Received: 25 July 2019 | Accepted: 16 April 2020
DOI: 10.1002/kpm.1637

Check for updates

WILEY

RESEARCH ARTICLE

Knowledge sharing and innovation: A systematic review

Delio Ignacio Castaneda[1] | **Sergio Cuellar**[2]

[1]Business Department, Pontificia Universidad Javeriana, Bogotá, Colombia

[2]Research Department, Pontificia Universidad Javeriana, Bogotá, Colombia

Correspondence
Delio Ignacio Castaneda, Business Department Pontificia Universidad Javeriana, Bogotá, Colombia.
Email: delio.castaneda@javeriana.edu.co

The purpose of this article is to investigate the ways in which innovation and knowledge sharing have been studied together in the academic literature. The method employed in this study was a systematic review that covered publications on knowledge sharing and innovation from 1973, when the first article relating the two topics was published, to 2017. The survey was based on 7,991 articles from the Scopus and ISI Web of Science databases using VantagePoint 11.0 software. Four periods were identified in the relationship between innovation and knowledge sharing: embryonic, emergent, growth young, and growth highest. The relationship between knowledge sharing and innovation continues to grow based on the number of papers published on the topic by year. This is the first systematic review of the relationship between knowledge sharing and innovation.

1 | INTRODUCTION

Innovation is among the most important organizational capacities to obtain and maintain competitive advantage. It is highly dependent on the exchange of knowledge among workers. Knowledge contributes to a sustained competitive advantage through its application to the design of new products or services, or to their improvement (Ceylan, 2013).

Innovation is facilitated by modern infrastructure, technology, and economic resources, but mainly through knowledge sharing among workers. According to Cardinal, Allesandri, and Turner (2001) innovation integrates technical, physical, and knowledge-related components into product development. The understanding of the process of innovation can be expressed in three ways: the actors involved, the types of activities contributing to innovation, and the different modes of innovation (Diercks, Larsen, & Steward, 2019).

The purpose of this article was to investigate ways in which innovation and knowledge sharing have been studied together in the academic literature. The authors identified periods of the relationship between the fields, the most relevant topics in each period, and the number of published papers yearly.

2 | THEORETICAL BACKGROUND

2.1 | Knowledge sharing

Serenko and Bontis (2016) claimed that knowledge sharing today is considered one of the most important topics of research in management. Helmstadter (2003) defined knowledge sharing as interactions between human actors where the raw material is knowledge. Knowledge sharing is the exchange of experience, skills, and tacit and explicit knowledge among employees (Hogel, Partboteeah, & Munson, 2003). Knowledge sharing is also the ability to transfer framed experiences, information, and expert insights into practices (Wiewiora, Trigunarsyah, Murphy, & Coffey, 2013). In a broad perspective, knowledge sharing is defined as the means by which organizations have access to their own and other organizations' knowledge (Cummings, 2003). Gibbert and Krause (2002) defined knowledge sharing as the desire of a collaborator in an organization to give others the knowledge that he or she has created or acquired. For Ipe and Wagner (2008), sharing knowledge is the act of making knowledge available to others. In a wider sense, knowledge sharing is the process of transference of experience and organizational knowledge to business processes through communication channels between individuals (Oyemomi, Neaga, & Alkhuraiji, 2016).

This is an open access article under the terms of the Creative Commons Attribution License, which permits use, distribution and reproduction in any medium, provided the original work is properly cited.
© 2020 The Authors. *Knowledge and Process Management* published by John Wiley & Sons Ltd.

Knowledge sharing is critical to both the creation and application of organizational knowledge (Hendriks, 2004; Huysman & De Wit, 2002), which are essential processes in organizational innovation and knowledge management.

2.2 | Innovation

The term innovation has multiple definitions and involves different approaches. For some authors, innovation is a process wherein knowledge is acquired, shared, and assimilated to create new knowledge that embodies products and services (Herkema, 2003), methods and processes (Brewer & Tierney, 2012), and social and environmental contexts (Harrington et al., 2017). Characteristic of innovations is the creation of value. According to Pfotenhauer, Juhl, and Aarden (2019), we cannot ensure economic competitiveness because our societies and institutions are not sufficiently geared toward innovation. Innovation is also becoming an imperative for policymakers around the globe (Pfotenhauer et al., 2019). The objective of innovation is to bring together innovators and regulators so that they can reach a common understanding of how a specific innovation can be introduced (Soete, 2019).

Some inputs to innovation are financial resources, and research and development (Murimbika & Urban, 2014), but also human inputs like ideas, attitudes, leadership, management planning (De Jong & Marsili, 2006), creativity, and self-efficacy (Castaneda, 2015). Innovation is based on human exchange of competence, expertise, information, intuitions, and creative approaches. In summary, innovation is associated with knowledge sharing. However, the more complex the innovation is, the greater the number of barriers that humans have to confront in its application (Torugsa & Arundel, 2016).

There are different taxonomies of innovation. According to the OCDE (2005), there are four types of innovation: product, process, marketing, and organizational. Other classifications of innovation are technological or not (Nelson, 1993), incremental or radical (Henderson & Clark, 1990), disruptive (Christensen & Raynor, 2003), and open innovation (Chesbrough, 2012).

2.3 | Knowledge sharing and innovation

A factor that encourages innovation is knowledge sharing. It is unlikely that innovation occurs in the absence of knowledge sharing (Kremer, Villamor, & Aguinis, 2019). Acquiring knowledge and skills through collaboration have been effective and efficient means of successful innovation (Adams, Day, & Dougherty, 1998). In the context of innovation, knowledge sharing is the exchange of expertise oriented to create or improve products and services of value. Knowledge sharing is an important resource underlying product development capability (Hoopes & Postrel, 1999). Mesmer-Magnus and DeChurch (2009) found based on a meta-analysis that knowledge sharing can predict team performance. The lack of knowledge is the main barrier to innovation (Storey & Kelly, 2002). According to Darroch and McNaughton (2002), an organization that encourages knowledge sharing is likely to produce new ideas and facilitate innovative capabilities. Belso and Diez (2018) found that firms that increase their involvement in knowledge networks tend to increase their innovative capacity.

Some studies have examined the relationship between knowledge sharing and innovation, but none to date has considered historical stages in the development of both concepts, which is the main purpose of this article. The importance of studying innovation and knowledge sharing together has been noted by several authors. Cavusgil, Calantone, and Zhao (2003) found that the greater the amount of tacit knowledge transferred is, the higher is the firm's innovation capability. Tacit knowledge sharing is essential for innovative capability because this is difficult to replicate by others. Knowledge sharing is a mechanism to convert tacit into explicit knowledge, and both types of knowledge are inputs to achieve innovation.

Camelo, García, Sousa, and Valle (2011) found in a survey of Spanish firms that knowledge sharing positively influenced innovation in organizations. This was also noted by Podrug, Filipovic, and Kovac (2017) in Croatian companies, where knowledge sharing increased innovative capability. Taminiau, Smit, and Lange (2009) found that the most fruitful route to innovation is informal knowledge sharing. Mura, Lettieri, Radaelli, and Spiller (2013) explained the way knowledge sharing and innovation are related. For the authors of this article, knowledge sharing-related behaviors positive influence the innovativeness of the sharers of knowledge in terms of propensity and capacity to promote and implement new ideas. Wang and Hu (2018) claimed that knowledge sharing is a mediator between collaborative innovation and organizational performance. It also has a mediatory role between subjective well-being and individual innovation (Wang, Yang, & Xue, 2017). There is also evidence that in clusters, knowledge sharing between firms can promote innovation (Connell, Kriz, & Thorpe, 2014). Kamasak and Bulutlar (2010) found that in-group knowledge sharing influenced exploitative innovation.

3 | METHODOLOGY

The method employed in this study was a systematic review, covering knowledge sharing and innovation publications from 1973, when the first paper relating the two topics was published, to 2017 (inclusive). Following Tranfield, Denyer, and Smart (2003), a review is “a replicable, scientific, and transparent process, in other words, a detailed technology, that aims to minimize bias through exhaustive literature searches of published and unpublished studies and by providing an audit trail of the reviewer's decisions, procedures, and conclusions” (p. 209).

The research protocol addressed the following question: How has literature on the relationship between innovation and knowledge sharing evolved from 1973 to 2017?

The study used two databases to obtain the literature associated with the research question: the Web of Science Core Collection and Scopus. The terms used in the search strings were defined according

to the research question to obtain the most relevant results from the preliminary literature search. The domains explored featured theoretical, empirical, and analytical journal articles.

The search string for the Web of Science was:

TS = [(knowledge near/5 share) OR (knowledge near/5 transfer) OR (knowledge near/5 exchange)) and innovat*)].and that for Scopus was:

TITLE-ABS-KEY [(knowledge W/5 share) OR (knowledge W/5 transfer) OR (knowledge W/5 exchange)) AND innovat*].

VantagePoint version 11.0 was applied to analyze the review outcomes. The screening and selection processes were developed, and the outcomes of the raw database search were concatenated.

To identify the evolution of the relationship between knowledge sharing and innovation, we applied the lifecycle theory (Chanchetti et al., 2016), which claims that areas of knowledge develop according to an S-curve operationalized in four stages: emergent, growing, maturation, and saturation. To identify the development of the relationship in time, we used as performance measure the number of articles, and to generate the S-curve, we used the accumulated number of articles.

Another complementary analysis of lifecycle was implemented using the methodology developed by (Ashton & Klavans, 1997), which uses two performance indicators to define the stages of the evolution of a topic: the number of publications and number of organizations per year. We defined two emergent stages: embryonic, between zero and the first confidence interval at 95%, and the emergent stage between the first confidence interval and the median. We defined two growing stages: growth young, between the median and the confidence interval at 95% over the median; and growth highest, beyond the superior confidence interval (Figure 3). Owing to the state-of-the-art in research on the relationship between knowledge sharing and innovation, the maturation and saturation stages do not apply.

To identify seminal articles or those that can be considered foundational in the generation of the literature on knowledge sharing and innovation, two bibliometric indicators based on social network analysis were used: indegree centrality, which indicates the number of times that a document was referenced by other documents in the analyzed network; and node-betweeness centrality, which indicates the capacity of nodes to connect different clusters and research areas (Saavedra, Iritani, Pavan, & Ometto, 2018).

