

Open Innovation and Collaboration: a systematic literature review

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Resumo

The concept of open innovation was developed from a fragmented body of knowledge, with multiple levels of analysis, and little depth and theoretical specificity, presenting a lack of alignment and consolidation, and evidencing the need for realization of knowledge in this theme. Given this, we propose this systematic review to extend the discussion on open innovation in a collaborative context, revisiting and synthesizing the research developed in this scope, identifying its main characteristics and analysis levels. Such a review, composed of an already validated methodology, involves data collection, analysis, and synthesis. Results revealed a literature that is mostly empirical, quantitative and has unclear limits on innovation's characteristics. As for the analysis levels, we observed a concentration of studies at the intraorganizational level focused on the organization's functional aspects. When raising the gaps, we point out potential avenues for future research, which, together with the systematization, constitute this work's main contribution.

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ABSTRACT

The concept of open innovation was developed from a fragmented body of knowledge, with multiple levels of analysis, and little depth and theoretical specificity, presenting a lack of alignment and consolidation, and evidencing the need for realization of knowledge in this theme. Given this, we propose this systematic review to extend the discussion on open innovation in a collaborative context, revisiting and synthesizing the research developed in this scope, identifying its main characteristics and analysis levels. Such a review, composed of an already validated methodology, involves data collection, analysis, and synthesis. Results revealed a literature that is mostly empirical, quantitative and has unclear limits on innovation's characteristics. As for the analysis levels, we observed a concentration of studies at the intraorganizational level focused on the organization's functional aspects. When raising the gaps, we point out potential avenues for future research, which, together with the systematization, constitute this work's main contribution.

Keywords: open innovation, collaboration, systematic review, determinants of innovation, levels of analysis.

1 Introduction

The phenomenon of open innovation (OI), defined as the intentional use of input and output of knowledge to accelerate internal innovation and expand markets for the external use of innovation (Chesbrough, 2006), has attracted the attention of scholars in the area of innovation management. This interest reflects the increasing number of publications on the topic (Bogers et al., 2017; Cheng & Huizingh, 2014; Lopes & Carvalho, 2018).

Different definitions and delimitations of the term open innovation encompass the establishment of relationships with multiple actors (Bianchi et al., 2011; Battistella et al., 2017), thus emphasizing the centrality and relevance of the different forms of collaboration between organizations and individuals in the process and the generation of innovation (Fisher & Qualls, 2018). Such collaboration takes place in the context of opening the organization's limits, allowing the exchange of knowledge, resources, and technologies with external stakeholders (Randhawa et al., 2016; West & Gallagher, 2006). We understand collaboration as a formalized exchange of knowledge and resources and the sharing of authority and responsibility, based on the parties' active participation (organizations or individuals) in innovation activities (Fisher & Qualls, 2018; Lamberti et al., 2017).

Although it has become imperative to comprehend the organization of innovation, understanding the benefits and possible limits of open innovation remains a challenge (Bogers et al., 2019). As it is a relatively recent construction, research on open innovation develops from a diverse and fragmented body of knowledge, with multiple and incipient elements and levels of analysis, in addition to little depth in its theoretical foundations (Bogers et al., 2017; Lopes & Carvalho, 2018; Randhawa et al., 2016).

The segmentation of the theoretical field of open innovation is demonstrated through the analysis of theoretical reviews on the theme, showing the focus of the works on the intersection between open innovation and specific business contexts and characteristics, such as family businesses (Feranita, Kotlar, & De Massis, 2017; Pellegrini & Lazzarotti, 2019), SMEs (Marullo et al., 2020), start-ups (Marullo et al., 2018; Spender et al., 2017), metrics used for open innovation (Lamberti et al., 2017) and the perspective of emerging countries (Paulo et al., 2017). Despite such contributions, there is a research gap with an integrative approach, covering the open innovation scenario as a whole.

Despite the growing attention it has received in organizational studies, open innovation is recognized as an umbrella concept, comprising a series of agents and activities and their interrelationships. This comprehensiveness increases its richness and complexity but hinders its theoretical development and its operationalization, so it is a gap that Alvisson and Sandberg (2011) recognize as confusion spotting. This gap restricts and makes it difficult to understand under what circumstances and at what levels the agents are involved in collaborative processes to innovate. This

context points to the need to develop a holistic and integrative perspective that consolidates knowledge in this scope (Huizingh, 2011), characterizing a fruitful research opportunity.

