



Unpacking the innovation ecosystem construct: Evolution, gaps and trends



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ABSTRACT

The innovation ecosystem construct has emerged as a promising approach in the literature on strategy, innovation and entrepreneurship. It draws upon former business ecosystem literature. However, the term innovation ecosystem has been employed in very polysemic and sometimes competing ways. Many adjectives used with reference to innovation ecosystems render the consolidation of the construct more difficult - which its characteristics, boundaries and relation with other, to some extent competing, constructs, such as supply chain and value chain are. To clarify concepts, to identify trends and research opportunities, we conducted a systematic literature review from 1993 to 2016, with a hybrid methodology including bibliometric and content analysis. Besides highlighting the most influential papers and exhaustively discussing the innovation ecosystem concept and its variations, we identify a turning point in the literature, the transition from business ecosystem to innovation ecosystem. Business ecosystem relates mainly to value capture, while innovation ecosystem relates mainly to value creation. We conclude by describing six research streams in innovation ecosystem: industry platform × innovation ecosystem; innovation ecosystem strategy, strategic management, value creation and business model; innovation management; managing partners; the innovation ecosystem lifecycle; innovation ecosystem and new venture creation. These streams lead us to propose opportunities for further research to solidify the innovation ecosystem concept.

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1. Introduction

There is an ongoing and fundamental debate around the organization of activities inside and outside the boundaries of the firm (Kapoor and Lee, 2013). Traditionally, this debate has focused mainly on the outsourcing of production activities (Rong et al., 2013c). Recently, many scholars turned their attention to the phenomenon of the network of actors involved in developing and in commercializing innovations. This phenomenon received different labels, such as open innovation (e.g., Chesbrough, 2003) or innovation networks (e.g., Lee et al., 2015). Indeed, this phenomenon might be observed in a number of cases, involving some of the most innovative companies in the world. Adner and Kapoor (2010) argue that complex innovations tend to involve a series of actors, demanding changes not confined to the supply networks (other actors may be impacted, such as regulators). To address this process of joint value creation, several scholars proposed and developed the concept of innovation ecosystem (e.g., Adner, 2006, Adner and Kapoor, 2016), which draws upon the former concept 1business ecosystem, initially proposed by Moore (1993).

The concept of innovation ecosystem has increasingly gained ground in the literature on strategy, innovation, and entrepreneurship. Scholars have developed a set of definitions and concepts in a variety of contexts, employing innovation ecosystem with different labels and, in some cases, with different meanings and purposes: digital innovation ecosystem (e.g., Rao and Jimenez, 2011), hub ecosystems (e.g., Nambisan and Baron, 2013), open innovation ecosystem (e.g., Chesbrough et al., 2014), platform-based ecosystem (e.g., Gawer, 2014). On the one hand, such uses might be associated with the relevance and flexibility of concept. On the other hand, such different conceptualizations might lead to contradictory and, in some cases, competing concepts. For instance, recently several scholars started regarding the business ecosystem as a synonymous of innovation ecosystem (e.g., Overholm, 2015, Gawer and Cusumano, 2014, Nambisan and Baron, 2013) while others suggested that innovation ecosystem and business ecosystem are different (e.g., Valkokari, 2015). Thoroughly examining the use of innovation ecosystem, Oh et al. (2016) found that the literature does not provide a robust definition of what an innovation ecosystem is. Thus, a lack of theoretical consistency concerning innovation ecosystem terminology may intensify the fuzzy landscape of research. As a consequence, the use of innovation ecosystem may produce a very fragmented and diverse theory, making comparison among studies difficult and failing to ensure a consolidation of knowledge.

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In these situations, literature review studies might help by providing an understanding of how the field evolved, shedding light on the points of consensus and divergences among scholars and diagnosing whether the intellectual structure within the discourse of a given theme has been properly discussed in the field. Although the innovation ecosystem literature has grown in recent years, little attention has been paid to empirical evidence employing bibliometric indicators (e.g., citation/co-citation) to understand the evolution of the innovation ecosystem approach. In this sense, the question that guides this paper is how the innovation ecosystem theory has evolved. To answer this research question we adopt a hybrid methodology, combining bibliometric and content analysis in a sample of articles about the innovation ecosystem, published in the main journals in the fields of strategy, innovation, and entrepreneurship.

This study provides a number of contributions to the innovation ecosystem literature. First, we show how the literature on innovation ecosystem has evolved by identifying the most-often cited papers and authors, and the main journals in which the innovation ecosystem construct has been developed. This may be useful, especially for new entrants in the field. Second, we undertook a number of analyses in order to understand the connections among the researchers involved in the innovation ecosystem literature and the main keywords employed. Hence, we identified the main features of innovation ecosystems, which might be a fundamental framework for understanding what an innovation ecosystem is. We showed the turning point articles: papers that promote a deep change in the field. In addition, we proposed that the concept of innovation ecosystem is different in relation to the concept of business ecosystem, although several scholars use them synonymously (e.g., Nambisan and Baron, 2013). We suggest a different understanding: innovation ecosystem is related to value creation while business ecosystem refers to value capture. We highlight the opportunities that such conceptualizations might offer to scholars. Fourth, we discuss in detail what makes the innovation ecosystem distinct in relation to other system approaches, notably the supply chain and value chain approaches. This discussion might shed light on the circumstances under which the innovation ecosystem concept is most appropriate. Fifth, we identify some areas of research, indicating some research questions, and gaps. Finally, we suggest a number of opportunities for further research and trends for the evolution of innovation ecosystem theory.

To do so, this paper is organized into four sections. The second section refers to research methods and explains the methodological procedures of the systematic literature review in detail. In the following

section, we present our main findings and discuss how the innovation ecosystem literature evolved. In the final section, we present the main conclusions of this paper, trends, and further research opportunities.

2. Research methods

The systematic review of the literature on innovation ecosystems conducted in this study includes a bibliometric and a content analysis. Bibliometric studies are gaining relevance, considering the growing number of scientific publications and the ability to use techniques to quantify the written communication process (Ikpaahindi, 1985), and how citation analysis can be used to identify important scientific papers, as well as their interrelationships (Chai and Xiao, 2012). The combination of content analysis with bibliometric analysis aims to identify literature trends, the most frequently discussed topics and fields, and gaps that may exist within the literature (Carvalho et al., 2013). Fig. 1 presents the phases of the systematic review.

2.1. Description of the sample

The bibliometric database was extracted from the *ISI Web of Science* database by *Thomson Reuters*. It was selected because it offers a feature through which a set of metadata can be collected, such as abstracts, authors, institutions, number of citations, references cited, and the journal impact factor, among others, which are essential for carrying out a bibliometric analysis.

In order to select the research database, we considered search criteria for the following topics: “*Innovation Ecosystem*” or “*Business Ecosystem*”. We employed business ecosystem as a topic for a number of reasons. The concept of innovation ecosystem draws upon the business ecosystem in the management field. As we mentioned, some authors regarded business ecosystem as synonymous of innovation ecosystem while others consider that both concepts are different. Thus, it is not clear in the literature how both concepts have evolved. Understanding the evolution of both concepts might shed light on differences and commonalities between them, opening new avenues of research. By addressing both innovation ecosystem and business ecosystem, we will be able to discuss the differences between them, which will help to make the innovation ecosystem construct more precise. Therefore, in the following analysis, we will address both constructs, by later specifying them and proposing the differentiation based on the focus on value creation or value capture.

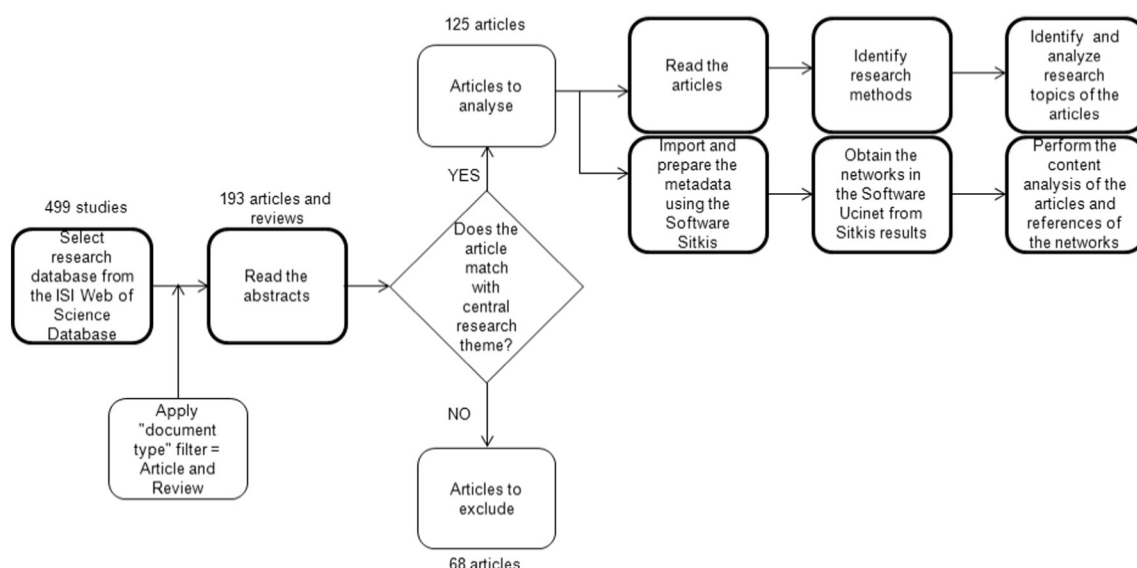


Fig. 1. Phases of the systematic review.

The search resulted in 499 studies, categorized by the *Web of Science* into different research areas. From this initial sample, we used some filters to refine the results, as described below.

For the “*Document Types*”, we considered the filters “*Article*” and “*Review*”, as these types of document undergo peer review and have the most complete set of metadata in the *ISI Web of Science* database. Once the results were refined, the sample resulted in 193 articles.

All the 193 abstracts were then read. We excluded some articles after this analysis. As a criterion for exclusion, we considered the fact that certain articles, despite containing the topics used in the search, did not address the concepts of “*Innovation Ecosystem*” or “*Business Ecosystem*” as their central theme or as part of their theoretical contribution. After reading the abstracts, 68 articles were excluded, leaving a final sample of 125 articles published in 76 journals, from 1993 to 2016.

2.2. Bibliometric analysis procedures

In this phase of the research, we employed a bibliometric analysis process similar to that conducted by [Carvalho et al. \(2013\)](#). Some of the results of the quantitative data analysis of the sample of 125 articles, shown below, were obtained with the assistance of bibliometric analysis tools for descriptive statistics available in the *ISI Web of Science*. For citation analysis and to obtain the degrees of centrality and betweenness of the networks, we used Sitkis 2.0 ([Schildt, 2002](#)) and Ucinet 6 for Windows 6.403 software ([Borgatti et al., 2002](#)). Additionally, we used the CiteSpace software ([Chen, 2006](#)) to develop the turning point articles network.