For each stage of development, embryonic, emergent, growth young, and growth highest, we identified the main thematic axis presenting the word co-occurrence network that creates a weighted network where each node is an abstract keyword, author keyword, or title keyword (abstract and title keyword were identified using the Vantage Point natural language processing tool). Edges connect words to each other, where the strength of an edge represents how often two words occur together in the same body of text. Moreover, a topic analysis was carried out using the LDA (latent Dirichlet allocation), a clusterization methodology that classifies keywords and phrases in different topics to compare the clusters found in a visualization of the words using the obtained results. It was used to identify the main topics developed in the relationship between knowledge sharing and innovation, and parallel topics. The main themes of each group were identified by frequency of keywords in the texts.

In each stage, the most important articles were recognized using the methodology followed by Betancur, Villa-Espinal, Osorio-Gómez, Cuéllar, and Suárez (2018). In this methodology, to normalize and avoid discrimination by the age of the articles were identified in each year the total forward citations and compared them with those of the articles analyzed for the total number of citations in the year of publication.

The H index, a bibliometric indicator that allows us to recognize the most relevant terms relating productivity and impact, was used as well. Core terms were identified recognizing in the web key words, terms with higher degree of centrality and betweenness. Emergent topics were those that had recently appeared for the first time in titles, abstracts, and keywords. Declining topics were also identified, as those that had not featured as much in the literature as in previous years.

Bibliometric analysis and subsequent analyses, such as coverage comprehensiveness and publication activity, were performed by combining VantagePoint with Vosviewer, Sci2, Knime, and Tableau.

4 | RESULTS

Two types of reports are initially presented in this section. The first pertains to the history of publication of articles on knowledge sharing and innovation from 1973 to 2017 (Figure 1), and the second was related to seminal articles on the relationship between the two (Table 1).

The literature on knowledge sharing and innovation has been growing, especially after 2000.

To enrich the review, we identified papers considered seminal with regard to the relationship between innovation and knowledge sharing. These articles were identified using frequently cited references in our main database of articles.

Another strategy we used was to construct a network of published articles on the relationship between knowledge sharing and innovation and the ones that had been cited. Using this network, the main cluster of references and articles with high indoor centrality (the most cited papers), and articles with high betweenness centrality (articles that acted as bridge between nodes in the network) were identified. They had more relationships with other publications or clusters than any other (Figure 2).

The size of a node represents the betweenness centrality and that of the label the indoor centrality; the number of links indicates the number of citations that a given article received from the most important articles. Table 2 presents the most representative articles from those in Figure 2.

The article by Cohen and Levinthal (1990) defines absorptive capacity as the ability to recognize the value of new information, and assimilate and apply it. The organization needs prior knowledge to assimilate and use new knowledge. Nonaka (1994) proposed a paradigm for managing the dynamic aspects of organizational knowledge-

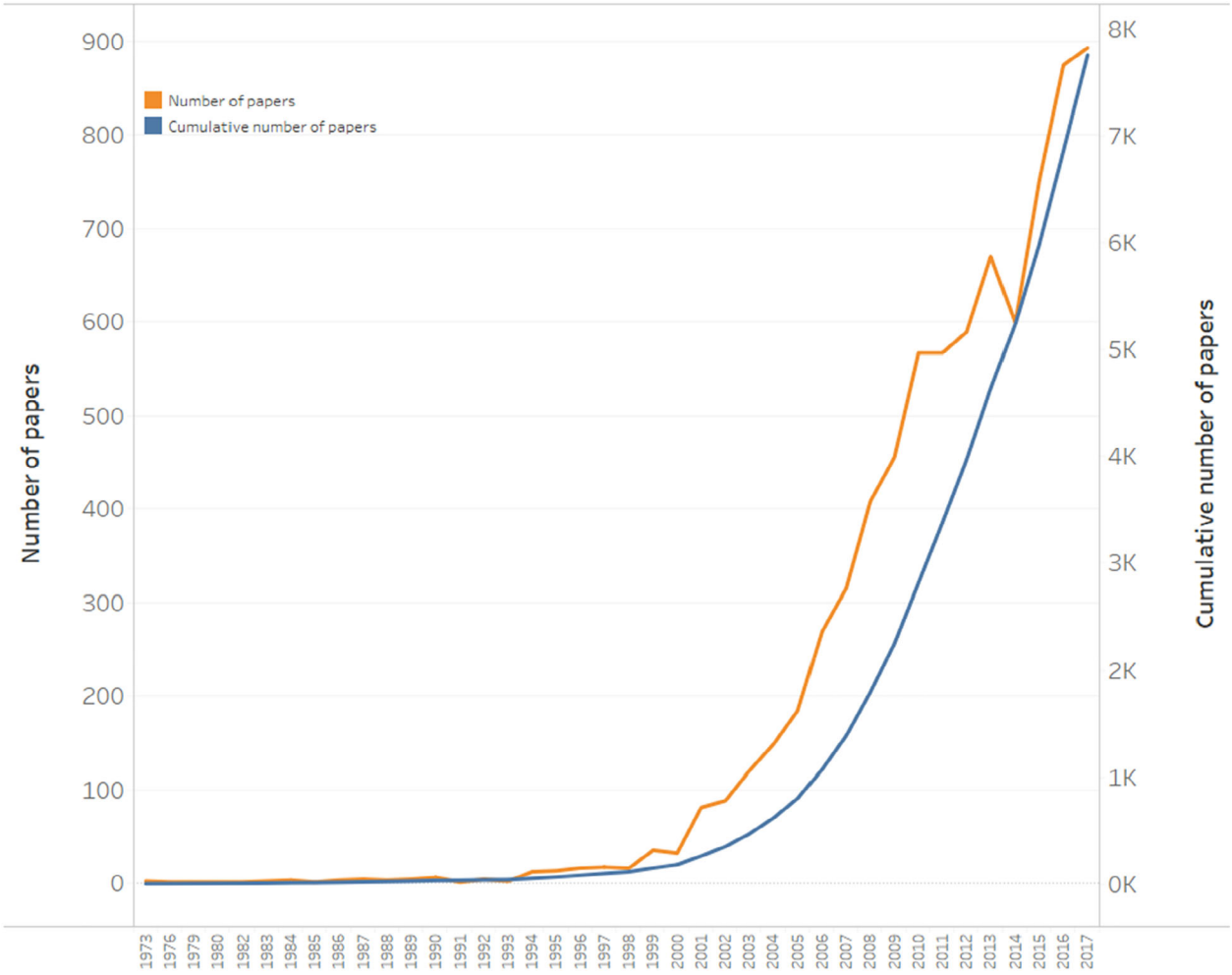

FIGURE 1 History of publication of articles on knowledge sharing and innovation [Colour figure can be viewed at wileyonlinelibrary.com]

creating processes. According to Nonaka (1994), knowledge is created through dialogue between possessors of explicit and tacit knowledge. Grant (1996) conceptualized an organization as an institution for integrating knowledge. He explored coordination mechanisms through, which firms integrate the specialist knowledge of their members. Kogut and Zander (1992) argued that what firms do better than markets is the sharing and transfer of the knowledge of individuals and groups within an organization. Szulanski (1996) claimed that the ability to internally transfer best practices is critical to a firm's ability to build competitive advantage through the appropriation of scarce internal knowledge. Granovetter (1973) argued that the degree of overlap between the friendship networks of individuals varies directly with the strength of their ties to each other. Eisenhardt (1989) described the process of inducting theory using case studies by specifying research questions to reach closure. March (1991) considered the relationship between the exploration of new possibilities and the exploitation of old certainties in organizational learning. Argote (2000) built in a framework of knowledge reservoirs to show why knowledge transfer can be challenging. Sammarra and Biggiero (2008) explored how different types of knowledge is exchanged and combined by collaborating firms to foster innovation. Howells (1996) analyzed the need to view tacit knowledge in a dynamic way and claimed that it can be acquired and transferred to the individual, group, organizational, and inter-firm levels. Howell (2002) explored the relationship between knowledge and geography. Pittaway, Robertson, Munir, Denyer, and Neely (2005) proposed a systematic review of research linking the networking behavior of firms with their innovative capacity.

Table 3 presents the stages, periods, and number of papers in each stage. We found that the relationship between innovation and knowledge sharing is currently in the stage of growth highest, and thus the maturation and saturation stages are not part of this study.

For each period, we evaluated the co-evolution of the two topics using techniques of unsupervised analysis that were performed using VOSviewer software (Van Eck & Waltman, 2011). In addition, we classified clusters that had been obtained with supervised learning techniques.

Academic exploration of the relationship between knowledge sharing and innovation began in 1973, when the first paper on the subject was published (Figure 3). We defined this year as the beginning of the embryonic stage, which is shown in the left quadrant of the *x*- and *y*-axes. At this stage, few papers and organizations had generated this research. Similar to the embryonic stage, but with more

papers and organizations involved, was the emergent stage shown in the left quadrant as well. In the right quadrant are shown the growth phases separated into two for the number of papers and organizations that had conducted academic research on the issue. In 2017, the number of papers on the relation between knowledge sharing and innovation was growing, which is why we claim it is the growth highest stage.