Given this perspective, our goal is to extend and deepen the discussion on open innovation in a collaborative context. To do so, we seek to (i) consolidate the research developed on open innovation in a collaborative context, (ii) identify the main characteristics and levels of analysis of this literature, and (iii) identify gaps between the different research topics on the topic.

In this regard, we conducted a systematic review of the literature on open innovation in collaboration, according to the methodology proposed and validated by Crossan and Apaydin (2010). Based on this review's findings, we established a multidimensional framework involving the levels of analysis and main determinants used in research on open innovation. We also raised the underlying theories used in the most cited works in the sample, pointing to the art's development and state in this research topic. The results presented offer a factual basis for building and refining the theory and improving the practice and empirical perception of open innovation.

2 Methodology Description

As presented in the introduction, we aim to extend and deepen the discussion of the literature on open innovation in a collaborative context. For this, we undertake a qualitative research, of bibliometric and descriptive character to analyze specific characteristics about the scientific production on the theme. We carried out a systematic review following the proposal of Crossan and Apayidin (2010) composed of three stages: (i) data collection, (ii) data analysis, and (iii) synthesis, as detailed in the following operationalization (Figure 1).

Figure 1. Research's operationalization

Database	ISI Web of Knowledge's Social Sciences Citation Index (SSCI)			
Keywords (in the field: title, keywords, or abstract).	'open innovation' AND 'collaborat *'; 'Open innovation' AND 'cooperat *'; 'Open innovation' AND 'partner *'			
Research data	May, 2020			
Title filters	Title: 'article' and 'review'; Language 'English'; Area: 'business' Period: '2010 to 2019'.			
Compiling the consideration set				
Group	Initial pool	Filtered	Abstract analysed	Less duplicates
Group 1 – Reviews and e meta-analyses	69	46	25	18
Group 2 – Highly cited papers	395	199	139	71
Group 3 – Recent papers	100	64	54	5
Total	564	309	218	94

3 Synthesis of Results

Based on data analysis, we collect the determinants of open innovation found in our set of considerations and organize them by levels of analysis, prepared from preliminary conceptual frameworks of the existing research. We conclude with the identification of the gaps in the investigated literature.

3.1 Theoretical perspective examination

In order to better explore and recognize the theoretical structure that supports the area of open innovation, we analysed the underlying theories of high impact articles, organizing them by level (individual, organizational, macro, multilevel). The findings are compiled in Figure 2.

Figure 2. Theories used in the highly cited papers by level

	Multilevel	Macro (econ./industry/market)	Organizational	Micro (group/individual)
RBV		Alexander and Martin (2013)	Drechsler and Natter (2012) Faems et al. (2010) Veer et al. (2016)	
Theories Related to Psychology	Ferraris et al. (2018); Kratzer et al. (2017)		Gesing et al. (2015) Lifshitz-Assaf (2018) Zubielqui et al. (2019)	Gebauer et al. (2013)
Theories of Learning and Knowledge Management	Cammarano et al. (2017)		Alexy et al. (2013); Cammarano et al. (2017) Lakemond et al. (2016); Malhotra and Majchrzak (2014); Santoro et al. (2018); Wang et al. (2015)	
Theories of Marketing	Mount and; Martinez (2014)			Fernandes and Remelhe (2016)

	Nucciarelli et al. (2017)		Ind et al. (2017)
Theories of Networks	Mazzola et al. (2016) Scuotto et al. (2016)		Wang et al. (2017); Xie et al. (2016) Rampersad et al. (2010)
Other theories	Almirall et al. (2010)	Guerrero and Urbano (2017)	Iturrioz et al. (2015); Pullen et al. (2012)

Organizing the adopted theories, we catalogued them by the analysis level, revealing a stimulating framework. Most psychological theories were applied at the individual level, as well as at the organizational level. The works that cover psychological aspects address topics such as the perception of justice, trust, skills, knowledge of individuals, as well as traits of the firm's relational capacity. Theories of learning and knowledge and theories of RBV are used at the organizational and macro levels. In terms of learning and knowledge, theories, absorptive theory, and knowledge-based view are addressed. The works that use RBV cover the organization's capacity for knowledge and technology resources, being concerned with its scarcity, acquisition, and diffusion. Game theory, an economic theory, is used at the multilevel level and the theoretical lens of emerging economies. Furthermore, one of the works covers the theoretical perspective of social capital, and another addresses the configuration theory.