From the results, we obtained the number of published articles by journal and year, identifying the journals that publish more on the subject and how the publications evolved over time. We also obtained the number of articles published by year, according to the research method applied.

A list of the most cited articles from the 125 selected articles was derived by considering the premise that the more it is cited, the greater the influence it has on a given field of research. The most cited articles within the 125 selected articles and the most cited references in these articles were considered to generate the networks of citations. Five networks of citations were developed: keywords, articles to references, co-citations, cross-citations, and turning point articles (time zone view).

The keyword network was built considering the overall period of analysis (1993–2016) and at intervals of years (2001–2005/2006–2010/2011–2016) within the overall period, to help identify the rise and decline of certain themes.

The articles to references network link the most cited articles with the most cited references from these articles, and the co-citations network presents the references cited from the articles of the initial sample that were cited together. The analysis of these networks can show common themes and interests of research groups. These networks can present other types of references, such as books or conference papers, which are not indexed in the *ISI Web of Science*, but they were incorporated into the analysis because they are frequently mentioned in the articles of the selected sample.

The cross-citation network shows the articles of the initial sample, which cite each other. This network might be useful to identify groups of researchers, as well as evidence of self-citation. The degrees of centrality and betweenness were calculated for the cross-citation network.

Finally, the turning point article network helped to identify visually the articles that led to changes in the discussion about the research theme.

2.3. Content analysis procedures

The articles selected were read and the following topics were considered for the content analysis: definition and main features of innovation ecosystem (differences and commonalities in relation to business ecosystem), types of innovation ecosystems, implications of the

construct innovation ecosystem to strategy and innovation, and research streams in innovation ecosystem and the opportunities identified in each stream.

3. Main findings and discussion: how the innovation ecosystem literature evolved

3.1. Descriptive statistics

One of the bibliometric analyses results revealed the 10 most-frequently cited journals which are also responsible for publishing approximately 35% of the articles in the sample. [Table 1](#) shows the number of articles published by year for these 10 journals, from 1993 to 2016, as well as the journal impact factor (2015).

[Table 2](#) shows the evolution of the publications according to the research method for four periods: 1993 to 2000; 2001 to 2005, 2006 to 2010 and 2011 to 2016. As shown, the majority of the studies are theoretical-conceptual and case studies and there are few quantitative studies, which could indicate that research related to the concept innovation ecosystem has not yet consolidated.

One of the premises of bibliometric analysis is to count the number of times a given article is cited by other papers, yielding a measure of its influence. That is, the more an article is cited, the greater its influence as a driver of concept and method in a given field of research.

Under this assumption, and using the information on the number of times an article is cited by the other papers that make up the database, we can draw up a list of the most relevant articles within the 125 selected articles. [Table 3](#) lists the 17 articles with more than twenty citations and the calculation of their impact index (A_{IF}). The impact index proposed by [Carvalho et al. \(2013\)](#) was calculated on the basis of the number of citations of an article (Citations) and the journal impact factor (JCR). The article impact index was calculated according to equation $A_{IF} = \text{Citation} * (\text{JCR} + 1)$.

The analysis of these articles showed that, until late 2007, only a few articles about “*Innovation Ecosystem*” and “*Business Ecosystem*” were cited. The article that was first and most frequently cited was [Moore \(1993\)](#). In his seminal paper, [Moore \(1993\)](#) suggested that a company can be viewed as part of a business ecosystem that crosses a variety of industries, in which companies coevolve capabilities around a new innovation. He proposed four evolutionary stages of a business ecosystem: birth, expansion, leadership and self-renewal. Another frequently cited article is [Santos and Eisenhardt \(2005\)](#), which provides an understanding of organizational boundaries and, in this context, the business ecosystems were considered a contemporary boundary issue. [Adner \(2006\)](#) proposed that the success of one company's growth strategy depends on how well the ecosystem risks are assessed. According to that study, three types of risks characterize innovation ecosystems: initiative risks (uncertainties of project management); interdependence risks (uncertainties of coordinating with complementary innovators); and integration risks (uncertainties presented by the adoption process in the value chain). Note that the author did not distinguish between risk and uncertainty. [Iansiti and Levien \(2004a\)](#) sought to describe healthy business ecosystems and proposed three measures of their health: productivity, robustness and niche creation, highlighting the concept of the keystone leader of the ecosystem.

The remaining articles begin to be cited as from 2007. [Teece \(2007\)](#) recognized the business ecosystem, rather than the industry, as the environmental context for the analytical purposes, when he discussed the dynamic capabilities framework. [Gawer and Cusumano \(2008\)](#) argued that platform leaders can form an innovation ecosystem with companies that produce complementary products and services to the platform, in order to increase the value of their innovations. [Garnsey et al. \(2008\)](#) found that techno-organizational speciation can be achieved by multiple niche creation, from which a new business ecosystem is developed. [Iyer and Davenport \(2008\)](#) discussed the key attributes that contributed to the successful development of the Google's innovation ecosystem.

Table 1
Number of articles per journal and per year.

Journals	Publication Year																										Total
	JCR (2015)	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016		
International Journal of Technology Management	0.867																1					3	2	1		7	
Harvard Business Review	2.249	1											1	1	1	1	1									6	
Strategic Management Journal	3.380														1	1	1	1			1			1	1	6	
Technovation	2.243																1	1				2	1	1	1	6	
Research Policy	3.470																1	2				2	2			5	
Technological Forecasting and Social Change	2.678																				1	2	1			4	
R&D Management	1.190																1					1		1	1	3	
Research-Technology Management	1.052																1				1					3	
Journal of Product Innovation Management	2.086																					2				2	
Academy of Management Review	7.288																									2	
66 other journals													1	1	1	1	6	2	4	8	5	23	12	14	4	81	
Total		1										1	1	1	2	2	9	6	7	10	7	30	23	19	7	125	

Table 2

Number of articles by periods showing the research method.

Research Method	Periods			
	1993–2000	2001–2005	2006–2010	2011–2016
Theoretical-conceptual	1	1	13	34
Case study			8	34
Modeling			2	14
Survey			1	6
Simulation			1	5
Experimental				2
Literature review		1		1
Action-research				1

Sunley et al. (2008) discussed the role of business ecosystems and firm architecture in driving innovation in a creative production system. Adner and Kapoor (2010) discussed how challenges are distributed across an ecosystem and how the location of the firm interferes with the value creation and value capture. Vargo (2009) reviewed the concept relationship using the support view of the business ecosystem literature. Carayannis and Campbell (2009) proposed the “Mode 3 Innovation Ecosystem” for knowledge creation, dissemination and use, with the participation of government, university, industry and non-governmental entities. Rohrbeck et al. (2009) studied the creation of an open innovation ecosystem by Deutsche Telekom. Li (2009) adopted a technological perspective to understand how Cisco System utilized the strategy of mergers and acquisitions for corporate growth based on a business ecosystem. Romero and Molina (2011) presented a literature review on value co-creation and co-innovation concepts and proposed a framework for creating interface networks to support the establishment of user-driven and collaborative innovation networks. Alexy et al. (2013) studied the collaboration mechanisms of the actors in an innovation ecosystem and proposed selective revealing as a strategy to learn about them. Gawer and Cusumano (2014) showed how industry platforms are related to managing innovation within and outside the firm.

Fig. 2 shows the 17 most-cited articles in the sample and how the articles citations were distributed over the years. Considering the 3059 citations found for the 125 articles, 80.8% of them were related to the 17 most-cited articles. These data highlight the research studies conducted by Adner, author of two articles among the six most-cited in the sample (Adner, 2006; Adner and Kapoor, 2010).

3.2. Bibliometric analysis

In the following sections, we present and discuss the main findings related to bibliometric analysis employed to address our research question: how has the innovation ecosystem construct evolved? The topics covered in our analysis and discussion are: the main keywords and keyword evolution (keyword network and the 10 most cited keywords by period of time); identification of theoretical foundations (articles-to-reference network and co-citation network), of some researchers groups (cross-citation), and of main scholars (degrees of centrality and betweenness); and finally, the most influential studies that shaped the evolution of the literature (turning point articles analysis).

3.2.1. The keyword network and keyword evolution

The keyword network (Fig. 3) was used to identify concepts associated with the innovation ecosystem and business ecosystem concepts. A minimum of five citations of each keyword was considered qualifying for this network. The keywords mentioned together are linked and the strength of the ties between the keywords corresponds to the intensity of their relationship. The main connections to business ecosystem are: innovation, strategy, ecology, technology, firm performance and dynamic capabilities. In relation to innovation ecosystem, the main connections found are: entrepreneurship, innovation, collaboration, creation, product development and technology. These findings are

Table 3

List of the 17 most-cited articles in the sample with more than twenty citations.

Article	Journal	Citations	% Citations	JCR (2015)	A _{IF}
Teece (2007)	Strategic Management Journal	1136	46	3380	4975,7
Moore (1993)	Harvard Business Review	222	9	2249	721,3
Santos and Eisenhardt (2005)	Organization Science	190	8	3360	828,4
Adner and Kapoor (2010)	Strategic Management Journal	156	6	3380	683,3
Iansiti and Levien (2004a)	Harvard Business Review	151	6	2249	490,6
Adner (2006)	Harvard Business Review	137	6	2249	445,1
Vargo (2009)	Journal of Business & Industrial Marketing	71	3	973	140,1
Gawer and Cusumano (2008)	MIT Sloan Management Review	67	3	2114	208,6
Carayannis and Campbell (2009)	International Journal of Technology Management	66	3	867	123,2
Rohrbeck et al. (2009)	R & D Management	41	2	1190	89,8
Sunley et al. (2008)	Journal of Economic Geography	41	2	3429	181,6
Li (2009)	Technovation	40	2	2243	129,7
Romero and Molina (2011)	Production Planning & Control	38	2	1532	96,2
Alexy et al. (2013)	Academy of Management Review	32	1	7288	265,2
Garnsey et al. (2008)	Research Policy	30	1	3470	134,1
Iyer and Davenport (2008)	Harvard Business Review	28	1	2249	91,0
Gawer and Cusumano (2014)	Journal of Product Innovation Management	27	1	2086	83,3

Obs.: Although Teece (2007) appears as the most-cited paper, it does not centrally address ecosystem, but focuses on dynamic capabilities instead. Strictly speaking, Moore (1993) should be considered the most-cited paper on (business) ecosystem.

expected. For instance, business ecosystem has been associated with a number themes related to strategy management domain (e.g.: performance, dynamic capabilities, strategy itself). The innovation ecosystem was associated with creation (value creation, new product development).