In the first period, the embryonic stage (12 papers), the main research topics were knowledge transfer and the role of knowledge managers in its transfer from multinationals to undeveloped countries. Some keywords occurring with high frequency were "cooperation" and "connection." The main topic of innovation at this stage was technological innovation (Figure 4). In the embryonic stage, some articles argued for the importance of technology and telecommunications for facilitating knowledge sharing and innovation (Garner, 1985; Rupp, 1976); one paper studied problems in knowledge transfer for

TABLE 1 Seminal articles on the relationship between knowledge sharing and innovation

Main author and publication year	Citations
Cohen, W. and Levinthal, D. (1990)	36,930
Nonaka, I. Takeuchi, H. (1995).	2,892
Szulanski, G. (1996)	9,942
Kogut, B. and Zander, U. (1992)	15,115
Grant, R. (1996)	17,115
Nonaka, I. (1994)	58,523
Tsai, W. (2001)	4,713
Hansen, M. (1999)	7,108
Zahra, S. and George, G. (2002)	9,222
Nahapiet, J. and Ghostal, S. (1998)	17,776
Powell, W., Koput, K. and Smith-Doerr (1996)	9,935
Nelson, R. and winter, S. (1982)	38,510
March, J. (1991)	20,938
Barney, J. (1991)	60,724
Lane, P. and Lubatkin, M. (1998)	5,675
Fornell, C. and Larcker, D. (1981)	48,881
Teece, D., Pisano, G and Schuen, A. (1997)	32,287
Granovetter, M. (1973)	49,212
Eisenhardt, K. (1989)	47,688
Dyer, J. and Singh, H. (1998)	13,281

TABLE 2 Most representative papers for the citation network and indicators of social network analysis from Figure 2

Authors and year of publication	ID
(Cohen & Levinthal, 1990)	A
(Nonaka, 1994)	B
(Grant, 1996)	C
(Kogut & Zander, 1992)	D
(Szulanski, 1996).	E
(Granovetter, 1973)	F
(Eisenhardt, 1989)	G
(March, 1991)	H
(Argote, 2000)	I
(Sammarra & Biggiero, 2008)	J
(Howells, 1996)	K
(Howell, 2002)	L
(Biggiero, 2007)	M
(Pittaway, Robertson, Munir, Denyer & Neely 2005)	N

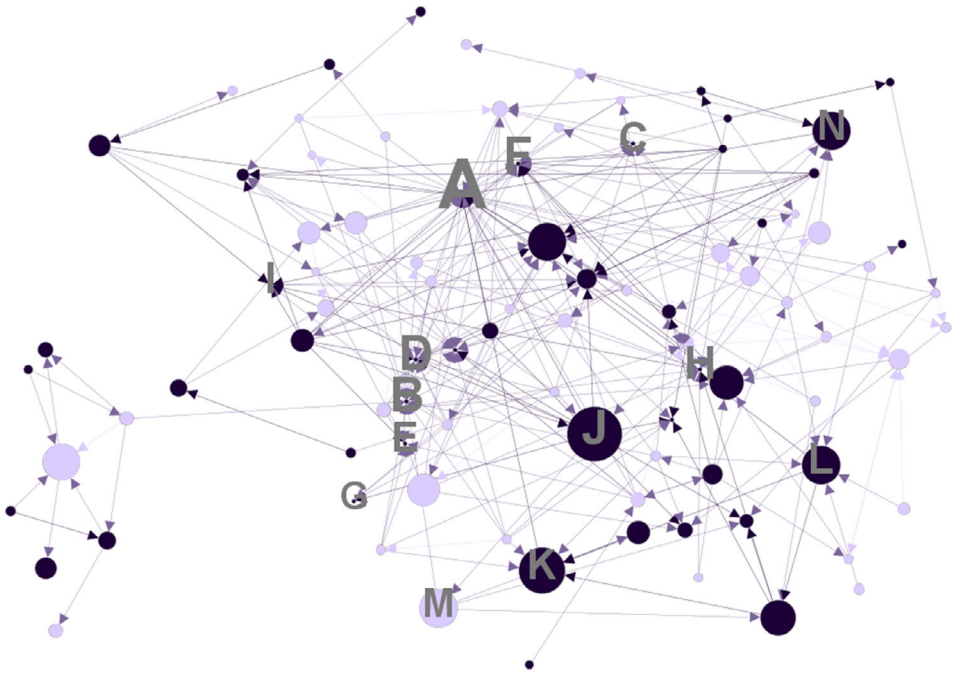

FIGURE 2 Main clusters of foundational papers [Colour figure can be viewed at wileyonlinelibrary.com]

innovation (Glaser, 1973); another considered innovation as a self-organizing process (Sahal, 1983). Some other articles dealt with applications of knowledge transfer to innovation in different fields, for example finance (Sorg, 1984), forestry (Bosman, 1982), business cycles (Low, 1984), and applied research (Glaser, 1973). One article considered the transference of innovation between organizations (Gaitskell, 1979) (Table 4).

Figure 4 presents the analysis of keywords in the embryonic stage.

The second period, the emergent stage (52 papers), started in 1986 and finished in 1995. The main research topics here were the role of universities in knowledge transfer for the generation of technological innovation and patent licenses, the importance of knowledge exchange between government and academy, and the relevance of networks in innovation dissemination. Figure 5 presents the keywords analysis in the emergent stage. In this stage, several articles considered the relationship between innovation and knowledge sharing in a variety of sectors, such as health (Crosswaite & Curtice, 1994; Indyk & Belville, 1995; Shank & Carson, 1994; Shea & Basch, 1990), agriculture (Feil, Lamers, & Hermann, 1995), chemical industry (Travis, 1990), education (Foster, Bollini, & Alkin, 1989), transit services (Wright & DeVore, 1986), and the government and public sectors (Obermeyer, 1990; Smith, Townsend, Whitaker, & Hester, 1989). Some articles dealt with the role of technology in relationship innovation and knowledge sharing (Angel, 1991; Garud & Nayyar, 1994; Gatchett, Fradkin, & Moore, 1992; Holden, 1992; Louis, 1993; Murray, Dixon, & Thomson, 1994; Pinelli, Barclay, Bishop, & Kennedy, 1992; Stankiewicz, 1994; Stewart, 1987; Trott, Cordey-Hayes, & Seaton, 1995). A few articles focused on patents (Arora, 1995; Hansen, 1995). One category was knowledge sharing and innovation in geographical territories (Batten, 1995; Hassink, Dankbaar, & Corvers, 1995), and another considered the relationship between firms and universities (Groenewegen, 1992; Pollock, 1987). Finally, some publications focused on processes, difficulties, and effectiveness in the knowledge sharing and innovation (Ball, 1995; Conroy & Turnquist, 1989; Kuehnel, May, & Liberman, 1986; Martinez-Brawley, 1995; Newell & Swan, 1995; Rai, 1995) (Table 5).

The third period, the growth young stage (990 papers), began in 1996 and finished in 2006. The main topics of innovation in this stage were innovation systems, product development, innovation policies, innovation management, and innovation diffusion. In relation to knowledge sharing, the most important topics were a community of practice, social networks, E-learning, knowledge management systems, and knowledge creation. Figure 6 presents the keyword analysis of the growth young stage.

Given the large number of papers, a cluster analysis was run in the third stage and the following categories were identified: absorption capacity for development of new products, knowledge networks, knowledge-based tools for innovation, knowledge flow technologies, knowledge sharing and development of products, knowledge transfer

TABLE 3 Lifecycle stages

Stage	Period	Number of papers
Embryonic	(1973–1985)	12
Emergent	(1986–1995)	52
Growth (young)	(1996–2006)	990
Growth (highest)	(2007–2017)	6,937

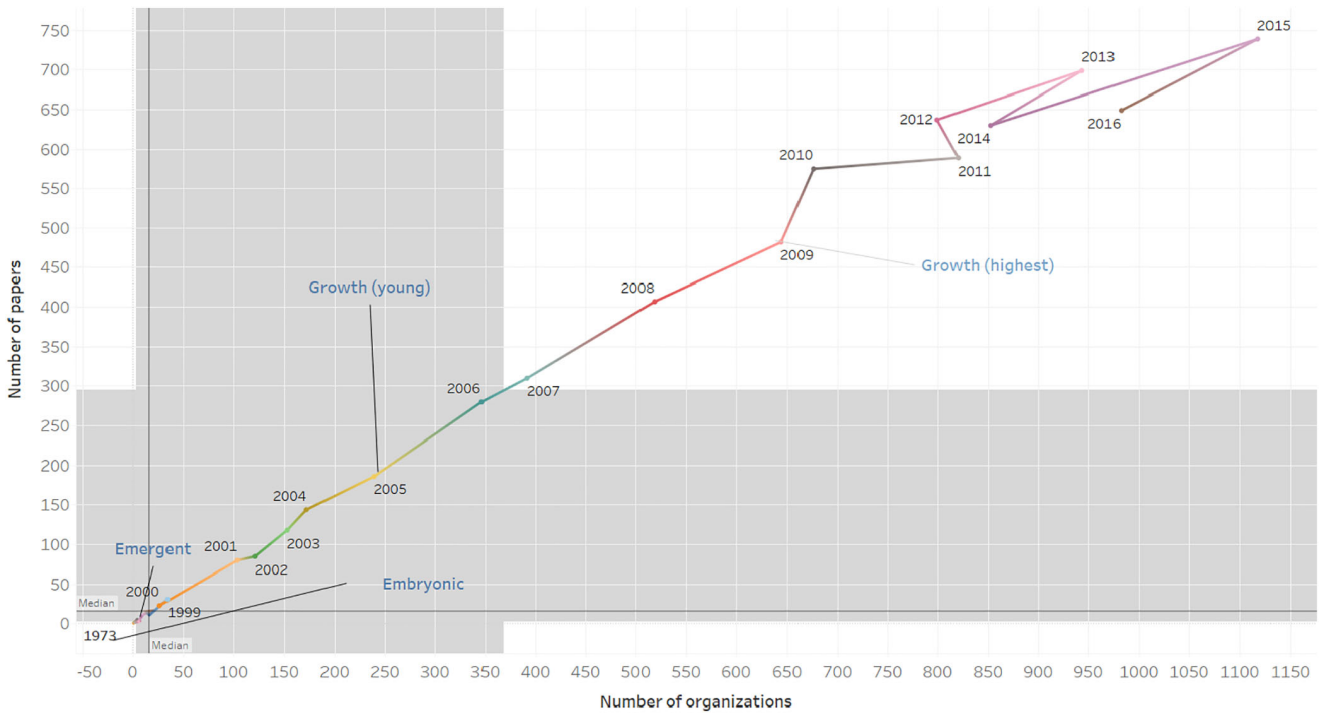

FIGURE 3 Lifecycle analysis using the number of papers and organizations [Colour figure can be viewed at wileyonlinelibrary.com]

