbulence and innovation" and "complexity of relationship": (1) Keystone players: creating a platform and improving the health of ecosystems as a whole, in which new network members create and share value. (2) Dominator: integrating a network horizontally or vertically to directly own and manage a large proportion of it. As the ultimate aggressor, dominator takes over their ecosystems and leaves no room for other network members. (3) Commodity: creating little value to sustain the ecosystem which ultimately collapses. (4) Niche players: developing specialized capabilities that differentiate them from other companies in the ecosystem (Iansiti and Levien, 2004a,b).

In 2006, Professor Ron Adner proposed "match your innovation strategy to your innovation ecosystem" in his *Harvard Business Review* article. He defined innovation ecosystems as the collaborative arrangements through which firms combine their individual offerings into a coherent and customer-facing solution. Accordingly, innovation ecosystems have become a core elements in the growth strategies of firms in a wide range of industries due to information technologies which have drastically reduced the costs of coordination (Adner, 2006). Furthermore, Adner (2006) argued that strategy making in an innovation ecosystem is iterative for formulating an ecosystem and its development, since there are so many interconnected pieces and players. Deploying strategies for innovation ecosystem can allow firms to create added value that no single firm could have created alone.

The concept of ecosystem is neither well defined nor well shared as an established concept, although the above essays can have practical insights and give practitioners institutive inspirations for the survival and growth of the firms. It is clear that further study and thoughtful discussion are needed to clarify the scope of the concept, the framework of ecosystem research, and their contributions and implications in both academic and practical contexts. This special issue, "Innovation Ecosystems: Theory, Evidence, Practice, and Implications", aims to offer an opportunity to clarify the connotation of the concept, to share the current achievement of academic research, and to discuss future direction of research.

We include 17 fine papers in this special issue. We cover wide arrays of research approaches in this special issue, including quantitative research, qualitative research, conceptual papers, review papers, simulation modeling, and case studies. The authors were asked to clarify potential and original contributions of the concept of innovation ecosystems beyond the existing literature, addressing concepts, theories, and research streams like national innovation system, regional innovation system, technopolis, relational view, and network view, etc. (Oh et al., 2016; Su et al., 2018; Su and Chen, 2015; Su and Wu, 2015). We include the papers that substantially advance the concept of innovation ecosystems through theory, evidence, practice, and implications. Authors have moved knowledge in the direction of future management practices in innovation ecosystems, for innovators, innovative organizations, and governments.

This special issue explores five important topics.

First, we discuss the fundamental basis of innovation ecosystems. We include definitions of innovation ecosystems and historical perspectives of innovation ecosystems studies.

We distinguish the concept of innovation ecosystem from other concepts such as business model, supply chain, value chain, platform, and network. We explore the framework and the design for the analysis of innovation ecosystems.

Second, we study dynamics of innovation ecosystems development and management. The important concepts of value creation, survival, growth, and decline of the innovation ecosystems are discussed. The important concepts of evolution and co-evolution of the innovation ecosystems and embedded actors are analyzed. Some issues of imitation, innovation, co-creation, and symbiotic relationships in the innovation ecosystems can be investigated further. We have the variety of patterns and formulations of social ecosystems, policy ecosystems, and business ecosystems. The special issue addresses organizational change and organizational processes as the ecosystems change. The issue of managing mutation and dramatic change of innovation ecosystems can be studied further; innovation ecosystems and organizational

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innovation of firms will deserve much more attention in future studies.

Third, we cover the important issue of actors' behaviors and strategies. There are many types of actors and relations among actors, species, and networks in the innovation ecosystems. Accordingly, strategic alliances and partners' selection of actors play key roles in the innovation ecosystems. All actors in innovation ecosystems have to face the challenges of competition and cooperation. We explore platform, standardization, modularization of service and products in the innovation ecosystems. We discuss supply chain management and supplier-customer relationships in the innovation ecosystems. And, we cannot neglect policy coalitions, initiatives and shared visions among stakeholders. Furthermore, governance mechanism, networked governance, and epistemic community in innovation ecosystems also deserve much more attention.

Fourth, some papers in this special issue emphasize the roles of actors and the functions of innovation ecosystems. They investigate strategies, behavior, and performance of the actors in the innovation ecosystems. Some authors address innovation platform development and innovation ecosystems (e.g. Nintendo Wii, 3D printing industry, etc.). Some authors analyze resource acquisition and mobilization in the innovation ecosystems. And some authors discuss the roles of governments, universities, research institutions, venture capital, and startups in the innovation ecosystem. In future research, we can explore more issues of resilience, recovery, risk management and crisis management in the innovation ecosystems. We also can have more studies on evaluation and standards establishment in such ecosystems.

Fifth, we include papers with structural analysis of innovation ecosystems. We have papers which incorporate game theory and agent-based simulation in their innovation ecosystems studies. We suggest future research can extend to the area, such as business intelligence in innovation ecosystems, and visualization of ecosystems structure, etc.