A complementary analysis in relation to keyword network is to investigate the evolution of keywords over time (Table 4). In the first period (2001–2005) analyzed, keywords were closely related to the environment and firm capabilities. Innovation was at the very center among keywords during 2006–2010. The last period (2011–2016) showed interesting results – innovation still remains at the top and new keywords emerge, such as management, strategy and ecology. The fact that innovation appears, as a central focus from 2006 on, might be associated with an important change in ecosystem research, when scholars started using the words innovation ecosystem instead of business ecosystem, as we will discuss in the content analysis.

These two initial analyses (keyword network and most-cited keywords) might be useful for researchers, particularly for new entrants in the field. First, these analyses indicated which keywords are most employed by scholars, helping to understand which themes might be related to business ecosystem and innovation ecosystem. Second, the keyword evolution might offer a roadmap for understanding the evolution of themes related to business ecosystem and innovation ecosystem.

3.2.2. Identifying theoretical foundations, research groups and main scholars

The following analyses, articles-to-references, helped to identify some of the constructs and concepts that might be regarded as the basis of the business ecosystem and innovation ecosystem concepts. Fig. 4 shows the article-to-references network. This network presents some of the most-cited articles in the initial sample and some of the references most frequently cited by these articles. A minimum of seven citations of each article and each reference was required for inclusion in this network. The analysis of the article-to-references network shows that 21 out of 27 references were not included in the initial sample of 125 articles.

Analyzing these references, we suggested that they might be organized into these themes, as follows (labeled in Fig. 4):

- i. Open innovation and product platform: a number of scholars cited studies related to open innovation and product platform. The authors cited: Henderson and Clark (1990), proposing the concept of architectural innovation; Gawer and Cusumano (2002), proposing a “Four-Lever Framework” for designing and implementing a successful platform strategy to become a leader in an industry; Chesbrough (2003), proposing that ecosystem is a way to obtain knowledge in the open innovation context; Gawer and Henderson

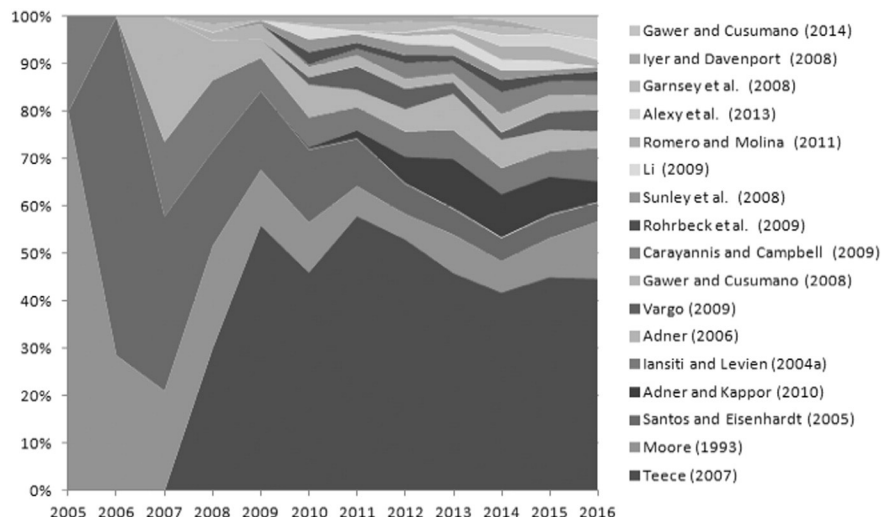


Fig. 2. Evolution of the citations distribution of the 17 most-cited articles over the years.

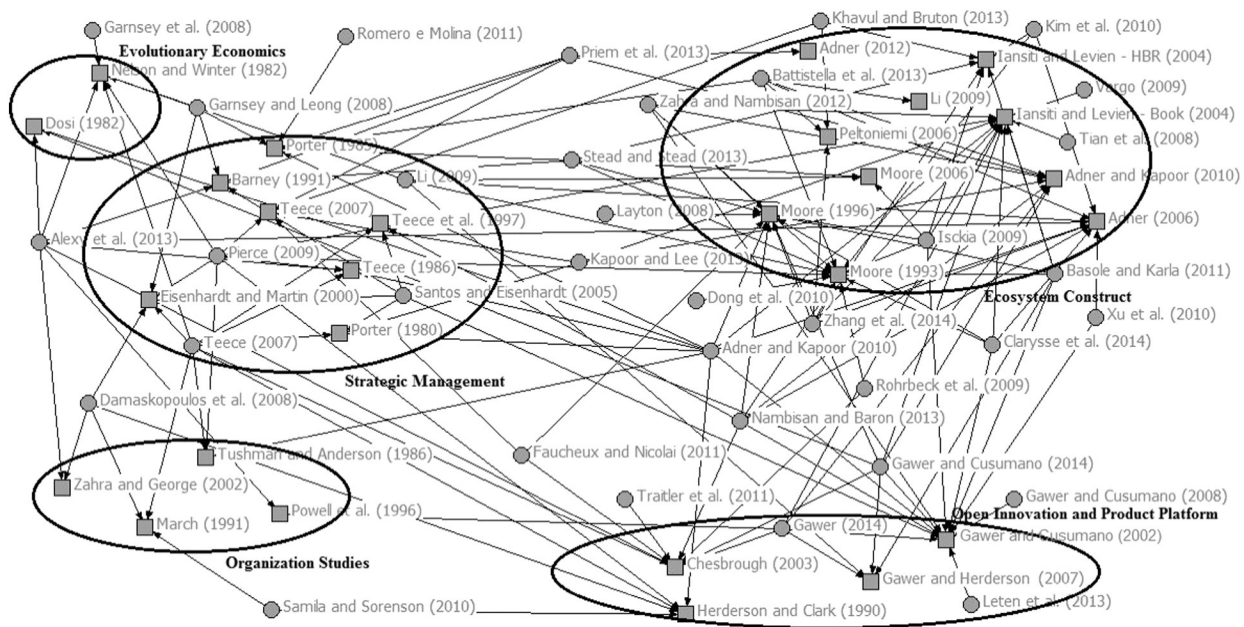


Fig. 4. Article-to-reference network. Obs. Circles represent the articles and squares represent the references.

references for research on a particular subject. Here, by analyzing the number of co-citations, we can observe that many scholars on business ecosystem (e.g., [Iansiti and Levien, 2004a, 2004b](#)) and innovation ecosystem (e.g., [Adner, 2006](#)) built their studies based on [Moore \(1993, 1996\)](#). Again, this co-citation network provided evidence that business ecosystem and innovation ecosystem are strongly linked to strategic management (citing [Porter, 1985](#), [Teece, 2007](#)) and, as expected, innovation management (e.g., [Chesbrough, 2003](#)). In addition, the analysis of the co-citation network highlights another five references that were not included in the initial sample of 125 articles. Those five are: [Brusoni and Prencipe \(2001\)](#), investigating the correlations between product, organizational and knowledge modularity (organization studies); [Eisenmann et al. \(2006\)](#), studying network effects of two-sided markets based on platforms (open innovation and product platform); [Dyer and Singh \(1998\)](#), offering a relational view of competitive advantage (strategic management); [Hughes \(1983\)](#), studying the electricity networks and the different modes of technology transfer (organization

studies); [Williamson \(1975\)](#), studying transaction cost economics (organization studies). Similar to [Fig. 4](#), we also labeled the main themes associated with the references highlighted in the co-citation network ([Fig. 5](#)).

The final analysis performed in this topic was the cross-citation network ([Fig. 6](#)). It represents the relationships among the articles of the sample of 125 articles. This analysis helped to identify groups of researchers, labeled in [Fig. 6](#) as entrepreneurial group; innovation group; platform-based group, and IT and telecommunication group, all of them building on business and innovation ecosystems constructs.

Centrality and betweenness degrees are two bibliometric indicators used to understand the importance, and especially the role of the articles in cross-citation network. The centrality degree relates the number of connections one article has to other articles; in other words, the higher the degree, the greater is the importance and the centrality of the paper in the network. An article which receives many ties (higher indegree centrality) is characterized as a prominent article. An article which

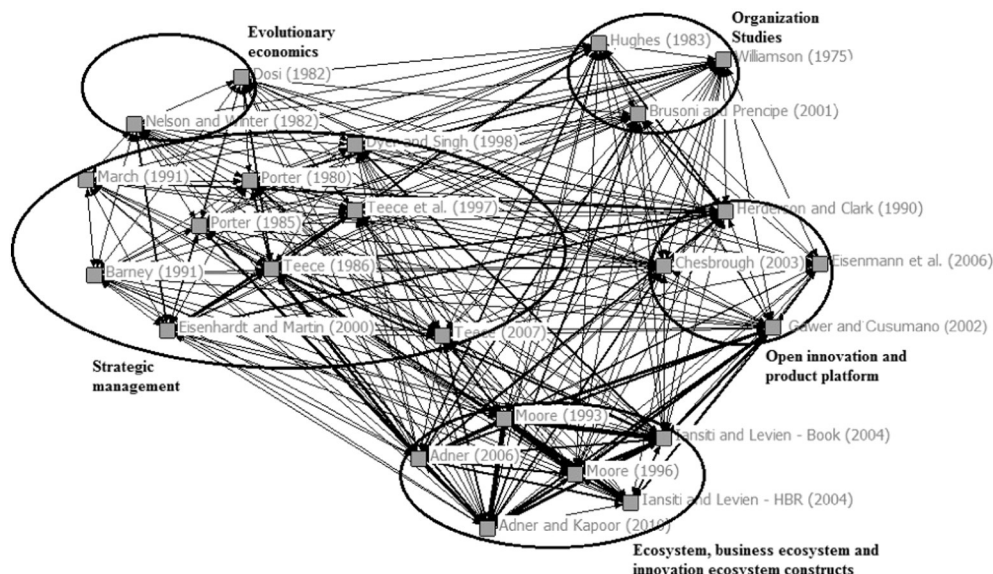


Fig. 5. Co-citation network.