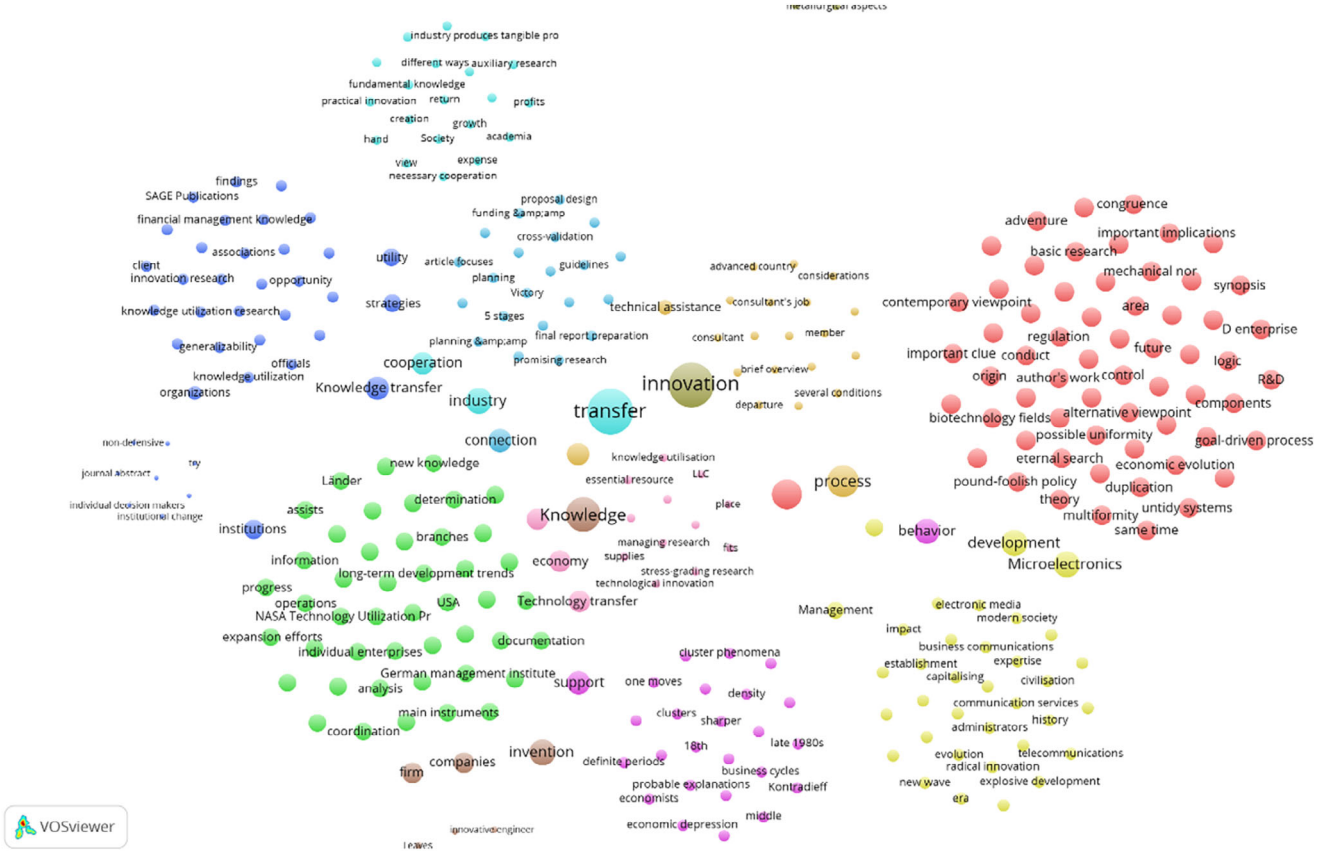

FIGURE 4 Keywords analysis in embryonic stage (1973–1985) [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 4 Major papers in the embryonic stage

Authors	Journal	Publication title	Citations in the year	Forward citations	Normalized citations	Publication year
Sahal D.	Technological forecasting and social change	Invention, innovation, and economic evolution	16	16	1	1983
Glaser E.	Professional psychology: Research and practice	Knowledge transfer and institutional change	25	25	1	1973

between universities and firms, innovation systems among countries, and human variables like trust, culture, and research and development for technological innovation. Table 6 presents the most important papers by forward citation in this stage. We also present the most cited papers in the stage. Paulus and Yang (2000) claimed that there are conditions under which idea sharing in groups can be productive, for example, attention and incubation. Spender and Grant (1996) proposed a strategy to approach the implications of knowledge for the firm. Meyer-Krahmer and Schmoch (1998) claimed that in scientific fields, university departments focus on basic research, and the industry is interested in scientific observations. In less science-based fields, the solution to technical problems is a major concern of the industry. Hargadon and Sutton (1997) blended the perspectives of network and organizational memory in a model of technological brokering that explains how an organization develops innovative products. Hansen (1999) explained the role of weak ties in sharing knowledge across an organization's subunits in a multiunit organization.

The fourth and current period (7,052 articles), the growth highest stage, began in 2007. In this period, literature on knowledge management focused on its absorptive capacity, the process of knowledge acquisition, the international transfer of tacit knowledge, and technology transfer in innovation management. The role of communities of practice in the innovation process has continued to be explored in this period. Information technologies have witnessed a large number of publications in relation to Web 2.0 and social media for learning processes. The importance of open innovation in knowledge sharing has been studied in product development, new types of business models, and processes of knowledge exchange. This phenomenon has been identified in SMEs. Another important topic is the role of universities in open innovation processes and the importance of patents in this field. Figure 7 presents the keyword analysis of the growth highest stage.

A cluster analysis was run in the fourth stage, and the following categories were identified: absorption capacity, technological transference, innovation systems and channels of exchange, network alliances,

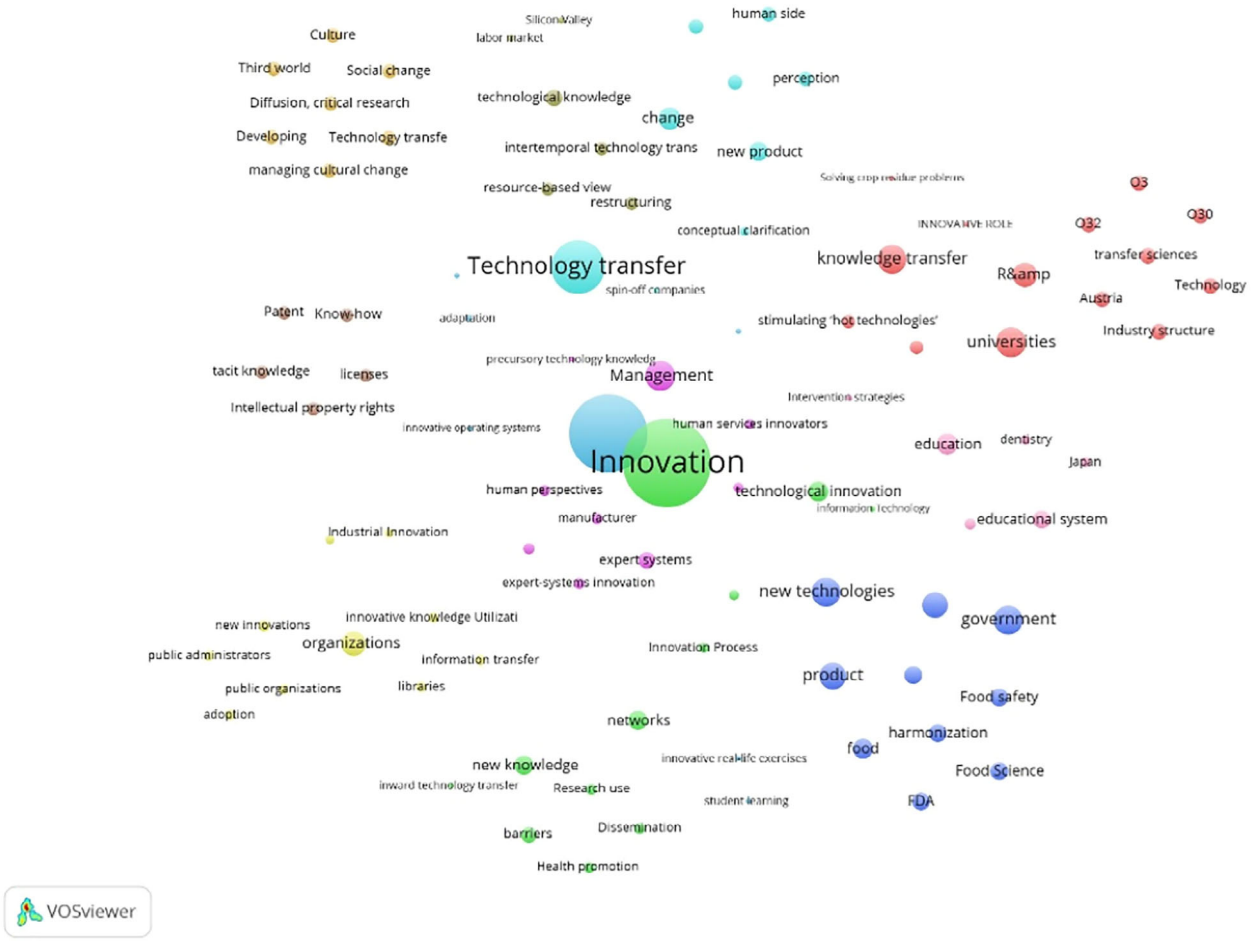

FIGURE 5 Keywords analysis in the emergent stage (1986–1995) [Colour figure can be viewed at wileyonlinelibrary.com]

organizational learning, organizational conditions for knowledge sharing, and innovation in services. Table 7 presents the most cited papers by forward citation in this stage. Coccoli, Maresca, and Stanganelli (Coccoli, Maresca, & Stanganelli, 2017) investigated how the rise of big data and cognitive computing systems is going to redesign the labor market and impact learning processes. Grimshaw, Eccles, Hill, Lavis, and Squires (2012) summarized current concepts and evidence to guide knowledge translation activities. Farinha, Ferreira, and Gouveia (2016) studied the knowledge-related and technology transfer processes taking place in cooperation between academia and industry. Sampson (2007) found that alliances contribute far more to the innovation of firms when technological diversity is moderate, rather than low or high. The topics of innovation in this stage were open innovation, creativity, innovation systems, and technological innovation.