Our analysis essentially reveals that the majority of highly cited articles did not apply an influential underlying theory (n = 41). Regarding the articles that employed another theory, we cannot identify a widespread adoption of a specific theoretical perspective, operating the underlying theories at a single level. It should be noted that among the works that adopted an underlying theory, the most used level of analysis was the organizational level (n = 16), demonstrating that a large part of the discussion about open innovation is concerned with its effects within the company(s) object of studies.

3.2 Determinants of open innovation

The analysis of open innovation determinants showed a high focus on organizational (business) factors connected to the focal organization's characteristics. It was possible to observe that a large part of the determinants covers the company's characteristics, capabilities, and skills (about 56% of the total determinants). Given the relevance of the organization, it was used as a reference for the classification of determinants at extra-organizational, intra-organizational, and inter-organizational levels (Bogers et al., 2017). Such divisions are compiled and demonstrated in Figure 3, where a separate rectangular area represents each level.

Figure 3. Determinants of open innovation by level of analysis

INTRAORGANIZATIONAL	
<p><u>STRUCTURAL ASPECTS</u></p> <p>Multinational; Size; Whether or not the company was a start-up; Company age; Nature of the firm's ownership; Growth stage; Foreign property; Internationalization; Legal capacity of companies; Export intensity; Equity; Hierarchical structure; Flexible work structures; Whether the organization is part of a divisional entity; Subsidiary status; Whether the firm is Family-owned; Founder's experiences (entrepreneurial, industry and managerial); Presence of professional investors as firm shareholders</p>	<p>(Brem et al., 2017; Cammarano et al., 2017; Cano-Kollman et al., 2017; Caputo et al., 2016; Chen et al., 2016; Cheng & Huizingh, 2014; Di Pietro et al., 2018; Dong & Netten, 2017; Drechsler & Natter, 2012; Faems et al., 2010; Ferraris et al., 2018; Freel & Robson, 2017; Greco et al., 2016; Greco et al., 2017; Guerrero & Urbano, 2017; Hewitt-Dundas & Roper, 2018; Holgersson & Granstrand, 2017; Janeiro et al., 2013; Lakemond et al., 2016; Love et al., 2014; Mazzola et al., 2016; Michelino et al., 2017; Mount & Martinez, 2014; Spithoven et al., 2013; Stefan & Bengtsson, 2017; Veer et al., 2016; Wang et al., 2015; Zouaghi et al., 2018).</p>
<p><u>FUNCTIONAL/OPERATIONAL ASPECTS</u></p> <p>Technological aptitude competence; Organizational support competency; Qualification of human resources; Scarce company resources; Product vs Service; Company process archetypes; Strength of the plant's internal resource base; Degree of modularity of the resource base; Organizational capabilities in extracting value from external knowledge; Stock of tangible and intangible resources; HRM practices; Relative labour productivity; Social media use; Internal capabilities; Market awareness; Capability to manage social media platforms; Project management procedures; Productivity.</p>	<p>(Alexy et al., 2013; Appleyard & Chesbrough, 2017; Chen et al., 2016; Drechsler & Natter, 2012; Ferraris et al., 2018; Freel & Robson, 2017; Hewitt-Dundas & Roper, 2018; Hughes & Wareham, 2010; Kratzer et al., 2017; Lakemond et al., 2016; Lifshitz-Assaf, 2018; Love et al., 2014; Malhotra & Majchrzak, 2014; Mount & Martinez, 2014; Radziwon & Bogers, 2019; Usman & Vanhaverbeke, 2017; Zouaghi et al., 2018; Zubielqui et al., 2019).</p>