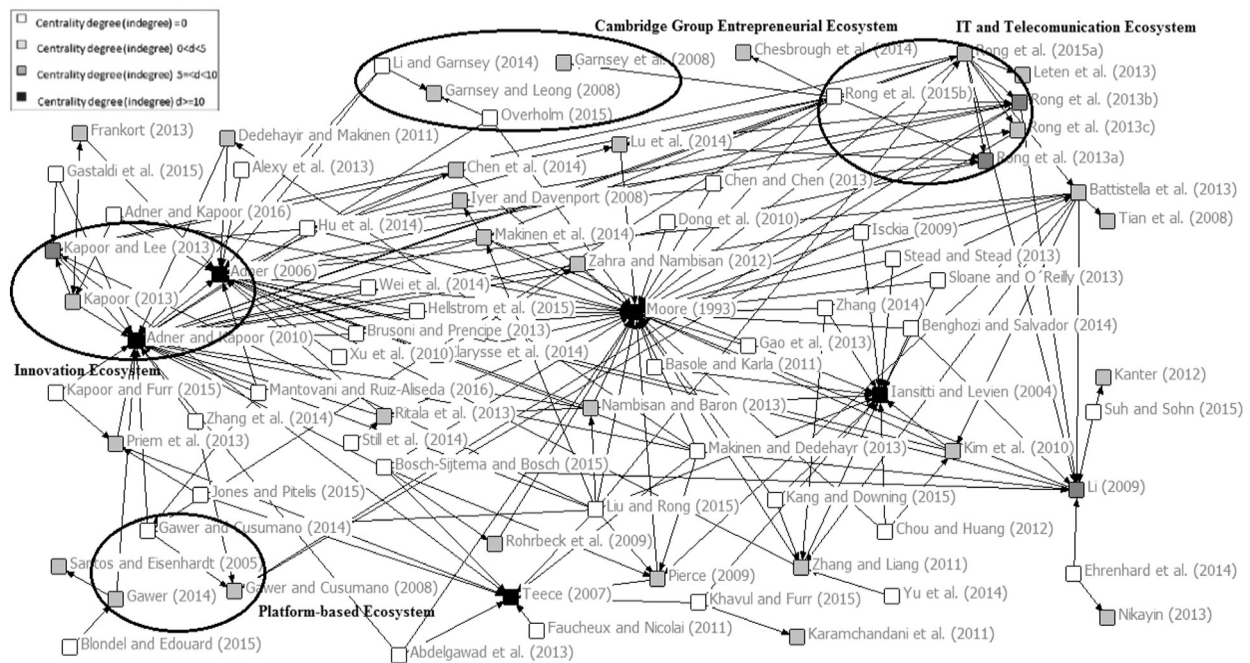


Fig. 6. Cross-citation network.

Table 5
Degrees of centrality and betweenness of the cross-citation network articles.

Article	Centrality			Article	Centrality		
	Outdegree	Indegree	Betweenness		Outdegree	Indegree	Betweenness
Rong et al. (2015b)	13	0	0	Kapoor and Lee (2013)	2	0	7
Rong et al. (2015a)	11	2	16	Kapoor and Furr (2015)	2	6	0
Liu and Rong (2015)	10	0	0	Gastaldi et al. (2015)	2	0	0
Hu et al. (2014)	8	0	0	Zahra and Nambisan (2012)	2	1	1
Battistella et al. (2013)	8	2	19	Stead and Stead (2013)	2	0	0
Mäkinen and Dedehayir (2013)	7	0	0	Gawer and Cusumano (2014)	2	3	2
Bosch-Sijtsema and Bosch (2015)	6	0	0	Chen et al. (2014)	2	1	0
Lu et al. (2014)	5	2	0	Pierce (2009)	2	4	2
Mäkinen et al. (2014)	5	2	4	Priem et al. (2013)	2	2	3
Rong et al. (2013b)	4	7	7	McAdam et al. (2016)	1	0	0
Zhang et al. (2014)	4	0	0	Gao et al. (2013)	1	0	0
Ritala et al. (2013)	4	1	4	Chen and Chen (2013)	1	0	0
Adner and Kapoor (2016)	3	0	0	Rong et al. (2013a)	1	7	1
Khavul and Bruton (2013)	3	0	0	Rong et al. (2013c)	1	2	1
Mantovani and Ruiz-Aliseda (2016)	3	0	0	Yu et al. (2014)	1	0	0
Kim et al. (2010)	3	2	2	Xu et al. (2010)	1	0	0
Kang and Downing (2015)	3	0	0	Alexy et al. (2013)	1	0	0
Chou and Huang (2012)	3	0	0	Adner and Kapoor (2010)	1	28	15
Clarysse et al. (2014)	3	0	0	Dong et al. (2010)	1	0	0
Wei et al. (2014)	3	0	0	Faucheux and Nicolai (2011)	1	0	0
Nambisan and Baron (2013)	3	1	0	Rohrbeck et al. (2009)	1	1	0
Hellstrom et al. (2015)	3	0	0	Moskowitz and Saguy (2013)	1	0	0
Brusoni and Prencipe (2013)	3	0	0	Blondel and Edouard (2015)	1	0	0
Benghozi and Salvador (2014)	3	0	0	Still et al. (2014)	1	0	0
Kapoor (2013)	3	2	7	Iansiti and Levien (2004a)	0	14	0
Li and Garnsey (2014)	3	0	0	Adner (2006)	0	23	0
Overholm (2015)	3	0	0	Moore (1993)	0	37	0
Abdelgawad et al. (2013)	3	0	0	Chesbrough et al. (2014)	0	1	0
Zhang and Liang (2011)	3	4	5	Santos and Eisenhardt (2005)	0	2	0
Basole and Karla (2011)	2	0	0	Gawer and Cusumano (2008)	0	4	0
Frankfort (2013)	2	1	0	Teece (2007)	0	11	0
Zhang et al. (2014)	2	0	0	Tian et al. (2008)	0	1	0
Ehrenhard et al. (2014)	2	0	0	Leten et al. (2013)	0	1	0
Gawer (2014)	2	1	3	Garnsey and Leong (2008)	0	2	0
Isckia (2009)	2	0	0	Garnsey et al. (2008)	0	1	0
Jones and Pitelis (2015)	2	0	0	Nikayin et al. (2013)	0	1	0
Li (2009)	2	8	6	Kanter (2012)	0	1	0
Suh and Sohn (2015)	2	0	0	Iyer and Davenport (2008)	0	1	0
Sloane and O'Reilly (2013)	2	0	0	Karamchandani et al. (2011)	0	1	0
Dedehayir and Mäkinen (2011)	2	1	0				

disseminates information to many others (higher outdegree centrality) is characterized as an influential article. Betweenness is a measure of the extent to which an article serves as a bridge between different research groups since it is connected to other articles that are not connected to each other.

Table 5 exhibits the calculations of the degrees of centrality and betweenness of the cross-citation network articles, which were calculated using the Ucinet software (Borgatti et al., 2002). The degree of centrality is subdivided into the indegree (number of connections that one article receives from other articles) and the outdegree (number of connections that one article establishes with others). The degree of betweenness points to articles that can be mediators between research themes that are not directly connected. The article by Rong et al. (2015b) can be characterized as an influential article since it has the highest outdegree centrality in the sample. The most important article in the sample considering the indegree centrality is the seminal article by Moore (1993), since it scores the highest number of connections from other articles. The articles by Battistella et al. (2013), Rong et al. (2015a) and Adner and Kapoor (2010) have the highest betweenness degrees; the article by Adner and Kapoor represents a bridge between the constructs, business ecosystem and innovation ecosystem. Adner and Kapoor's (2010) work also suggests two important patterns in the evolution of business ecosystem construct: first, scholars start employing innovation ecosystem instead of business ecosystem and second the scholars decide to focus on innovation ecosystem to investigate value creation.

3.2.3. Turning point articles: which studies determined the evolution of business ecosystem and innovation ecosystem constructs

To increase the evidence on how the innovation ecosystem literature has evolved, we performed the turning point studies network analysis. This analysis allows identifying and understanding which the main studies are that changed the intellectual structure within the discourses of business ecosystem and innovation ecosystem. Fig. 7 shows the turning point studies network. This network presents the aggregated co-citation

network in a chronological manner (time zone view), to follow the evolution of the knowledge domain over time. A time interval of 23 years, between 1993 and 2016, was divided into 23 equal time periods, and an individual citation network is obtained from each time segment.

The analysis of the turning points studies network shows the works that deeply changed the discussion on the business and innovation ecosystems literature. Those are: Moore (1993, 1996), Gawer and Cusumano (2002), Iansiti and Levien (2004b), Adner (2006) and Adner and Kapoor (2010). As aforementioned, Moore (1993, 1996) was the pioneer in proposing the concept of business ecosystem. Gawer and Cusumano (2002) developed the concept of a platform-based ecosystem and remarked the role of the platform in business ecosystems. As we will discuss further, the existence of platform might be seen as a key feature of business ecosystem and innovation ecosystem. Iansiti and Levien (2004b) noted the strategic side of business ecosystem, discussing the role of the keystone firm, the different strategies according to the type of ecosystem, measures for ecosystem performance, risk and advantages for the keystone firm, and the role of the platform.

However, the main change we would like to highlight is the employment of the term innovation ecosystem instead of business ecosystem. Two authors strongly contributed to disseminating the term innovation ecosystem: Adner (2006) and further, Adner and Kapoor (2010). However, the differences between business ecosystem and innovation ecosystem are not clear in the literature. In the content analysis, we stress both concepts in order to identify commonalities and differences between them.

3.3. Content analysis

In the following sections, we present and discuss the content analysis. Since the innovation ecosystem construct is built upon ecosystem and business ecosystem constructs, we initially discuss the definitions of these constructs. This discussion helped us to identify some common features between innovation ecosystem and business ecosystem. We also identify a critical feature that differentiates innovation ecosystem

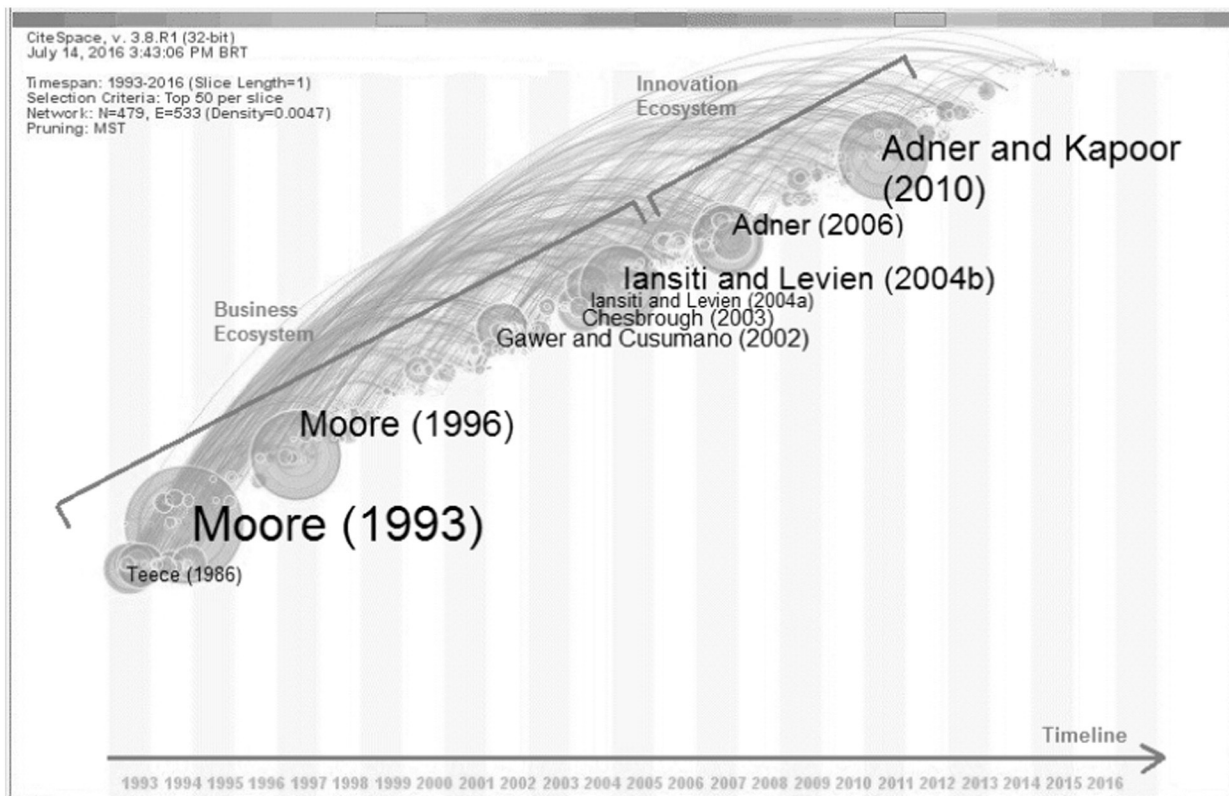


Fig. 7. Turning points articles network (Time zone view).

and business ecosystem. By characterizing the differences between the two constructs, we help to strengthen the innovation ecosystem construct. In addition, we identified some types of innovation ecosystems. Following that, we present and discuss why innovation ecosystem matters to strategy and innovation. Finally, we identify and suggest some opportunities for further research.