The H index is a method to recognize key actors. It has been used by governments and in international rankings to evaluate the relationship between productivity and the impact of a particular actor. In this article, Figure 8, we used the H index to identify the relevant topics in knowledge sharing, innovation, and related areas that were analyzed. In the category of knowledge sharing, the consolidated topics were knowledge transfer, knowledge management, knowledge sharing, technology transfer, tacit knowledge, and knowledge exchange. In the category of innovation, the most relevant topics found using the H index were entrepreneurship, innovation systems, technological innovation, and development of products and creativity. In the associated topics' category, the most relevant thematic was collaboration as well as the network, community of practice, organizational learning, and intellectual capital.

Another methodology to complement the previous analysis is a portfolio that was divided into four quadrants. These were as follows:

Established Keywords

These were keywords based on indicators of social network analysis that were relevant because they were repeated together with other words or were intermediaries between the relevant topics.

4.1 | Core keywords

They were consolidated words in the field with a high H index.

4.2 | Emergent

They were keywords that had appeared recently and allow us to detect weak signals, in this case from 2015 to 2017.

TABLE 5 Key papers in the emergent stage

Authors	Journal	Publication title	Citations in the year	Forward citations	Normalized citations	Publication year
Basch C.; Shea S.	American journal of health promotion	A review of five major community-based cardiovascular disease prevention programs. Part II: Intervention strategies, evaluation methods, and results	95	82	0,86,315,789	1990
Holden P.	Knowledge-based systems	Expert systems in manufacturing. Part 1: A users' perspective on expert-systems innovation	7	6	0,85,714,285	1992
Angel D.	Environment & Planning A	High-technology agglomeration and the labor market: The case of Silicon Valley	70	70	1	1991
Orlandi M.	Preventive medicine	Promoting health and preventing disease in health care settings: An analysis of barriers	112	94	0,83,928,571	1987
Gruber T.; Kuokka D.; Mcguire J.; Olsen G.; Tenenbaum J.; weber J.	Concurrent engineering	SHADE: Technology for knowledge-based collaborative engineering	92	87	0,94,565,217	1993

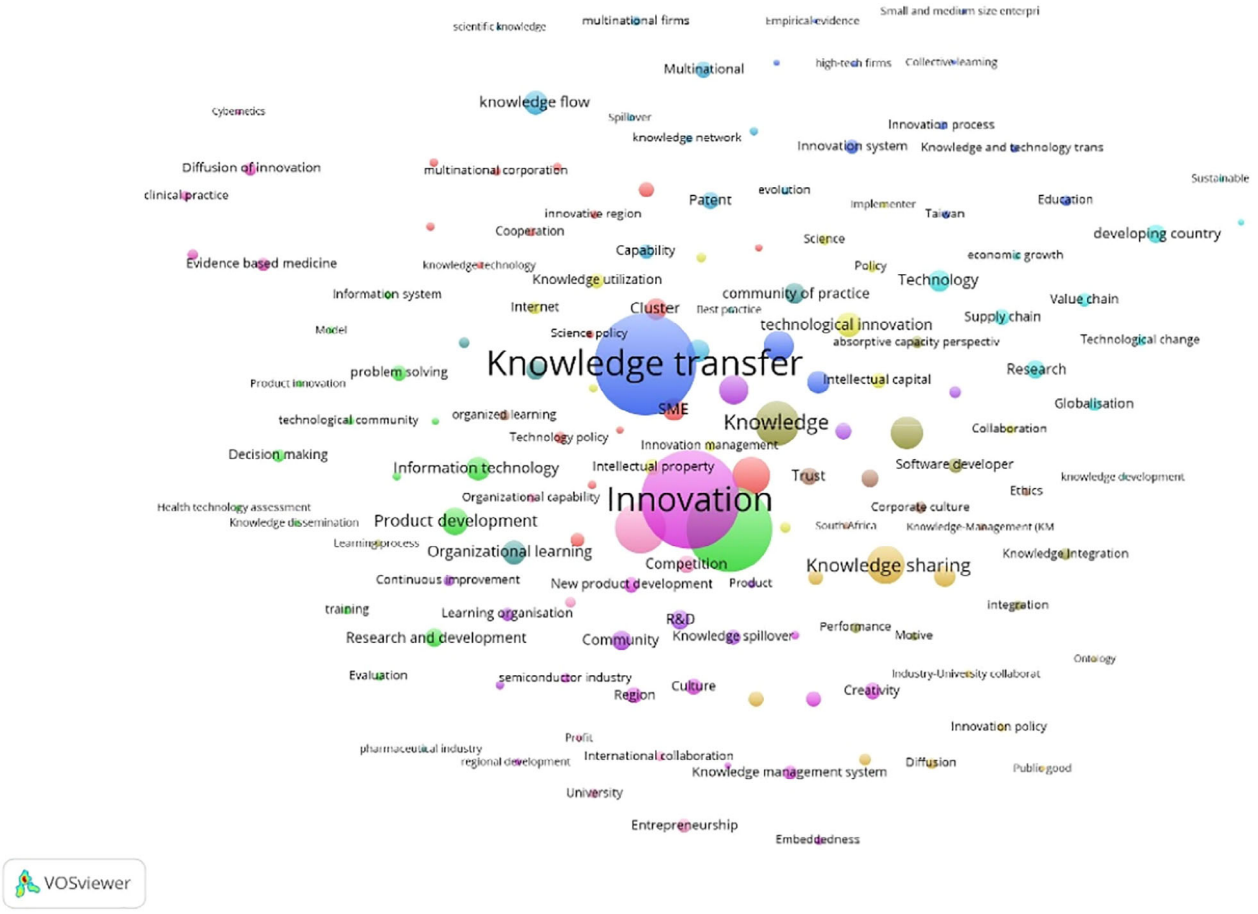

FIGURE 6 Keyword analysis in the growth young stage (1996–2006) [Colour figure can be viewed at wileyonlinelibrary.com]

TABLE 6 Key papers in the growth young stage

Authors	Journal	Publication title	Citations in the year	Forward citations	Normalized citations	Publication year
Paulus P.; Yang H.	Organizational behavior and human decision processes	Idea generation in groups: A basis for creativity in organizations	885	340	0,3,841,807	2000
Grant R.; Spender J.	Strategic management journal	Knowledge and the firm: Overview	1,290	551	0,4,271,317	1996
Meyer-Krahmer F.; Schmoch U.	Research policy	Science-based technologies: University–industry interactions in four fields	554	383	0,6,913,357	1998
Hargadon A.; Sutton R.	Administrative science quarterly	Technology brokering and innovation in a product development firm	2,334	1,109	0,4,751,499	1997
Hansen M.	Administrative science quarterly	The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits	5,568	2,590	0,4,651,580	1999

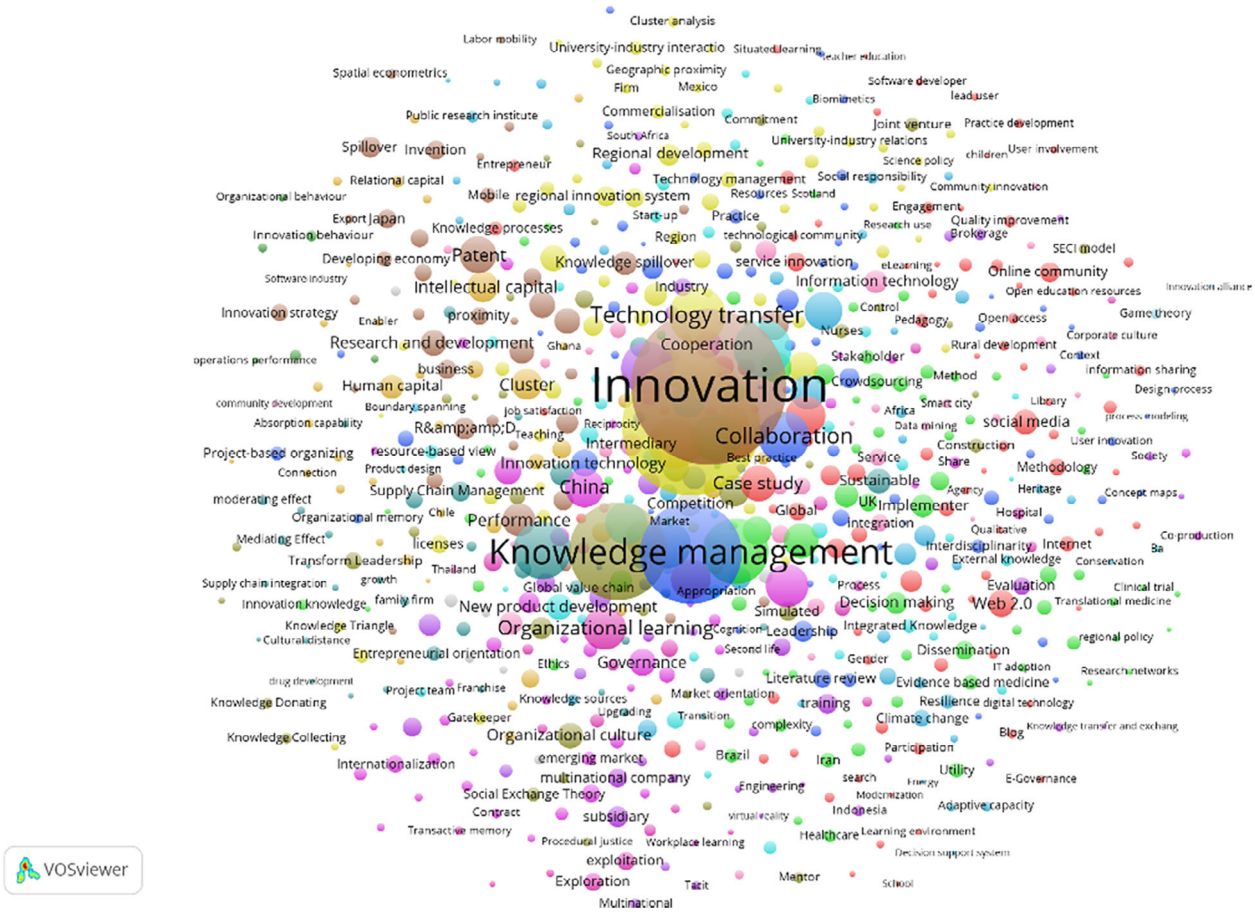

FIGURE 7 Keyword analysis in the growth highest stage (2007–2017) [Colour figure can be viewed at wileyonlinelibrary.com]

4.3 | Declining keywords

These were words that had disappeared in the last few years, 2010–2017.

