Chapter 47
Digital Innovation Ecosystems: A Systematic Literature Review and a New Definition

Irina Gorelova, Francesco Bellini, Adriano Fabbri, and Fabrizio D'Ascenzo

Abstract The rapid development of digital technologies creates digital ecosystems that penetrate into the everyday lives of society. The digital ecosystem is a relatively new phenomenon and has multiple connotations and dimensions in the scientific literature, but it is univocally recognized as a context of the technological execution of both innovation and business ecosystems. The concept of digital innovation ecosystems (DIE) is only partially debated in the scientific literature, so the main objective of this research is to provide a full-fledged definition of the phenomenon under consideration. To reach this goal, an approach based on a broad systematic literature review (SRL) of scholarly studies is adopted. SRL on the definitions and dimensions of DIEs provides evidence of the nature of this rising trend, allowing an in-depth understanding of the dynamics in this domain. The main results of the research are the aggregation and analysis of the various definitions of DIEs, their systematization, and the formulation of comprehensive and shared DIEs.

Keywords Digital innovation ecosystems · Conceptualization · Systematic literature review

47.1 Introduction

Digital technologies are currently the key elements that shape the everyday life of society. Digitalization is becoming an important topic of discourse both in scientific literature and at the governmental, national, and supranational levels. Thus, the United Nations Digital Strategy 2022–2025 aims to create a world in which digital is an empowering force for people and the planet in three directions of change:

I. Gorelova (✉) · F. Bellini · A. Fabbri · F. D'Ascenzo
Department of Management, Sapienza University of Rome, Rome, Italy
e-mail: irina.gorelova@uniroma1.it; francesco.bellini@uniroma1.it; adriano.fabbri@uniroma1.it; fabrizio.dascenzo@uniroma1.it

G. Lagioia et al. (eds.), *Innovation, Quality and Sustainability for a Resilient Circular Economy*, Circular Economy and Sustainability,
https://doi.org/10.1007/978-3-031-28292-8_47

structural transformation, leaving no one behind, and building resilience (UNDP 2022).

In the current dynamic context, innovations are increasingly the result of a network that could present the form of an "ecosystem" (Kolloch and Dellermann 2018) and less and less the result of the action of a single entrepreneur (Hagedoorn 1996); all this poses new challenges to the actors involved in innovation processes (Adner and Kapoor 2010). The concept of "ecosystem" is widely studied in the literature (Christensen and Rosenbloom 1995; Kolloch and Dellermann 2018; Basole 2009) as well as the concept of "innovation systems" (Freeman 1987; Breschi and Malerba 1997), but "innovation ecosystems" have become popular in recent years, and the debate around the ambiguity of the term has been increasing over time (Granstrand and Holgersson 2020). A synthetic way to describe this phenomenon is reported by Dodgson et al. (2014), where "innovation ecosystems" are defined as a range of different ways to define value-creating interactions among different actors; in fact, they can represent a new way to conceive value creation linked to the concept of innovation (Adner and Kapoor 2010).

Digital innovation ecosystems (DIEs), being an inevitable part of the innovation context, lack a coherent theory to synthesize diverse opinions, experience-based insights, and research findings about DIEs (Wang 2020). Therefore, the main goal of this research is to gather evidence from the scientific literature on the definitions of DIEs and their further conceptualization. The gathered evidence could contribute to advancing research in the fields of innovation and digital transformation.

The paper is organized as follows: Sect. 47.2 step-by-step illustrates the research method applied to the study and introduces the research question; in Sect. 47.3, the results of the study are represented; and Sect. 47.4 provides concluding remarks on the study.

47.2 Methodology

A systematic literature review (SRL) is a key tool of an evidence-based approach that enables a researcher to analyze and structure the knowledge existing in the scientific literature for its further practical and scientific use (Tranfield et al. 2003). Following the format of previous SLRs (Durach et al. 2017; Savastano et al. 2019), a six-step review process was carried out in this research, as shown below:

1. Stage one of our research involves the definition of the research questions and keywords. To do so, the keyword combination "digital innovation ecosystem" was chosen; a wildcard was applied to the keyword combination to embrace the cases when the keyword combination was used in the plural. Taking into account all of the above, the main research question (RQ) of the paper is as follows: What is the "state of the art" of the academic literature regarding DIEs?
2. The next step of the study is the determination of the required characteristics of the studies and the inclusion criteria to focus on relevant and rigorous literature

sources only. The authors agreed to study peer-reviewed articles and conference papers written in English, with no limitation on the year of publication or geography of the study. To ensure academic quality, the Web-of-Science (WOS) and Scopus online databases were used in the research; the study was corroborated by supplementary materials identified in Google Scholar, so when the articles were extracted from the Google Scholar database, the authors additionally checked whether the study was subject to peer review.