3.3.1. Definition of ecosystem, business ecosystem and innovation ecosystem (concepts, feature, metaphor)

In this section, we discuss the evolution, main features, and the roots of ecosystem, business ecosystem and innovation ecosystem constructs. To do so, we analyzed the most-cited papers (Table 3), the turning point articles (Fig. 7) and the rest of the papers in our sample, and provided a chronological view of the most influential papers that changed the course of the discussion on the ecosystems. We start this section by providing a historical perspective of the ecosystem, business ecosystem and innovation ecosystem constructs. As this paper focuses on innovation ecosystem, our aim is not providing an exhaustive discussion about an ecosystem construct, but we present a brief overview of this construct, which consists of the basis of innovation ecosystem and business ecosystem. Later, we discuss the main common characteristics between business ecosystem and innovation ecosystem.

Valkokari (2015) suggested that the ecosystem concept has a long tradition, emerging during the 1930s and then being employed by ecology researchers with different meanings. In the social sciences, Valkokari (2015) shows that researchers used the concept considering the global economy as an entity formed by living organisms, such as organizations and customers. Moore (1993) was the pioneer author in management to propose the business ecosystem concept. Moore (1993) argued that frameworks related to networks, such as strategic alliances and virtual organizations, lack guidance for managers seeking to understand the relationships between firms and change. He suggested that “even fewer of these theories help executives anticipate the managerial challenges of nurturing the complex business communities that bring innovations to market” (p. 75). Building on the concept related to the biological fields, Moore (1993) proposed that managers should think of companies as part of an ecosystem, which consists of a loosely interconnected network of actors (a community), including companies and other entities, coevolving their capabilities around an innovation, sharing knowledge, technologies, skills and resources, cooperating and competing.

Other authors followed Moore's track. For instance, Basole and Karla (2011, p. 314) proposed that “an ecosystem can be described as a networked system that contains a set of objects (e.g., actors, nodes, etc.) that are tied to each other”.

The basis of the business ecosystem construct was built by lansiti and Levien (2004a, p. 3). These authors also built a concept of ecosystem analogous to biology: “the analogy between business networks and biological ecosystems can aid this understanding by vividly highlighting certain pivotal concepts”. lansiti and Levien (2004a, p. 1) argued that business ecosystems are formed by loosely connected networks of entities – “of suppliers, distributors, outsourcing firms, makers of related products or services, technology providers, and a host of other organizations—affected, and are affected by, the creation and delivery of a company's own offerings.” They pointed out that “like an individual species in a biological ecosystem, each member of a business ecosystem ultimately shares the fate of the network as a whole, regardless of that member's apparent strength” (p. 1).

Of course, some scholars criticized the analogies to natural ecosystems. Oh et al. (2016, p. 4) argued that although “Moore (1993) was consistent in applying the ecological system metaphor to business”, “he did not establish rigorous correspondence rules between natural and business ecosystems” and his work “is simply an extended (though persuasive) metaphor”. Moreover, Oh et al. (2016, p. 4) remark that a “natural ecosystem does not have policies”.

Some authors undertook efforts to root the ecosystem construct in the literature on management and economics. For instance, Overholm (2015) argued that a business ecosystem is a theoretical approach related to the inter-organizational networks and alliance portfolio. Priem et al. (2013) suggested that ecosystem is one useful framework for modeling strategic issues related to firm behavior, value creation and value capture. Kapoor and Lee (2013) bring concepts from the institutional theory, mainly the hierarchy of organizational forms and market to the ecosystem theory. In this way, Isckia (2009, p. 342) argued that business ecosystems reshape both markets and hierarchies.

The business ecosystem concept evolved and led to different conceptualizations of business ecosystem (Gomez-Uranga et al., 2014). For instance, Moore (2006, p. 33) proposed that business ecosystems “refer to intentional communities of economic actors whose individual business activities share in some large measure the fate of the whole community”. Adner (2006, p. 2), in one of the turning point articles, considered the business ecosystem an innovation ecosystem, which might be described as “the collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution”. That is, business ecosystem started to be considered an innovation ecosystem. Another turning point article, which contributed to disseminating the term innovation ecosystem, was developed by Adner and Kapoor (2010, p. 309), who suggested that the construct ecosystem is “a way of making interdependencies more explicit”. Zahra and Nambisan (2012, p. 220) considered business ecosystem to be synonymous with innovation ecosystem as “a group of companies - and other entities including individuals, too, perhaps - that interacts and shares a set of dependencies as it produces the goods, technologies, and services customers need”.

These different approaches might lead to contradictory and, in some cases, competing conceptualizations. They do not make clear the difference between business and innovation ecosystems. Ritala et al. (2013, p. 5) explained that some authors considered innovation ecosystems clusters of innovation activities, related to certain themes (e.g., software) while other authors addressed ecosystem as “formed around challenging commonly-shared business objectives by seeking their satisfaction through innovation-driven goals”. In specific cases, the lack of clarity may hide some aspects related to the evolution of the concept, including features and types of ecosystem. For instance, Nambisan and Baron (2013, p. 1074) proposed the concept of a hub ecosystem, “wherein a single firm establishes and leads the ecosystem”. Such authors suggested that the hub ecosystem is similar to the platform-based network (proposed by Gawer and Cusumano, 2008), or the keystone model (initially proposed by lansiti and Levien, 2004a). Huang et al. (2013) suggested that service-oriented business ecosystem is formed by a collection of business services, while other authors considered a digital ecosystem as one type of business ecosystem. In addition, some authors considered the business ecosystem a metaphor (e.g., Adner and Kapoor, 2010), while others suggested that business ecosystem represents an organizational form, building on the institutional literature (e.g., Moore, 2006; Pierce, 2009).

Note that the term innovation ecosystem as employed by Adner (2006) is quite different from that employed by Carayannis and Campbell (2009), which is more associated with clusters and the relationship between universities and firms. The term innovation ecosystem is also often used with a meaning closer to the idea of the National System of Innovation employed by neo-Schumpeterian or evolutionary economists, such as Lundvall (1992), Nelson (1993), Freeman (1995), and many others. We are not entering this discussion; ecosystem loses its strength as a construct when employed in such a broad way. Moreover, the National System of Innovation (or regional, or sectoral or other variants of NSI) is so embedded in the discussion of policy making, so well discussed, that there is no need for another term, especially if it is taken in a loose way. In addition, an innovation ecosystem is different from a knowledge ecosystem, which consists of a group of organizations focused on generating knowledge (Clarysse et al., 2014).

Jing and Xiong-jian (2011) argued that, despite differences in the concepts adopted by authors, it is possible to identify and to summarize some common features, such as: a large group of organizations; inter-connectedness and interdependency; and co-evolution. Li (2009, p. 380) presented a similar list of characteristics, remarking that business ecosystem “move beyond market positioning and industrial structure by having three major characteristics: symbiosis, platform, and co-evolution. Nambisan and Baron (2013, p. 1071) suggested the following list of characteristics: “dependencies established among the members (members’ performance and survival are closely linked to those in the ecosystem), a common set of goals and objectives (shaped by the ecosystem-level focus on a unique customer value proposition), and a shared set of knowledge and skills (complementary set of technologies and capabilities)”.

Table 6 provides the definitions of ecosystem, business ecosystem and innovation ecosystem employed by the most-cited and turning point articles. In this table, we also identify the main features of the concepts proposed by these scholars.

3.3.1.1. Business ecosystem and innovation ecosystem: common features. Analyzing the papers related in Table 6, we identified the following commons features of the business ecosystem and innovation ecosystem concepts:

1. Among scholars, there is an understanding that both business ecosystem and innovation ecosystem are composed of interconnected and interdependent network actors, which includes the focal firm, customers, suppliers and complementary innovators. Iansiti and Levien (2004a, p. 2) suggested as examples of complementors “regulatory agencies and media outlets that can have a less immediate, but just as powerful, effect on your business”. They also identified other actors: keystone, dominators and niche players. Iyer et al. (2006) suggested that ecosystem actors may have three roles: bridge, hub and broker. Adner and Kapoor (2010) explained that partners (suppliers) are located upstream of the ecosystem while the complementors are downstream of the ecosystem. Rong (2011) found three different functional roles among actors: i) the initiator, who builds the ecosystem and sets the platform; ii) the specialist, actor that add value to the central platform; iii) the adopter, who develops products following the initiator and co-designs the platform with the specialist. Zahra and Nambisan (2012) point out that those ecosystems are also constituted by corporate-sponsored ventures and independent entrepreneurs.
2. A feature of business ecosystem and innovation ecosystem proposed by different authors is that business ecosystem or innovation ecosystem may be led by a keystone actor (Iansiti and Levien, 2004a) or by a platform leader (Gawer and Cusumano, 2008). Iansiti and Levien (2004a) suggest that the leader is often a well-established and large firm, which provides a common platform, set the goals, and is responsible for its health.
3. Many scholars suggest that a business ecosystem and an innovation ecosystem are built on a platform (e.g., Iansiti and Levien, 2004a; Gawer and Cusumano, 2008; Li, 2009). Iansiti and Levien (2004a) considered a platform a set of tools, services and technologies. Gawer (2014) identified three different types of platforms: technological platform, supply-chain platform and industry platform.
4. Authors also agreed that members face cooperation and competition in business and innovation ecosystems (e.g., Moore, 1993; Iansiti and Levien, 2004a; Adner, 2006; Adner and Kapoor, 2010).
5. The business ecosystem and innovation ecosystem might have a lifecycle that follows a co-evolution process. Moore (1993) proposed a lifecycle model composed of four phases: birth, expansion, leadership and self-renewal. Rong (2011) refined the Moore’s (1993) lifecycle model by proposing five phases: emerging, diversifying, converging, consolidating and renewing.