The analysis is shown in three colors, Figure 9. Topics related to innovation are in green, those on knowledge sharing in red, and the other topics are in black. The core keywords were the most important words according to the H index. They were "innovation," "open innovation," "knowledge transfer," "knowledge management," "knowledge sharing and network," "social capital," and organizational learning in the related topics. Indicators of social network analysis showed once again the importance of open innovation as the main outcome of the process of knowledge sharing for innovation. Technology transfer had been studied as a deliverer of innovations in a large number of papers. Absorptive capacity and social capital were the main related topics.

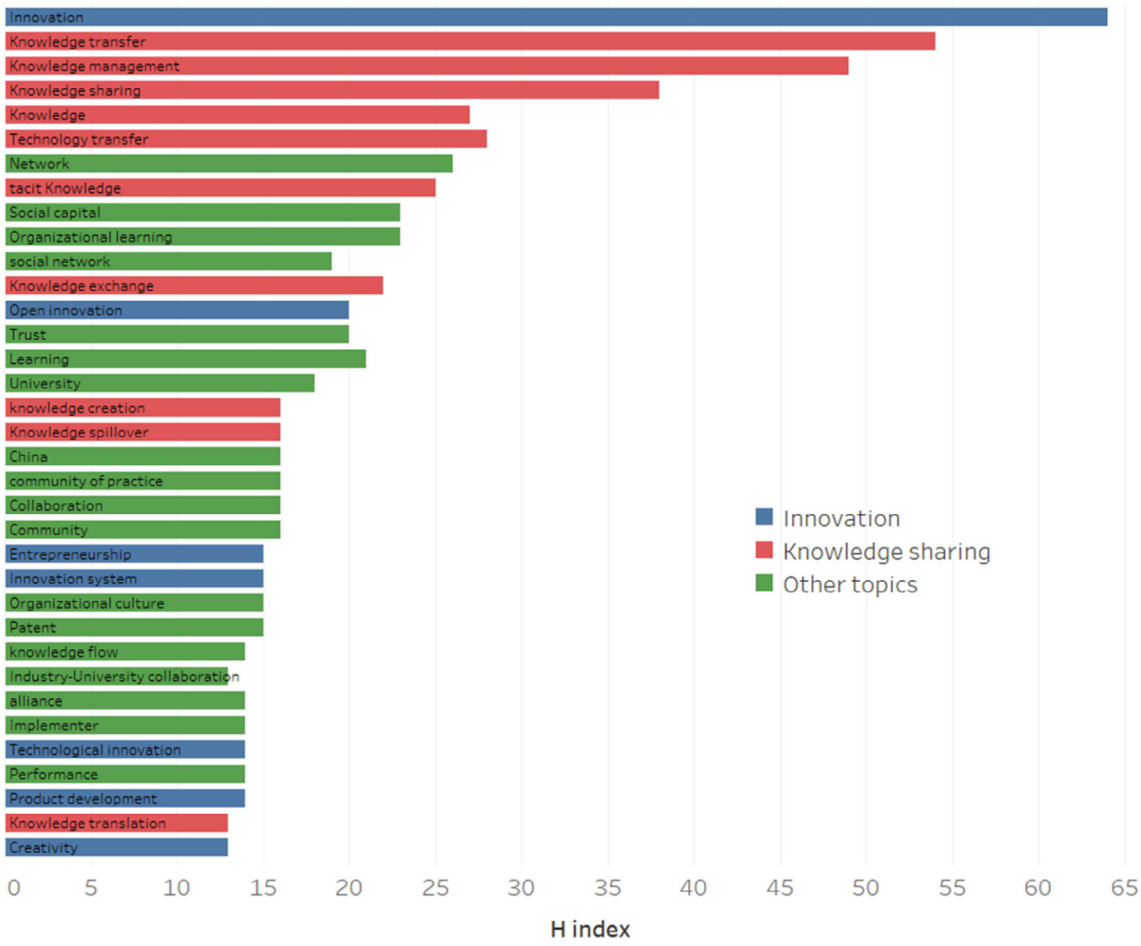

FIGURE 8 Key topics according to the H index [Colour figure can be viewed at wileyonlinelibrary.com]

EMERGING	CORE
Entrepreneurial Learning Innovative Supplier Knowledge coproduction Knowledge hiding Industry 4.0 Supplier Innovation	Innovation Open Innovation Knowledge Transfer Knowledge Sharing Knowledge Management Network Social Capital Organizational learning
Industrial Innovation Knowledge Chain Knowledge Capture Technological Community Network of Practice	Innovation Open Innovation Knowledge Transfer Knowledge Sharing Technology Transfer Absorptive capacity Network
DECLINING	ESTABLISHED

FIGURE 9 The major, newly established, and declining topics in knowledge sharing and innovation [Colour figure can be viewed at wileyonlinelibrary.com]

Emerging topics are low signals that are emerging in the field. Our analysis showed that entrepreneurial learning and innovative suppliers were new topics related to innovation. In relation to knowledge sharing, the emerging topics were knowledge co-production and knowledge hiding. The related new topics were Industry 4.0 and contingency theory.

Declining keywords were topics that had not been popular in the field in the last few years and were disappearing. In innovation, the most important topic in this category was industrial innovation. Knowledge chain and knowledge capture were topics that had been disappearing in knowledge sharing. In the category of related topics, technological community and the network of practice had disappeared in the last few years.

In this article, we used different techniques to analyze the historical relationship between knowledge sharing and innovation. The period considered was 1973 to 2017. The study was based on 7,991 articles from the Scopus and ISI Web of Science databases using VantagePoint 11.0 software. We found four periods of the relationships, which we called embryonic, emergent, growth young, and growth highest. At present, the relationship between knowledge sharing and innovation is in the growth highest period.

TABLE 7 Key papers in the growth highest stage

Authors	Journal	Publication title	Normalized forward citations	Citations in the year	Forward citations	Publication year
Coccoli M.; Maresca P.; Stanganelli L.	Journal of visual languages and computing	The role of big data and cognitive computing in the learning process	0,11,764,705	17	2	2017
Grimshaw, J.; Eccles, M.; Hill, S.; Lavis, J.; Squires, J.	Implementation science	Knowledge translation of research findings	0,05052356	3,820	193	2012
Farinha L.; Ferreira J.; Gouveia B.	Journal of the knowledge economy	Networks of innovation and competitiveness: A triple helix case study	0,05	200	10	2016
Sampson, R.	Academy of management journal	R & D alliances and firm performance: The impact of technological diversity and alliance organization on innovation	0,039142857	7,000	274	2007

5 | DISCUSSION

A success factor that leads to innovation is knowledge sharing. Innovation can take place only in the presence of knowledge sharing (Kremer et al., 2019). The purpose of this article was to investigate ways in which innovation and knowledge sharing have been studied together in the academic literature.

Using our research methodology, we found 7,991 papers from 1973 to 2017 that relate innovation and knowledge sharing. The current state of the relationship between the topics is growth highest, which means that the number of articles published on the topic is still growing.

We identified 20 seminal papers in the field, the most representative of which was the article by Nonaka (1994) called "A dynamic theory of organizational knowledge creation." We also provided a short description of the most representative papers according to a bibliometric citation network and indicators of social network analysis.

In addition, we found major research topics in the relationship between knowledge sharing and innovation in four stages: embryonic, emergent, growth young, and growth highest. In the embryonic stage (1973–1985) keywords with the highest frequency were "cooperation" and "connection." This is consistent with work by Belso and Diez (2018), who found that firms that increase their involvement in knowledge networks tend to increase their innovative capacity. In the emergent stage (1986–1995), representative was the application of knowledge sharing and innovation to different sectors, for example, health (Indyk & Belville, 1995) and education (Foster et al., 1989). In the growth young period (1996–2006), because of the large number of papers, a cluster analysis was performed to yield such categories as the absorptive capacity for new development products and knowledge networks. The cluster analysis in the growth highest period (2007–2017) yielded the following categories: absorptive capacity, the process of knowledge acquisition, and technology transfer in innovation management.

Using the H index, the most consolidated topics found in knowledge sharing were knowledge transfer, knowledge management, and technology transfer. In the case of innovation, they were innovation systems, technological innovation, and the development of products and creativity.

Finally, a complementary methodology was used to identify the established, core, emergent, and declining keywords. The established topics were open innovation, knowledge sharing, and absorptive capacity. The core topics were open innovation, knowledge sharing, and knowledge management. The emerging topics were entrepreneurial learning, innovative supplier, knowledge coproduction, and knowledge hiding. The main declining topics were industrial innovation and the knowledge chain.

A common topic in the analysis of the growth young and growth highest stages, as well as among the most established topics, was absorptive capacity. Cohen and Levinthal (1990) defined the term as the ability to recognize the value of new information, assimilate it, and apply it to commercial ends. According to them, absorptive capacity is critical to innovative capability. At the same time, the fundamental tool to assimilate and apply knowledge is knowledge sharing. In conclusion, absorptive capacity is a connector between knowledge sharing and innovation.

A major emerging topic in the relationship between knowledge sharing and innovation is knowledge hiding, understood as an intentional attempt by an individual to withhold or conceal knowledge that has been requested by another person (Connelly, Zweig, Webster, and Trougakos (2012). This is not the opposite of knowledge sharing. According to Connelly et al. (2012), knowledge sharing is an outcome of prosocial intentions and knowledge sharing a result of self-focused intentions. It is likely that the number of studies on knowledge hiding will increase in the next few years.

6 | CONCLUSIONS

Innovation is dependent of knowledge sharing. This behavior contributes to the design of services, products, business models, processes,

and new organizational schemes. Knowledge sharing is the transference of experience, skills and information into practices, like it is the case of innovation. A characteristic of innovation is the creation of value, process that is possible by knowledge sharing. An organization that encourages knowledge sharing facilitates innovation capabilities.

From results is possible to state that the literature on knowledge sharing and innovation started in 1973 has been growing after 2000 and continue growing. The lifecycle stages showed that in 2017 the publication of articles on the relationship knowledge sharing and innovation is higher than in previous years. From the lifecycle stages, it is also concluded that the study of knowledge sharing and innovation moved from a technological approach to knowledge networks in the growth young stage and to the process of acquisition in the growth highest stage.