3. Stage three involves the primary retrieval of a sample of potentially relevant literature according to the keywords and inclusion criteria discussed using the default search field TITLE-ABS-KEY in Scopus, the topic field in WOS, and the above-mentioned keyword combination in the search box of Google Scholar.
4. In the fourth stage of the study, the pertinent literature was selected. PRISMA 2020 checklist was adopted for the stages of identification, screening, and inclusion of papers in this review (Page et al. 2021). Twenty-five articles were chosen for the final examination.
5. The next step of the systematic review process includes synthesizing the literature by applying coding schemes. The coding categories were predefined and corresponded to the aim of the study and its RQ.
6. Finally, the results of the study were analyzed and reported, providing a descriptive overview of the studied literature and discussing thematic findings. The findings of the review process are presented in the next section.

47.3 Results and Discussions

47.3.1 Characteristics of the Studied Literature

As mentioned in the section above, 25 articles were from 451 found in three databases for our research. The first mention of DIE dates back to 2011, but research on the topic has been growing since 2018, peaking in 2020. Such a distribution of the literature may indicate that the DIE phenomenon is just beginning to enter the scientific discourse, even though the studied literature shows in-depth research on this topic.

Regarding the distribution of studies by country, the USA is the leader in DIE research, and Brazil, Germany, and the UK are in second place. Other EU countries represented in the scientific literature are Austria, Finland, France, Italy, Latvia, Poland, Slovenia, Spain, and Sweden. In total, the countries of the EU account for approximately half of the studies.

The articles are almost equally distributed between the sources and their types: journal publications and conference proceedings. The authors believe this may indicate the gradual settlement of the DIE phenomenon into scientific discourse in recent years.

Table 47.1 represents the most used keywords in the studied literature, ranked from 1 to 6, given that other collected keywords have a frequency of 1, which is

Table 47.1 Distribution of the keywords by frequency

Keyword	Frequency	%	Rank
Innovation system	8	9.36	1
Ecosystem	6	7.02	2
Digital innovation	5	5.85	3
Digitalization	4	4.68	4
Industry 4.0	4	4.68	4
Digital innovation ecosystem	3	3.51	5
Digital transformation	3	3.51	5
Ecology	3	3.51	5
Startups	3	3.51	5
Digital ecosystem	2	2.34	6
Innovation community	2	2.34	6
Open innovation	2	2.34	6
Technology	2	2.34	6

explained by the limited range of the studied literature. In addition to the keywords used to retrieve the literature, the most frequently used keywords are predictably connected to the specific elements of the digital innovation domain. However, the sample also included keywords related to the stakeholders of the DIE—startups and innovation community—which will be discussed below.

47.3.2 Definitions of the DIEs

The literature body proposes several DIE definitions presented in Table 47.2. According to the evidence gathered, DIE could be defined as a complex innovation ecosystem of a sociotechnical nature aimed at creating new products and services using digital technologies to create value. Scholars stress the presence of technological (digital) and social (physical) mutually interdependent components; the parts of DIE constantly coevolve, learning how to interact effectively.

47.4 Conclusions

Digital transformation occupies an important place in managerial and scientific discourse. This research discusses the phenomenon of DIEs and their definitions. The systematic literature review on the topic shed light on the state of the art in the scientific discussion on the topic and gave insights into the nature of the DIE that contributed to the formulation of the shared definition of the DIE. The main limitation of the study is a limited literature sample; however, the literature studied represents a significant contribution to the rising scientific discourse on the topic. The

Table 47.2 DIE definitions in the literature

Paper	Definitions of the "DIE" concept
Kolloch and Dellermann (2018)	An innovation ecosystem as a social technological system (actor network) consisting of two inseparable parts: a social system (human actor network) and a technological system (nonhuman actor network)
Suseno et al. (2018)	DIE models the interactions and relationships between organizations and stakeholders, in creating new products and services using digital technologies in order to create value
Wang (2018)	A special type of sociotechnical system
	A complex arrangement of technologies, methodologies, concepts, business application areas, organizations, and institutional contexts; a network of heterogeneous social and technical elements, which coevolve over time
Beltagui et al. (2020)	DIEs account for industry-spanning cooperative and competitive dynamics among firms related to innovations that combine physical and digital elements
Cvar et al. (2020)	A complex system of various actors having different roles, interacting in mutual interdependence, constantly learning how to interact effectively
Wang (2020)	A special type of sociotechnical systems, a dynamic collective of interdependent actors and the resources they draw on to innovate with digital technology
Wang (2021)	A loosely coupled set of autonomous actors (people and organizations who interact without hierarchical fiat) involved in the development and implementation of innovations enabled by digital technologies