Table 6

Definitions and main features of ecosystem, business ecosystem and innovation ecosystem from the 17 most-cited articles in the sample.

Article	Definition of ecosystem/business ecosystem/innovation ecosystem	Main features
Teece (2007)*	“[...] the business ‘ecosystem’—the community of organizations, institutions, and individuals that impact the enterprise and the enterprise’s customers and suppliers. The relevant community, therefore, includes complementors, suppliers, regulatory authorities, standard-setting bodies, the judiciary, and educational and research institutions. It is a framework that recognizes that innovation and its supporting infrastructure have major impacts on competition.” (p. 1325)	Dynamics capabilities; platforms; co-evolution; capture value; complex interactions.
Moore (1993)	“A business ecosystem [...] crosses a variety of Industries [...], companies coevolve capabilities around a new innovation: they work cooperatively and competitively to support new products, satisfy customer needs, and eventually incorporate the next round of innovations. Every business ecosystem develops in four distinct stages: birth, expansion, leadership, and self-renewal – or, if not self-renewal, death. [...] While the center may shift over time, the role of the leader is valued by the rest of the community. Such leadership enables all ecosystem members to invest towards a shared future in which they anticipate profiting together.” (p. 76)	Stages of maturity; roles (leader or follower); co-opetition.
Santos and Eisenhardt (2005)	“[...] ecosystem [...] i.e., community of players such as complementors, suppliers, and regulators interacting in an industry” (p. 496)	Sphere of influence; control, power conception; ownership (direct sales force; acquisitions and hiring) and non-ownership (influence over distributors through support and better incentives; collusion, lobbying, consortia, alliances, friendship ties, and board relationships) mechanisms.
Adner and Kapoor (2010)	“In [...] technology-based ecosystems, reducing dependence simply isolates the organization. In contrast, the power conception focuses on creating a sphere of influence through alliances and other forms of interdependence. Competence can be synergistic with power when resources are used to exercise influence, especially in shifting patterns of cooptation.” (p. 499)	Strategic flexibility; offensive/defensive boundaries; dynamic markets; network position; co-opetition.
Iansiti and Levien (2004a)	“The ecosystem construct, as a way of making interdependencies more explicit, [...] have focused on understanding coordination among partners in exchange networks that are characterized by simultaneous cooperation and competition.” (p. 309)	Complementors; technological and behavioral uncertainties.
	“[...] the performance of these [...] firms derives from something that is much larger than the companies themselves:	Alternative strategies (commodity, niche, keystone or dominator); platforms; network effect.

Table 6 (continued)

Article	Definition of ecosystem/business ecosystem/innovation ecosystem	Main features
	the success of their respective business ecosystem. These loose networks – of suppliers, distributors, outsourcing firms, makers of related products or services, technology providers, and a host of other organizations – affect, and are affected by, the creation and delivery of a company's own offerings." (p. 01)	
Adner (2006)	"Most companies today inhabit ecosystems that extend beyond the boundaries of their own industries" (p. 02)	Risk management; coordination (work on critical bottlenecks).
	"[...] innovation ecosystems—the collaborative arrangements through which firms combine their individual offerings into a coherent, customer-facing solution" (p. 02)	
Vargo (2009)	Uses the definition by Iansiti and Levien (2004a)	Roles; resource integrator; business ecosystems must be seen in terms of service-based, network with- network relationships, including the network of the customer.
Gawer and Cusumano (2008)	Use the definition by Iansiti and Levien (2004a)	Platform-based ecosystem; complementors, network effects, partnership; key players;
Carayannis and Campbell (2009)	"[...] Innovation Ecosystem, where people, culture and technology, [...] meet and interact to catalyze creativity, trigger invention and accelerate innovation across scientific and technological disciplines, public and private sectors [...] and in a top-down, policy-driven as well as bottom-up, entrepreneurship-empowered fashion." (p. 202–203)	Co-existence; co-evolution; co-specialization; actors (government, university, industry and NGOs); clusters; networks.
Rohrbeck et al. (2009)	Use the definition by Moore (1993)	By working cooperatively and competitively with other companies in order to co-evolve capabilities, to support new products, satisfy customer needs and incorporate a new round of innovations, the company builds a business ecosystem; business ecosystem; open innovation ecosystem.
Sunley et al. (2008)	They do not define ecosystem	Not applied.
Li (2009)	"Business ecosystem is an emerging concept [...] and [...] is now an increasing focus of a firm's business strategy. [...] An ecosystem can also provide an emerging orientation to create novelty in business operations." (p. 379)	Symbiosis, platform, co-evolution; actors (suppliers, distributors, outsourcing firms, makers of related products or services, technology providers, and a host of other organizations).
Romero and Molina (2011)	"...a value co-creation system as a set of people, organizations and technology acting as a symbiotic business ecosystem in which organizations and customers interact in dynamic and reciprocal relations towards their commitment in the process of co-producing offerings:	Value co-creation and co-innovation; collaborative innovation networks; cooperative process; customer communities.

Table 6 (continued)

Article	Definition of ecosystem/business ecosystem/innovation ecosystem	Main features
	products, services and experiences, in a mutually beneficial producer/customer relationship." (p. 11)	
Alexy et al. (2013)	Use the definition by Adner (2006)	Technological trajectories; players' diversity; knowledge capture; platform; value accretive.
Garnsey et al. (2008)	Use the definition by Moore (1993)	A business model can be thought of as a design that specifies how a firm is connected to others in its ecosystem in order to create and to capture value.
Iyer and Davenport (2008)	Use the definition by Iansiti and Levien (2004a)	Innovation ecosystem; keystone; evolution; value creation; platform; content providers, consumers, advertises, innovators; complementors; value creation; value systems.
Gawer and Cusumano (2014)	Use the definition by Iansiti and Levien (2004a)	Platform-based ecosystem; platform leader, complementors, network effects, partnership; key players;

Obs.: [Teece \(2007\)](#) does not centrally address the ecosystem concept, focusing on dynamic capabilities instead.

These five main features provide a framework to help understand the common features between business ecosystem and innovation ecosystem. Nevertheless, in our analysis, we also faced another fundamental controversy around the way some scholars approach both constructs: treating business ecosystem as synonymous of innovation ecosystem (e.g., [Adner, 2006](#), [Gawer and Cusumano, 2008](#), [Adner and Kapoor, 2010](#), [Gawer and Cusumano, 2014](#), [Overholm, 2015](#)) while [Valkokari \(2015\)](#) pointed out that business and innovation ecosystems are distinct. The distinction is our next discussion.

3.3.1.2. Differentiating business ecosystem from innovation ecosystem: value capture × value creation. We suggest that addressing business ecosystem as a distinct concept in relation to innovation ecosystem may have theoretical advantages. We build on [Gawer's \(2014\)](#) ideas, which indicated that the literature on platforms was divided into two separate perspectives: innovation (technological) and competition (economics). Similarly, the ecosystem construct encompasses two sides in management: innovation, which refers to value creation, and business, which predominantly involves value capture. [Ritala et al. \(2013, p. 5\)](#) defined value creation as "the collaborative processes and activities of creating value for customers and other stakeholders", while value capture "refers to the individual firm-level actualized profit-taking; that is, how firms eventually pursue to reach their own competitive advantages and to reap related profit". [Adner and Kapoor \(2010\)](#) argued that value creation precedes value capture.

Discussing platforms, [Gawer \(2014\)](#) gave an excellent example to illustrate the differences between the innovation and the business sides. On the innovation side, [Gawer \(2014, p. 1239\)](#) described how "the social networking platform Facebook innovated on a new mobile phone "homescreen" application, Facebook Home, having used Android (Google's mobile phone operating system, itself an important technological platform) as a tool to build it". On the business side, [Gawer \(2014, p. 1239\)](#) described how Facebook and Google competed to increase value capture, changing the relationship from cooperation to competition: "Facebook then positioned Home to take centre-stage in the end-user mobile phone experience, thereby expanding Facebook's presence in the mobile phone space, thus turning a formerly collaborative relationship with Google into a competitive one."

We stress that considering business ecosystem distinct from the innovation ecosystem may open interesting avenues for research. For instance, researchers might properly and more thoroughly investigate the different mechanisms associated with value creation (more related to the innovation side) and with value capture (more related to the competitive power side).

3.3.2. Types of innovation ecosystem

Following the insight into the differences between the concepts of innovation ecosystem by Adner (2006) and by Carayannis and Campbell (2009), we identified the fact that many other authors proposed different types of innovation ecosystem.

Nambisan and Baron (2013, p. 1074) suggested that the literature offers a number of innovation ecosystems, such as “hub-based ecosystem, open source community, research and development (R&D) consortium, crowdsourcing ecosystem”. Nambisan and Baron (2013, p. 1072) argued that “a hub-based innovation ecosystem that involves a single firm assuming the ecosystem leadership (setting the goals and defining the innovation platform) and exercising considerable influence over the strategies and fortunes of all other members”.

Zahra and Nambisan (2012), building on Nambisan and Sawhney (2007), proposed four different types of innovation ecosystems, linking strategic thinking and entrepreneurship: Orchestra, Creative Bazaar, Jam Central, and MOD Station. The Orchestra Model refers to “a group of firms coming together to exploit a market opportunity based on one explicit innovation architecture/platform defined and shaped by a dominant firm, or the keystone player” (p. 222). The Creative Bazaar Model consists of an innovation ecosystem in which “a dominant firm shops for innovation in a global bazaar of new ideas, products, and technologies. It then uses its proprietary infrastructure to build on these ideas and commercialize them” (Zahra and Nambisan, 2012, p. 225). The Jam Central Model is related to “a collection of independent entities, such as research centers, collaborating to envision and to develop an innovation in an emergent or radically new field. The term ‘jam’ signifies the improvisational nature of innovation (i.e., the objectives and direction of innovation tend to emerge organically from the collaboration) and the lack of centralized leadership in the ecosystem (i.e., there are no dominant companies and the governance responsibility is diffused among partners)”. And MOD Station Model refers to innovation ecosystems in which “some companies allow their customers to create modifications” (p. 227) and “distribute them” (p. 227).

Generally, these types of innovation ecosystem are mainly associated with a well-established firm. In the entrepreneurship field, some scholars have employed the innovation ecosystem construct to address venture creation. For instance, Habbershon (2006) proposed the concept of family ecosystem, composed of the family and business actors. Garnsey et al. (2008) and her colleagues have related the innovation ecosystem to the context of a new venture: which consists of a network of partners, in which the entrepreneurs access, obtain and combine important resources in order to create value to customers.