From the seminal articles, it is concluded that dialogue is the main instrument to convert knowledge into innovation. Also that knowledge is exchanged to foster innovation.

Based on the H index method used in this study, it is possible to conclude that the most relevant thematic in the relationship knowledge sharing and innovation is collaboration. This process explains the collective construction of knowledge and the generation of products and services.

From the key topics analysis, it is concluded that the most established topics are open innovation, knowledge transfer, and absorptive capacity. This last concept facilitates that organizations identify and interiorize external knowledge that contributes to the achievement of institutional goals. The emerging words are entrepreneurial learning, innovative supplier, knowledge coproduction, knowledge hiding, and industry 4.0. These topics will be the focus of research in the next years. In particular, knowledge sharing can be related to technologies like internet of things and artificial intelligence as a source of innovation.

6.1 | Limitations

Our study had certain limitations. We did not use grey literature such as Google Scholar and Microsoft Academic because we preferred the most stringent databases in relation to the quality of articles: Scopus and the Web of Science. Although we tried to conduct the analysis with the most robust and precise query strategies, there is always the possibility of have overlooked keywords that could have been relevant to the study.

For the analysis of the growth young and growth highest stages, we used data mining techniques owing the large volume of data analyzed. This might have affected the accuracy of interpretation of the information.

ORCID

Delio Ignacio Castaneda https://orcid.org/0000-0001-8916-763X

REFERENCES

Adams, M., Day, G., & Dougherty, D. (1998). Enhancing new product development performance: An organizational learning perspective. *The Journal of Product Innovation Management*, *15*(5), 403–422.

Angel, D. (1991). High technology agglomeration and the labor market: The case of Silicon Valley. *Environment and Planning A*, *23*(10), 1501–1516.

Argote, L (2000). *The Psychological Foundations of Knowledge Transfer in Organizations*, San Diego, CA: Academic Press.

Arora, A. (1995). Licensing tacit knowledge: Intellectual property rights and the market for know-how. *Economics of Innovation and New Technology*, *4*(1), 41–60.

Ashton, W. B., & Klavans, R. A. (1997). *Keeping abreast of science and technology: Technical intelligence for business*, Columbus, OH: Battelle Press.

Ball, S. (1995). Enriching student learning through innovative real-life exercises. *Education + Training*, *37*(4), 18–25.

Batten, D. (1995). Network cities: Creative urban agglomerations for the 21th century. *Urban Studies*, *32*(2), 313–327.

Belso, J., & Diez, I. (2018). Firm´s strategic choices and network knowledge dynamics: How do they affect innovation?*Journal of Knowledge Management*, *22*(1), 1–20.

Betancur, J. A., Villa-Espinal, J., Osorio-Gómez, G., Cuéllar, S., & Suárez, D. (2018). Research topics and implementation trends on automotive head-up display systems. *International Journal on Interactive Design and Manufacturing (IJIDeM)*, *12*(1), 199–214. https://doi.org/10.1007/s12008-016-0350-3

Bosman, D. (1982). Management of forestry research to improve knowledge utilization. *South African Forestry Journal*, *120*, 29–35.

Brewer, D., & Tierney, W. (2012). Barriers to innovations in the US education. In B. Widavsky, A. Kelly, & K. Carey(Eds.), *Reinventing higher education: The promise of innovation* (pp. 11–40). Cambridge, MA: Harvard Education Press.

Camelo, C., García, J., Sousa, E., & Valle, R. (2011). The influence of human resource management on knowledge sharing and innovation in Spain: The mediating role of affective commitment. *International Journal of Human Resource Management*, *22*(7), 1442–1463.

Cardinal, L., Allesandri, T., & Turner, S. (2001). Knowledge codifiability, resources, and science based innovation. *Journal of Knowledge Management*, *5*(2), 142–154.

Castaneda, D. I. (2015). Knowledge sharing: The role of psychological variables in leaders and collaborators. *Suma Psicológica*, *22*(1), 63–69.

Cavusgil, S., Calantone, R., & Zhao, Y. (2003). Tacit knowledge transfer and firm innovation capability. *Journal of Business & Industrial Marketing*, *18*(1), 6–21.

Ceylan, C. (2013). Commitment-based HR practices, different types of innovation activities and firm iinovation performance. *The International Journal of Human Resource Management*, *24*(1), 208–226.

Chanchetti, L., Diaz, S., Milanez, D., Leiva, D., de Faria, L., & Ishikawa, T. (2016). Technological forecasting of hydrogen storage materials using patent indicators. *International Journal of Hydrogen Energy*, *41*, 18301–18310.

Chesbrough, H. (2012). Open Innovation. *Research Technology Management*, *55*(4), 20–27.

Christensen, C., & Raynor, M. (2003). *The innovator´s solution: Creativity and sustaining successful growth*. Boston, MA: Harvard Business School Press.

Coccoli, M., Maresca, P., & Stanganelli, L. (2017). The role of big data and cognitive computing in the learning process. *Journal of Visual Languages and Computing*, *38*(c), 97–103.

Cohen, W., & Levinthal, D. (1990). Absorptive capacity: A new perspective on learning and innovation. *Administrative Science Quarterly*, *35*(1), 128–152.

Connell, J., Kriz, A., & Thorpe, M. (2014). Industry clusters: An antidote for knowledge sharing and collaborative innovation. *Journal of Knowledge Management*, *18*(1), 137–151.

Connelly, C., Zweig, D., Webster, J., & Trougakos, J. (2012). Knowledge hiding in organizations. *Journal of Organizational Behavior*, *33*(1), 64–88.

Conroy,P. and Turnquist,L. (1989). Managing the introduction of new technologies: An AI case study. Paper presented at: Proceedings of International Conference on Microcomputers in Transportation, New York.

Crosswaite, C., & Curtice, L. (1994). Disseminating research results- the challenge of bridging the gap between health research and health action. *Health Promotion International*, *9*(4), 289–296.

Cummings, J. (2003). *Knowledge sharing: A review of the literature*. Washington, DC: World Bank.

Darroch, J., & McNaughton, R. (2002). Examining the link between knowledge management practices and type of innovation. *Journal of Intellectual Capital*, *3*(3), 210–222.

De Jong, J., & Marsili, O. (2006). The fruit flies of innovations: A taxonomy of innovative small firms. *Research Policy*, *35*(2), 213–229.

Diercks, G., Larsen, H., & Steward, F. (2019). Transformative innovation policy: Addressing variety in an emerging policy paradigm. *Research Policy*, *4*(2), 880–894.

Eisenhardt, K (1989). Building theories from case study research. *The Academy of Management Review*, *14*(4), 532–550.

Farinha, I., Ferreira, J., & Gouveia, B. (2016). Networks of innovation and competitiveness: A triple helix case study. *Journal of the Knowledge Economy*, *7*(1), 259–275.

Feil, P., Lamers, J., & Hermann, L. (1995). Knowledge transfer in the field: Solving crop residue problems in Niger. *The Journal of Technology Transfer*, *20*(1), 31–41.

Foster, W., Bollini, D. and Alkin, O. (1989). On the implementation of a nationwide expertise educational network. Paper presented at: Proceedings Frontiers in Education Conference.

Gaitskell, R. (1979). You can´t take it with you a survey of employed inventor´s rights. *Electronics and Power*, *25*(8), 562–564.

Garner, B. (1985). Convergence of technologies: State of art. *National Conference Publication*, *85*(6), 47–52.

Garud, R., & Nayyar, P. (1994). Transformative capacity: Continual structuring by interpersonal technology transfer. *Strategic Management Journal*, *15*(5), 365–385.

Gatchett, A., Fradkin, L., & Moore, M. (1992). EPA´s federal technology transfer act program. *Journal Air Waste Management Association*, *42*(7), 892–895.

Gibbert, M., & Krause, H. (2002). Practice exchange in a best practice marketplace. In G. Davenport & G. Probst(Eds.), *Knowledge Management Case Book: Best Practices* (pp. 68–84). Berlin, Germany: Publicis MCD.

Glaser, E. (1973). Knowledge transfer and institutional change. *Professional Psychology*, *4*(4), 434–444.

Granovetter, M (1973). The strength of weak ties. *American Journal of Sociology*, *78*(6), 1360–1380.

Grant, R (1996). Toward a knowledge-based theory of the firm. *Strategic Management Journal*, *17*(2), 109–122.

Grimshaw, J., Eccles, M., Hill, S., Lavis, J., & Squires, J. (2012). Knowledge translation of research findings. *Implementation Science*, *7* (1), 50.

Groenewegen, P. (1992). Stimulating "hot technologies" interorganizational networks in Dutch ceramic research. *R&D Management*, *22*(4), 293–306.

Hansen, M. (1999). The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. *Administrative Science Quarterly*, *44*(1), 82–111.

Hansen, P. (1995). Publicly produced knowledge for business: When is it effective?*Technovation*, *15*(6), 387–397.

Hargadon, A., & Sutton, R. (1997). Technology brokering and innovation in a product development firm. *Administrative Science Quarterly*, *42*(4), 716–749.

Harrington, D., Walsh, M., Owens, E., Joyner, D., McDonald, M., Griffiths, G., … Lynch, P. (2017). Green innovation capabilities: Lessons from Irish-welsh collaborative innovation learning network. *University Partnerships for International Development*, *8*, 93–121.

Hassink, R., Dankbaar, B., & Corvers, F. (1995). Technology networking in border regions: Case study of the Euregion Maas-Rhine. *European Planning Studies*, *3*(1), 63–83.

Helmstadter, E. (2003). The institutional economics of knowledge sharing. Basic issues. In E. Helmstadter(Ed.), *The economics of knowledge sharing. A new institutional approach* (pp. 11–38). Cheltenham y Northampton, MA: Edgard Elgar.

Henderson, R., & Clark, K. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. *Administrative Science Quarterly*, *35*(1), 9–30.

Hendriks, P. (2004). *Assessing the role of culture in knowledge sharing, in proceedings of fifth European conference in organization, knowledge, learning and capabilities*. Austria: Innsbruck.

Herkema, S. (2003). A complex adaptive perspective on learning within innovation projects. *The Learning Organization*, *10*(6), 340–346.