DIE digital innovation ecosystems

authors deliberately narrowed the range of literature, concentrating only on the literature that discussed DIEs and no other ecosystems that have a similar nature and connotation, to reveal the characteristics of DIEs as they understood the scholars that use this definition. Thus, the study of the DIE phenomenon at an early stage of its development and the findings of our research represent some interesting theoretical, empirical, and policy implications. Therefore, the theoretical contribution of the present study consists of the conceptualization of the discussion on the common elements of DIE in the scientific discourse, which were previously neglected in the literature. The shared definition of DIEs could raise the discussion in future scientific studies. The managerial implication of this paper resides in the evidence of the role and place of organizations in the DIE environment, which has significant potential to leverage their activity. From an institutional and political viewpoint, the present results can support governments and local administrations in improving their role in the DIE context through research and innovation projects and programs, with the goal of increasing the effectiveness and efficiency of stakeholders' engagement. These outcomes also have a strong social and economic impact on economic development; hence, the development of DIEs prompts advancements in other spheres of life. Future studies on the topic consist of the identification of internal and external context DIE variables and levels of DIE allocation with the following construction of the DIE conceptual model.

References

Adner R, Kapoor R (2010) Value creation in innovation ecosystems: how the structure of technological interdependence affects firm performance in new technology generations. Strateg Manag J 31:306–333

Basole RC (2009) Structural analysis and visualization of ecosystems: a study of mobile device platforms. AMCIS 2009 proceedings, p 292

Beltagui A, Rosli A, Candi M (2020) Exaptation in a digital innovation ecosystem: the disruptive impacts of 3D printing. Res Policy 49:103833

Breschi S, Malerba F (1997) Sectoral innovation systems: technological regimes, Schumpeterian dynamics, and spatial boundaries. In: Edquist C (ed) Systems of innovation: technologies, institutions and organizations, 1st edn. Routledge, London, pp 130–156

Christensen CM, Rosenbloom RS (1995) Explaining the attacker's advantage: technological paradigms, organizational dynamics, and the value network. Res Policy 24:233–257

Cvar N, Trilar J, Kos A et al (2020) The use of IoT technology in smart cities and smart villages: similarities, differences, and future prospects. Sensors 20:3897

Dodgson M, Gann DM, Phillips N (2014) The Oxford handbook of innovation management. Oxford University Press

Durach CF, Kembro J, Wieland A (2017) A new paradigm for systematic literature reviews in supply chain management. J Supply Chain Manag 53(4):67–85. https://doi.org/10.1111/jscm.2017.53.issue-4. https://doi.org/10.1111/jscm.12145

Freeman C (1987) Technology, policy, and economic performance: lessons from Japan. UNKNO Publisher. isbn:0861879287

Granstrand O, Holgersson M (2020) Innovation ecosystems: a conceptual review and a new definition. Technovation 90-91:102098

Hagedoorn J (1996) Innovation and entrepreneurship: Schumpeter revisited. Ind Corp Chang 5:883–896

Kolloch M, Dellermann D (2018) Digital innovation in the energy industry: the impact of controversies on the evolution of innovation ecosystems. Technol Forecast Soc Change 136:254–264

Page MJ, Moher D, Bossuyt PM et al (2021) PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews. BMJ 372:160

Savastano M, Amendola C, Bellini F et al (2019) Contextual impacts on industrial processes brought by the digital transformation of manufacturing: a systematic review. Sustainability 11:891

Suseno Y, Laurell C, Sick N (2018) Assessing value creation in digital innovation ecosystems: a social media analytics approach. J Strateg Inf Syst 27:335–349

Tranfield D, Denyer D, Smart P (2003) Towards a methodology for developing evidence-informed management knowledge by means of systematic review. Br J Manag 14:207–222

Unied Nations Development Programme (2022). Available at: https://digitalstrategy.undp.org/. Accessed 10 June 2022

Wang P (2018) Taking the "eco" seriously: a multilevel model of digital innovation ecosystems. In: Proceedings of the 22nd Pacific Asia conference on information systems – opportunities and challenges for the digitized society: are we ready? PACIS 2018

Wang P (2020) Theorizing digital innovation ecosystems: a multilevel ecological framework. In: 27th European conference on information systems – information systems for a sharing society, ECIS 2019

Wang P (2021) Connecting parts with the whole: toward an information ecology theory of digital innovation ecosystems. MIS Q 45:397–422