3.3.3. Why the innovation ecosystem concept matters to strategy and innovation

The literature offers several system approaches for management, such as supply chain, value chain, and, more recently, innovation ecosystem. In this section, we discuss what the innovation ecosystem concept adds in relation to these systemic approaches. Such discussion is fundamental to understand why the innovation ecosystem concept matters to the strategy and innovation literature and practice.

The supply chain is a well-disseminated approach in management, receiving massive attention from academia and practitioners. Rong et al. (2013c), building on Lambert and Cooper (2000), state that supply chain management refers to a number of business processes, focusing on the exchange of information and the flow of materials from suppliers to end users. The supply chain concept allows managers to propose strategies to design the chain configuration, chain information systems,

governance structures, and risk mitigation (Rong et al., 2010). Gawer (2014) explained that formal (or contractual) relations among buyers and sellers often characterize supply chains. Gawer (2009, p. 52) indicated that some supply chains might be organized around a supply chain platform: “a set of subsystems and interfaces that forms a common structure from which a stream of derivative products can be efficiently developed and produced by partners along a supply chain”.

An important limitation of the supply-chain concept is that it does not include other important actors, notably the complementors. In addition, Adner and Kapoor (2010) highlighted that relations in an innovation ecosystem might be more unstable, evolving in unforeseen ways, moving from cooperation to competition and vice-versa. In this sense, the governance of an innovation ecosystem might not be clear, especially with respect to complementors. Also, Rong et al. (2013c, p. 400) argued that “the study of the business ecosystem could equip firms with more knowledge of interactions between different stakeholders rather than direct supply chain partners”. Indeed, Rong et al. (2013c, p. 400) stressed that “supply chain theories mostly focus on the production process of an existing product” while “the business ecosystem study focuses on the commercialization process or partners’ interaction before the formulation of a stable supply chain”. Building on Zhang and Gregory (2011), Rong et al. (2013c, p. 400) showed that research on supply chain covers the evolution of industry, focusing on efficiency improvement, partner selection, configuration and capabilities, while the “business ecosystem extends the supply chain scope and covers the areas of industry evolution”. Although these authors mention business ecosystem, such arguments are also valid to the innovation ecosystem.

Considering Gawer’s (2009) and Rong et al.’s (2013c) arguments, we can argue that the supply chain concept supposes a given and stable interaction of firms. The chain follows the material flow. Its governance is also given, implying that the arrangement for value creation is done, stable; each partner has a well-defined role. The dispute concerning value capture is ruled by formal contracts, defining prices, conditions etc. This situation is different from an innovation ecosystem, in which products are not necessarily defined in advance; the network of actors is a construction, varying according to the ecosystem evolution. That is, in opposition to a chain, an innovation ecosystem not necessarily has one stable governance (Adner and Kapoor, 2010) or a stable configuration, since partners can change independently of formal contracts. Focusing on value co-creation, the ecosystem construct has a stronger relation to firms’ strategy, while supply chain has a stronger relation to operations strategy.

Another well-recognized system approach is the value chain, which may be at the firm or at industry levels (Adner and Kapoor, 2010). Porter (1985) proposed that value chain disaggregates a firm into a set of relevant and strategic activities. Also, Porter proposed that the value system concept, which describes how the value created by the supplier’s chain is the input employed in a firm’s chain. Adner and Kapoor (2010, p. 309) argued that “although the very imagery of a value chain (at the level of both firms and industries) suggests interdependencies characterized as an ordered arrangement of activities, the literature has largely neglected the impact of the relative locations of activities along the chain”. Similarly to supply chain, the value chain concept does not consider organizations that “fall outside the traditional value chain of suppliers and distributors that directly contribute to the creation and delivery of a product or service” (Iansiti and Levien, 2004a, p. 2). Additionally, Mäkinen and Dedehayir (2013) indicated many global businesses involve the ecosystem construct (innovation ecosystem and business ecosystem), which refers to multiple industries rather than activities limited to a single industry or value chain.

The innovation ecosystem and business ecosystem constructs offer new possibilities to operationalize the environment. The value chain (at the firm and at industry levels) considers the environment as given (as seen in Porter, 1985). The firm has low control under suppliers’ and customers’ choices and its performance is mainly affected by external forces and how the firm is positioned in a given industry.

The supply chain approach tries to increase control over performance, considering suppliers actors that can be managed by contracts and managerial approaches. However, policy makers, customers, and other complementors fall out of the supply chain approach. The ecosystem construct considers that firms may undertake efforts to manage (directly and indirectly controlling) regulators, media, customers, innovative complementors and other actors. Of course, part or most of the environment still remains outside the firms' influence.

Table 7 summarizes the main characteristics and differences among the value chain, supply chain, business ecosystem and innovation ecosystem.

In addition, the innovation ecosystem concept opens new avenues for strategy and innovation researchers and practitioners. The business and innovation ecosystems concepts offer a new understanding of competition: moving from a single industry to multiple ecosystems competing for the same customers (Pierce, 2009, Adner and Kapoor, 2010). Adner and Kapoor (2010), Priem et al. (2013), and Ritala et al. (2013) suggested that innovation ecosystems bring value creation to the center stage, criticizing the current literature on strategy, networks and economics, which overemphasize value capture over value creation. For instance, Adner and Kapoor (2010, p. 309) remarked that the literature on strategy “has explored the role of co-specialization, bargaining power, and relationships between exchange partners in shaping firms' value capture, it has tended to assume away the question of how value is created in the first place”. For Adner (2006, p. 3), “the most important strategic implication is that risk assessment changes dramatically”, presenting, as aforementioned, “a new set of risks - new dependencies that can brutally derail a firm's best efforts”.

The innovation ecosystem may be important to analyze entrepreneurial movements to set up a new business. Entrepreneurial action may shift from equating uncertainty at the firm level to managing collective uncertainties, those that affect more than a single actor in an innovation ecosystem (Salerno et al., 2015). That is, building an innovation ecosystem and managing collective uncertainties at the innovation ecosystem level is a strategy pursued by entrepreneurs. The entrepreneurial kind of innovation ecosystem is a framework that adheres very well to this situation.

3.3.4. Research streams and opportunities in innovation ecosystem

By now, we have identified the key research areas, the most-cited papers and authors related to these areas, key research questions and some gaps. To do so, we employed some results from our bibliometric and content analysis. First, using citation/co-citation analysis, we found some initial clusters of themes and researchers. By using the turning point articles, we found that some of them originated specific streams of research. Following that, reading all 125 articles in our sample, we identified other emerging streams, as discussed below. Table 8 presents the main aspects of these research streams.

3.3.4.1. Industry platform × innovation ecosystem. In this stream, scholars explored a number of issues: how to link platform and ecosystem; how to become a platform leader; how to design an industry platform; and so on. We also identified some opportunities for further research. i) It is not clear how a firm becomes a leader of an industry platform (as suggested by Gawer, 2014); ii) Which the organizational processes to implement and manage an industry platform are; iii) How to integrate the supply chain platform and the industry platform, an issue not addressed by Gawer (2014); iv) To understand how firms manage radical innovations in the industry platform context. Two aspects emerge here: how to implement an industry platform related to a radical innovation; and how a firm leads an ecosystem and the renewal of an industry platform when facing a competition based on a radical innovation; v) Finally, under which circumstances a firm should build an industry platform.

3.3.4.2. Innovation ecosystem strategy, strategic management, value creation and business model. A critical issue to investigate is how firms create value in the innovation ecosystem context. In this stream, we have identified a number of opportunities for further research. i) How to bring value creation in the ecosystem to the center of strategic management (as proposed by Priem et al., 2013 and Adner and Kapoor, 2010); ii) How to understand the ecosystem dynamic based on the perspectives of resource-based view and dynamic capabilities; iii) Which strategy fits in each context (in line with Iansiti and Levien, 2004a); iv) New strategic tools for innovation ecosystems. For example, the roadmapping approach is still underdeveloped in the context of ecosystem; few scholars have explored this issue (e.g., Li, 2009).

3.3.4.3. Innovation management. Scholars explored a vast list of subjects associating ecosystem with innovation management, such as risk management, uncertainty management, project management, portfolio management, etc. In our analysis, we identified a number of opportunities for further research. For example, the literature we investigated does not centrally address how firms manage radical innovations in the ecosystem context. Gawer and Cusumano (2014) suggested, as an opportunity for further research, exploring disruptive innovation in the context of a platform-based ecosystem. Building on it, it would be interesting to explore the relations between ambidexterity and ecosystem, new product development management associated with loose-coupled partners and complementors, and the limits and risks of pivot strategy.

3.3.4.4. Managing partners. Kapoor and Lee (2013, p. 292) suggested that “an interesting direction for future research would be to explicitly consider the link between firm's organizational form and the indirect network effects associated with complements”. Considering that cooperation and competition coexist in an innovation ecosystem, how do firms manage partners with such ambiguity? Additionally, considering

Table 7
Main characteristics and differences between value chain, supply chain, business ecosystem and innovation ecosystem.

	Value chain (at firm)	Value chain (at industry)	Supply chain	Business Ecosystem	Innovation Ecosystem
Level of analysis	Firm	Industry	Supply chain	Ecosystem	Ecosystem
Main focus	Reducing cost and improving resources which might bring competitive advantage by differentiation	Co-specialization, bargaining power, and relationships between exchange partners	Flows of materials and information across the chain	Value capture, location of actors, integration,	Value co-creation; location of actors, integration, challenges distributed across partners and complementors.
Agents	One firm with its own human resources	Firm, customers and suppliers	Suppliers and assemblers	Suppliers, focal firm complementors, and customers.	Suppliers, focal firm complementors, and customers.
Coordination mechanisms	Managerial hierarchies	Formal contracts	Formal contracts	Ecosystem governance, formal contracts (with suppliers), loose informal agreements with complementors if any	Ecosystem governance, formal contracts (with suppliers), loose informal agreements with complementors if any.

Table 8
Research streams and opportunities in innovation ecosystem.