We introduce 17 papers of our special issue as follows. We categorize all the papers in four clusters: review, concept, framework, and cases.

## 1. Cluster A: review

The first group includes four papers. Dedehayir et al. (2018) and Gomes et al. (2018) focused on the innovation ecosystem concept. Tsujimoto et al. (2018) reviewed ecosystem concept comprehensively. Scaringella and Radziwon (2018) offered a systematic literature review of ecosystems rooted in the territorial approach.

Dedehayir et al. (2018) focused on the innovation ecosystem genesis. The birth phase of the innovation ecosystem is relatively chaotic, similar to the fuzzy front end of new product development. Through intensive study of 60 publications, the authors extracted and conceptualized several key roles of actors in the phase of ecosystem genesis. The four roles are identified; leadership, direct value creation, value creation support and entrepreneurial ecosystem. Understanding the detailed roles in the ecosystem birth phase, policymakers and practitioners will be encouraged to facilitate ecosystem emergence.

Gomes et al. (2018) also focused on the innovation ecosystem concept. Using systematic review and a hybrid methodology including bibliometric and content analysis of 125 articles, the authors found the turning point of the conceptual change. According to the analysis of authors, Adner (2006) and Adner and Kapoor (2010) strongly contributed to the conceptual change from business ecosystem to innovation ecosystem. The business ecosystem concept relates to value capture, on the other hand, the innovation ecosystem concept relates to value creation. Authors mapped the definitions and main features of ecosystem, business ecosystem and innovation ecosystem from the 17 most cited articles in their sample. Readers easily can understand and follow the conceptual difference and evolution in the complex ecosystem research field.

Tsujimoto et al. (2018) reviewed the ecosystem concept comprehensively. The authors focused on 90 papers published in the top journals. Based on the theoretical background, they identified four research perspectives; industrial ecology, business ecosystem, platform management and multi-actor network. Integrating existing literature, this paper proposed a model of ecosystem research. Moreover, the authors proposed an original definition of the ecosystem and the concept of the coherent ecosystem.

Scaringella and Radziwon's (2018) theoretical paper offers a systematic literature review of ecosystems based on a selection of 104 articles and books and their archetypes. First, they identify and discuss the four main types of ecosystems – business, innovation, entrepreneurial, and knowledge ecosystems. Second, they provide a theoretical overview from the territorial approach. Third, they identify the invariants across the four diverging streams from the ecosystem approach and the seven diverging streams from the territorial approach. Finally, they propose a research framework based on the comparison between key invariants from both approaches. Accordingly, they links the ecosystem and territorial approaches and contribute to create a theoretical framework that reflects the complex interconnection between models, theories, and emerging concepts.

## 2. Cluster B: framework

The second group of papers in this special issues concerns framework, and includes three papers. All of them proposed original frameworks for the innovation ecosystem.

Shaw and Allen (2018) provided six perspectives extracted from the basic similarity between the natural ecosystem and the innovation ecosystem: Ecosystem, organism/type of business model, population, community, landscape and biome. The authors defined the innovation ecosystem as pathways of interlinked business models. The core concept of their framework is von Uexküll's notion of ‘umwelt’: self-world. This means the limitation on sensing, acting and understanding of actors in the ecosystem. Using their framework, readers can understand the basic mechanism of the complex interaction among actors. They apply the framework using a smartphone healthcare app's ecosystem case study. This case analysis illustrates the effectiveness of their framework.

Walrave et al. (2018) focused on the ‘external’ viability of the innovation ecosystem in the socio-technical environment. The authors illustrate the Better Place as a state-of-the-art example of the internally (only) effective ecosystem. The authors emphasized the concept of the external development of the ecosystem for path-breaking innovations. The existing socio-technical regime often resists the path-breaking value proposition by the entrepreneurial startups. Based on the multi-level perspective on innovation ecosystems, the authors provided four propositions. The key concept of the propositions is ‘manipulation’ of the ecosystem using experimentation and feedback from the socio-technical environment. Manipulation is effective for internal alignment and external viability of the ecosystem.

Russell and Smorodinskaya (2018) provided an innovation ecosystem view based on complexity science. First, authors observed the innovation ecosystem view in the four different existing research streams. Second, based on complexity science concepts, they provided the generic properties of innovation ecosystem. The authors especially emphasized the self-organizing and adaptive aspect of the innovation cluster ecosystem. Finally, they compared the traditional system thinking approach with complexity ecosystem thinking. Consequently, this paper significantly contributes a conceptual base for ecosystem research and practice resting on complexity science.

## 3. Cluster C: theory

The third group of this special issue is theoretical work and includes three papers. All three papers analyzed evolving patterns of ecosystems based on quantitative simulation. But the focus of their modeling is different.

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