Hogel, M., Partboteeah, K., & Munson, C. (2003). Team level antecedents of individuals knowledge networks. *Decision Sciences*, *21*(1), 40–51.

Holden, P. (1992). Expert systems in manufacturing. Part 1: A users 'perspective on expert-systems innovation. *Knowledge Based Systems*, *5*(2), 149–157.

Hoopes, D., & Postrel, S. (1999). Shared knowledge "glitches" and product development performance. *Strategic Management Journal*, *20*(9), 837–865.

Howells, J (1996). Tacit knowledge, innovation and technology transfer. *Technology Analysis and Strategic Management*, *8*(2), 91–106.

Howells, J (2002). Tacit Knowledge, innovation and economic geography. *Urban Studies*, *39*(5), 871–884.

Huysman, M., & De Wit, D. (2002). *Knowledge sharing in practice*. Dordrecht, the Netherlands: Kluwer Academics Publishers.

Indyk, D., & Belville, R. (1995). Lnking frontline work and state of art knowledge: A community exchange system. *Journal Case Management*, *4*(2), 48–53.

Ipe, K., & Wagner, C. (2008). Weblogging: A study of social computing and its impact on organizations. *Decision Support Systems*, *45*(2), 242–250.

Kamasak, R., & Bulutlar, F. (2010). The influence of knowledge sharing on innovation. *European Business Review*, *22*(3), 306–317.

Kogut, B, & Zander, U (1992). Knowledge of the firm, combinative capabilities and the replication of technology. *Organization Science*, *3*(3), 383–397.

Kremer, H., Villamor, I., & Aguinis, H. (2019). Innovation leadership: Best-practice recommendations for promoting employee creativity, voice and knowledge sharing. *Business Horizons*, *62*(1), 65–74.

Kuehnel, T., May, P., & Liberman, R. (1986). The zeitgeist of innovation. *Knowledge, Creation, Diffusion, Utilization*, *8*(2), 270–273.

Louis, H. (1993). Abrasive jet cutting technology: Future demands and developments. *Geomechanics Conference Proceedings.*, 255–260.

Low, W. (1984). Discoveries, innovations, and business cycles. *Technological Forecasting and Social Change*, *26*(4), 355–373.

Martinez-Brawley, E. (1995). Knowledge diffusion and transfer of technology: Conceptual premises and concrete steps for human services innovators. *Social Work*, *40*(5), 670–682.

Mesmer-Magnus, J., & DeChurch, L. (2009). Information sharing and team performance: A meta analysis. *Journal of Applied Psychology*, *94*(2), 535–546.

Meyer-Krahmer, F., & Schmoch, U. (1998). Science based technologies: University-industry interactions in four fields. *Research Policy*, *27*(8), 835–851.

Mura, M., Lettieri, E., Radaelli, G., & Spiller, N. (2013). Promoting professionals´ innovative behavior through knowledge sharing: The moderating role of social capital. *Journal of Knowledge Management*, *17*(4), 527–544.

Murimbika, M., & Urban, B. (2014). Strategic innovation at the firm level: The impact of strategic management practices on entrepreneurial orientation. *International Journal of Innovation Management*, *18*(2), 1–38.

Murray, P., Dixon, G. and Thomson, R. (1994). Implementation of innovative operating systems in the forties field. Paper presented at: Proceedings European Production Operations Conference.

Nelson, R. (1993). *National innovation systems: A comparative analysis*. New York: Oxford University Press.

Newell, S., & Swan, J. (1995). Professional associations as important mediators of the innovative process. *Science Communication*, *16*(4), 371–387.

Nonaka, I (1994). A dynamic theory of organizational knowledge. *Organization Science*, *5*(1), 14–37.

Obermeyer, N. (1990). Bureaucratic factors in the adoption of gis by public organizations: Preliminary evidence from public administrators and planners. *Computers, Environment and Urban Systems*, *14*(4), 261–271.

OCDE, (2005). Manual de Oslo: Guía para la recogida e interpretación de datos sobre innovación.Madrid: Eurostat.

Oyemomi, O., Neaga, L., & Alkhuraiji, A. (2016). How knowledge sharing and business process contribute to organizational performance: Using the fs QCA approach. *Journal of Business Research*, *69*(11), 5222–5227.

Paulus, P., & Yang, H. (2000). Idea generation in groups: A basis for creativity in organizations. *Organizational Behavior and Human Decision Processes*, *82*(1), 76–87.

Pfotenhauer, S., Juhl, J., & Aarden, E. (2019). Challenging the "deficit model" of innovation: Framing policy issues under the innovation imperative. *Research Policy*, *48*(4), 895–904.

Pittaway, I, Robertson, M, Munir, K, Denyer, D, & Neely, A (2005). Networking and innovation: A systematic review of the evidence. *Journal of Management Review*, *5*(3-4), 137–168.

Pinelli, T., Barclay, R., Bishop, A., & Kennedy, J. (1992). Information technology and aerospace knowledge diffusion: Exploring the intermediary- end user interface in a policy framework. *Internet Research*, *2*(2), 31–49.

Podrug, N., Filipovic, D., & Kovac, M. (2017). Knowledge sharing and firm innovation capability in Croatian ICT companies. *International Journal of Manpower*, *38*(4), 632–644.

Pollock, S. (1987). Adaptation to chronic illness. Analysis of nursing research. *The Nursing Clinics of North America*, *22*(3), 631–644.

Powell, W, Koput, K, & Smith-Doerr, L (1996). Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. *Administrative Science Quarterly*, *41*(1), 116–145.

Rai, A. (1995). External information source and channel effectiveness and the diffusion of CASE innovations: An empirical study. *European Journal of Information Systems*, *4*, 93–102.

Rupp, E. (1976). The RKW: A new approach towards technology transfer methods for the promotion of innovation in small and medium sized companies. *Research Policy*, *5*(4), 398–412.

Saavedra, Y. M. B., Iritani, D. R., Pavan, A. L. R., & Ometto, A. R. (2018). Theoretical contribution of industrial ecology to circular economy. *Journal of Cleaner Production*, *170*, 1514–1522.

Sahal, D. (1983). Invention, innovation and economic evolution. *Technological Forecasting and Social Change*, *23*(3), 213–235.

Sammarra, A, & Biggiero, L (2008). Heterogeneity and specificity of interfirm knowledge flows in innovation networks. *Journal of Management Studies*, *45*(4), 800–829.

Sampson, R. (2007). R&D alliances and firm performance: The impact of technological diversity and alliance organization on innovation. *Academy of Management Journal*, *50*(2), 364–386.

Serenko, A., & Bontis, N. (2016). Negociate, reciprocate, or cooperate? The impact of exchange modes on inter-employee knowledge sharing. *Journal of Knowledge Management*, *20*(4), 687–712.

Shank, F., & Carson, K. (1994). The regulatory environment past and future- incentive or impediment to developments in food science and technology: A perspective from FDA. *Critical Review Food Science Nutrition*, *34*(2), 207–214.

Shea, S., & Basch, C. (1990). A review of five major community- based cardiovascular desease prevention programs. Part II: Intervention strategies, evaluation methods and results. *American Journal of Health Promotion*, *4*(4), 279–287.

Smith, S., Townsend, T., Whitaker, C., & Hester, S. (1989). Photovolataics for utility- scale applications: Project overview and data analysis. *Solar Cells*, *27*(1–4), 259–266.

Soete, L. (2019). Science, technology and innovation studies at a crossroad: SPRU as case study. *Research Policy*, *48*(4), 849–857.

Sorg, J. (1984). The transfer of financial management knowledge innovations. *Science Communication*, *5*(3), 353–367.

Spender, J., & Grant, R. (1996). Knowledge and the firm: Overview. *Strategic Management Journal*, *17*(S2), 5–9.

Stankiewicz, R. (1994). Spin-off companies from universities. *Science and Public Policy*, *21*(2), 99–107.

Stewart, C. (1987). Technology transfer vs. diffusion: A conceptual clarification. *The Journal of Technology Transfer*, *12*(1), 71–79.

Storey, C., & Kelly, D. (2002). Innovation in services: The need for knowledge management. *Australasian Marketing Journal*, *10*(1), 59–70.

Szulanski, G (1996). Exploring internal stickiness: Impediments to the transfer of best practice within the firm. *Strategic Management*, *17*(2), 27–43.

Taminiau, I., Smit, W., & Lange, A. (2009). Innovation in management consulting firms through informal knowledge sharing. *Journal of Knowledge Management*, *13*(1), 42–55.

Torugsa, N., & Arundel, A. (2016). Complexity of innovation in the public sector: A workgroup-level analysis of related factors and outcomes. *Public Management Review*, *18*(3), 392–416.

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing evidence informed management knowledge by means of systematic review. *British Journal of Management.*, *14*(3), 207–222.

Travis, A. (1990). The meeting of practical men. *Journal of the Society of Chemical Industry*, *68*(451), 456.

Trott, P., Cordey-Hayes, M., & Seaton, R. (1995). Inward technology transfer as an interactive process. *Technovation*, *15*(1), 25–43.

Van Eck, N., & Waltman, L. (2011). Text mining and visualization using VOSviewer. *ISSI Newsletter*, *7*(3), 50–54.

Wang, C., & Hu, Q. (2018). Knowledge sharing in supply chain networks: Effects of collaborative innovation activities and capability on innovation performance. *Technovation*, *70*.–. https://www.sciencedirect.com/science/article/pii/S0166497217308994.

Wang, J., Yang, J., & Xue, Y. (2017). Subjective well-being, knowledge sharing and individual innovation behavior. *Leadership and Organization Development Journal*, *38*(8), 1110–1127.

Wiewiora, A., Trigunarsyah, B., Murphy, G., & Coffey, V. (2013). Organizational culture and willengness to share knowledge: A competing values perspective in Australian context. *International Journal of Project Management*, *38*(8), 1163–1174.

Wright, P., & DeVore, P. (1986). New content for the transportation professional: The UMTA – West Virginia University transportation education project. *Transportation Research Record*, *1101*, 22–25.

How to cite this article: Castaneda DI, Cuellar S. Knowledge sharing and innovation: A systematic review. *Knowl Process Manag*. 2020;27:159–173. https://doi.org/10.1002/kpm.1637