Research streams	Main authors	Description	Examples of research questions and aims that guide this stream	Representative contributions	Examples of some gaps identified/opportunities for further research
Industry platform × innovation ecosystem	Gawer and Cusumano (2008) Rong et al. (2013b) Gawer (2014)	In this stream, authors explored a number of issues: how to link platform and ecosystem; how to become a platform leader; how to design an industry platform.	How do companies become platform leaders? How do companies implement an industry platform?	Rong et al. (2013b) provided a matrix framework to describe platform strategy in relation to three dimensions (technology, application and organization) Gawer (2014, p. 1247) made “two main contributions: to have summarized and bridged the two prevailing conceptualizations of technological platforms, and to have developed a new theoretical framework for platforms, culminating in a new conceptualization of platforms as evolving organizations or meta-organizations”	Rong et al. (2013b, p. 92) suggested as further research topics: “further study of other cases in the same industry is required”; “more industries should be tested in order to further generalize the findings; “tools should be developed for platform strategies for practical use” Gawer (2014, p. 1248) suggested as gaps in the literature: “how platforms set out their boundaries, by following the same logic that organizations use to set out their organizational boundaries”.
Innovation ecosystem strategy, strategic management, value creation and business model	Iansiti and Levien (2004a) Tian et al. (2008) Zahra and Nambisan (2012) Wei et al. (2014)	This stream links strategic management and ecosystem.	Which strategies for which ecosystem type? How to nurture an ecosystem? How to design an ecosystem business model?	Wei et al. (2014, p. 301): “technological innovation is increasingly embedded in the business ecosystem” Zahra and Nambisan (2012) linked strategic thinking and entrepreneurship.	Priem et al. (2013) argued that a remaining gap is the link among resource-based view, dynamic capabilities, value creation, business model and ecosystem.
Innovation management	Adner (2006) Adner and Kapoor (2010)	In this stream, scholars focused on issues related to innovation management, such as risk management and uncertainty management.	How to manage innovation challenges across the ecosystem? How does the location of challenges interfere with value creation? How to manage projects in the ecosystem? How to manage the innovation integration across the ecosystem?	The relevance of managing bottlenecks in an ecosystem: “challenges in the external ecosystem can either enhance or erode a firm's competitive advantage from technology leadership” (Adner and Kapoor, 2010, p. 326) Some mechanisms related to managing innovation ecosystems: formally (meetings, IPR agreements, formal project teams) and informally (informal relationships between people) coordinated structures (Ritala et al., 2013).	
Managing partners	Kapoor and Furr (2015) Kapoor and Lee (2013).	In this stream, scholars investigated the links between the focal firm and complementors, strategies to manage partners, so on.	Kapoor and Furr (2015, p. 417) explored “the drivers of entrants’ technology choices in an emerging industry by considering the role of both firm-level and ecosystem-level complementarities.”	Kapoor and Lee (2013, p. 291) found that “the benefit of the alliance form in facilitating coordination and cooperation between firms and their complementors is confirmed by the result that hospitals pursuing alliances with physicians are more likely to invest in new imaging technologies” Kapoor and Furr (2015, p. 433) found that “the importance of complementary assets availability and technology performance towards entry choice varies according to whether diversifying entrants’ pre-entry capabilities and start-ups’ founder experience are related or unrelated to the industry illustrates the benefits of distinguishing between these types of pre-entry capabilities and experience”.	Kapoor and Lee (2013, p. 292) suggested “an interesting direction for future research would be to explicitly consider the link between firm’s organizational form and the indirect network effects associated with complements.”
The innovation ecosystem lifecycle	Dedehayir and Mäkinen (2011) Rong et al. (2013b) Groesser	In this stream, authors explored how ecosystems co-evolve.	How do ecosystems co-evolve? How do ecosystem partners co-evolve? How does the focal firm drive the ecosystem evolution?	Dedehayir and Mäkinen (2011, p. 634) “have extended the current understanding of industry evolution by developing a temporal measure of the sub-industry’s own technological industry clockspeed, and further,	Dedehayir and Mäkinen (2011, p. 635) suggested as further study “further research that considers consumer demand and its evolution in analyzing such transition between competitive domains of the reverse salient

Table 8 (continued)

Research streams	Main authors	Description	Examples of research questions and aims that guide this stream	Representative contributions	Examples of some gaps identified/opportunities for further research
	(2014)			by developing a temporal measure of the sub-industry's systemic technological industry clockspeed".	sub-industry"
Innovation ecosystem and new venture creation	Garnsey et al. (2008), Garnsey and Leong (2008) Habbershon (2006) Li and Garnsey (2014) Overholm (2015) Nambisan and Baron (2013)	In this stream, scholars applied the ecosystem construct to understand venture creation and development.	How do new ventures influence the ecosystem? How do entrepreneurs build an ecosystem to create value to customers? How can the ecosystem approach be used to understand entrepreneurial action?	Overholm (2015, p. 22) found that opportunities are created in two manners: "(1) Cognitively, as the ecosystem describes a mode of value creation that helps new entrants formulate their ecosystem plan and understand what can be achieved. (2) Practically, as the ecosystem itself is accessible for new entrepreneurs to enter". Habbershon (2006, p. 882) found that "the ecosystems model makes it evident, however, that the family and business cannot be separated without destroying the ecosystem".	Overholm (2015) suggested exploring the relations among opportunity creation and recognition, business ecosystem and intellectual property-driven business models.

the entrepreneurial kind of innovation ecosystem, managing partners means creating partners, and so the question: how does a firm aiming to be a keystone in an infant entrepreneurial innovation ecosystem sense, convince and select partners? Which heuristics, which tool?

3.3.4.5. The innovation ecosystem lifecycle. In this stream of research, we mapped some gaps. For instance, Dedehayir and Mäkinen (2011, p. 635) suggested "further research that considers consumer demand and its evolution in analyzing such transition between competitive domains of the reverse salient sub-industry". Another opportunity for further research is to explore the competition and cooperation dynamics in more detail.

3.3.4.6. Innovation ecosystem and new venture creation. In this stream, the researchers employed the ecosystem as lens for new venture creation and entrepreneurial action. We mapped some interesting opportunities for further research: i) To explore opportunity creation and recognition in different innovation ecosystems, validating the framework proposed by Overholm (2015); ii) To employ the conceptual model (self-regulatory process and entrepreneurial action) and the findings proposed by Nambisan and Baron (2013), for investigating how entrepreneurs cope with uncertainties at the firm and at the ecosystem levels; iii) To identify the heuristics employed by ecosystem entrepreneurs in different ecosystems and to compare it with effectuation and causation heuristics (proposed by Sarasvathy, 2001).

4. Conclusions, limitations and further research

The aim of this paper is to systematize the discussion on the concept of ecosystem, its evolution, gaps, opportunities and trends. To this end, we applied a systematic literature review with a hybrid methodology composed of bibliometric analysis and content analysis, covering the period 1993–2016.

The business ecosystem construct, followed by the innovation ecosystem construct, emerged as one of most promising approaches in the literature on innovation, strategic management, and entrepreneurship. Using social network analysis, we showed that the literature remains concentrated on a small number of authors, notably Moore (1993), Iansiti and Levien (2004a), Adner (2006), and Adner and Kapoor (2010). By analyzing the most employed keywords, we showed that innovation has become the most often used keyword. Analyzing the turning point articles, we suggested that an important change occurred in the literature: authors

are using the term innovation ecosystem instead of business ecosystem. That led us to stress the similarities and differences between business and innovation ecosystems, the first more focused on value capture, the second on value co-creation.

Our findings showed that scholars presented different conceptualizations of innovation ecosystem, which may lead to contradictory and competing concepts. In our analysis, we showed the polysemic nature of the concept, used in distinct context with different means and purposes. Some authors employed terms indistinctively, such as business ecosystem, innovation ecosystem, platform-based ecosystem, open innovation ecosystem, and so on. Other authors employed innovation ecosystem synonymously with national innovation system or cluster, without adding much value with this new terminology, as stated by Oh et al. (2016). These different conceptualizations might be perceived as positive, showing that the innovation ecosystem concept gained ground quickly. However, these different uses of the innovation ecosystem word do not contribute to the formalization of a concept. For instance, it is difficult to make comparisons among studies, leading to a very fragmented approach instead of ensuring the consolidation of knowledge. As Li and Garnsey (2014) and Oh et al. (2016) warned, scholars adopted the construct innovation ecosystem according to their convenience and to the purposes of their studies. This makes it more difficult to establish the conceptual body of knowledge and boundaries of the innovation ecosystem construct, similarly to any system approach. The innovation ecosystem terminology fits these criticisms.

To bring some clarification on this issue, we performed a systematic analysis of the different concepts of innovation ecosystems. We proposed a conceptual framework, in which we characterized the innovation ecosystem construct with respect to the following features: an innovation ecosystem is set for the co-creation, or the jointly creation of value. It is composed of interconnected and interdependent networked actors, which includes the focal firm, customers, suppliers, complementary innovators and other agents as regulators. This definition implies that members face cooperation and competition in the innovation ecosystem; and an innovation ecosystem has a lifecycle, which follows a co-evolution process.

Some authors have considered the business ecosystem similar to the innovation ecosystem. We proposed a different understanding: the innovation ecosystem refers to value creation, while the business ecosystem is related to value capture. In initial papers, business ecosystem was related to both value creation and capture. Nevertheless, after the turning point towards innovation ecosystem, emphasis went to value

creation, as in the idea of an entrepreneurial innovation ecosystem that can be considered a subtype of the innovation ecosystem. This approach may open some interesting opportunities for research. First, it avoids considering value creation similar to value capture and vice-versa. Second, it provides room to explore in detail the particular dynamics associated with value creation and value capture. Moreover, there is room to investigate the imbricated joint dynamics of value creation and value capture.

We also highlighted the differences among the constructs of innovation ecosystem, business ecosystem, supply chain and value chain (at the firm and at industry levels). This clarification may offer guidance for research on determining under which circumstance the innovation ecosystem construct is most appropriate, providing a more powerful explanation regarding the investigated phenomenon. In addition, this clarification helps to understand the possibilities that innovation ecosystem construct offers to strategy and innovation research. For instance, the innovation ecosystem construct brings value creation to the center stage and offers a new lens for modeling the collective dimension of value creation. As an example for the literature on innovation, it provides a perspective for investigating the emergence of industry platforms.

We found some gaps and trends in the ecosystem literature. We mapped six research areas, some key research questions, and some of the leading studies (Table 8). As a fundamental gap, there is a need for more theoretical development on the ecosystem, innovation ecosystem and business constructs, making clear aspects such as the boundaries of such constructs (as suggested by Li and Garnsey, 2014). As a trend, we identified that innovation ecosystem constructs have been used in the context of entrepreneurship. Some authors, such as Nambisan and Baron (2013), discussed how entrepreneurs participated in a large innovation ecosystem, led by a well-established firm (a keystone leader).

Another stream, led by Elizabeth Garnsey, employed the innovation ecosystem construct as the context in which entrepreneurs obtain important resources for creating value for customers. In this stream, the authors considered that entrepreneurs might build an innovation ecosystem rather than follow the leadership of a keystone firm. In that sense, innovation ecosystem building is a key research area, including decision heuristics, pivot implications, and the management of collective uncertainty, those that affect more than one actor in the ecosystem.

Finally, an important trend is to employ the innovation ecosystem construct to address radical innovation, new markets, or emerging industries. In these situations, value creation predominates over value capture. Also, in these cases, the relationships among actors are unstable and unclear, co-evolving in unforeseen ways, which may be changing from cooperation to competition.

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