<p style="text-align: center;"><u>STRATEGIC ASPECTS</u></p> <p>Company strategy; Company business model; Objectives of the business model; Factors oriented to the company - internal technological capacity; support ecosystem; strong and credible relationship with the user base; Strategic orientation; Past financial performance; Financial capabilities; Openness oriented approach; Company's CSR strategy; Mission and vision statement; Strong values in collaboration; Information failures; Value chain model; Understanding of how value is received (value-in-use or value-in-exchange); Understanding of how value is created or captured; Differentiation practices; Integration practices; Culture; Customer orientation (B2B or B2C); Core competencies</p>	<p>(Alexy et al., 2013; Almirall et al., 2014; Appleyard & Chesbrough, 2017; Bianchi et al., 2010; Cheng & Huizingh, 2014; Chesbrough, 2011; Chesbrough et al., 2018; Di Pietro et al., 2018; Faems et al., 2010; Hewitt-Dundas & Roper, 2018; Ind et al., 2017; Lauritzen & Karafyllia, 2019; Lakemond et al., 2016; Mount & Martinez, 2014; Nucciarelli et al. 2017; Radziwon & Bogers, 2019; Secundo et al., 2019; Snow et al., 2011; Stefan & Bengtsson, 2017; Usman & Vanhaverbeke, 2017).</p>
<p style="text-align: center;"><u>KNOWLEDGE AND INNOVATION ASPECTS</u></p> <p>Internal innovation activities; Operational / practical tools to help managers manage innovation projects; Innovation expenditures; Introduction of market innovation; Success level of the company's innovation; Innovation intensity level; R&D intensity; Higher levels of internal R&D activities; R&D capabilities; Internal research scope; Innovation strategy; R&D expenses; Companies that are innovation leaders; Companies in the knowledge-intensive services sector - KIBS; Previous experience of innovation ties; Subsequent patent citation; Technological registration; Novelty level of an innovation - radical x incremental; Enabling technologies; Companies that register trademarks; OI planning strategy; OI capabilities; Coupled OI; Company's ability to establish and benefit from relationships with multiple partners; Costs of searching for relevant agents; Product and/or technology complexity; Patent portfolio; Appropriability mechanisms/strategies (formal and informal); Knowledge management system (IT infrastructures; collaborative technologies; ICT adoption); Innovation Management Culture; Stock of knowledge composition; Knowledge management strategies (exploration x exploitation); Open-innovation value processes; Innovation synergies; Innovation barriers; Firm's conventions over time; Accumulated stock of knowledge; Sustainability innovation performance; Economic innovation performance; Company's specialization on the technological domain; Share of joint patents; Ratio of potentially pioneering inventions on the total number of patents; Ratio of inventions originating further applications on the total number of applications; Patent motivation (bargaining, protection, improving the corporate image, attracting external financing, internal reasons); Extent to which R&D is outsourced to an external partner.</p>	<p>(Bianchi et al., 2010; Brem et al., 2017; Cammarano et al., 2017; Cammarano et al., 2017; Cano-Kollman et al., 2017; Caputo et al., 2016; Chatterji & Fabrizio, 2014; Chen et al., 2016; Chesbrough, 2017; Chesbrough et al., 2018; Dong & Netten, 2017; Drechsler & Natter, 2012; Faems et al., 2010; Freel & Robson, 2017; Greco et al., 2016; Greco et al., 2017; Guerrero & Urbano, 2017; Hewitt-Dundas & Roper, 2018; Holgersson & Granstrand, 2017; Holgersson et al., 2018; Hughes & Wareham, 2010; Iturrioz et al., 2015; Janeiro et al., 2013; Kratzer et al., 2017; Lakemond et al., 2016; Lauritzen & Karafyllia, 2019; Love et al., 2014; Malhotra & Majchrzak, 2014; Mazzola et al., 2016; Michelino et al., 2017; Mount & Martinez, 2014; Radziwon & Bogers, 2019; Rauter et al., 2018; Spithoven et al., 2013; Santoro et al., 2018; Scuotto et al., 2016; Theyel, 2013; Usman & Vanhaverbeke, 2017; Veer et al., 2016; Wadhwa et al., 2016; Wang et al., 2015; Zouaghi et al., 2018).</p>
INTERORGANIZATIONAL	
<p style="text-align: center;"><u>NETWORK PURPOSE AND RESULTS</u></p> <p>Scope of R&D cooperation - different stages in which companies cooperate; Research and development cooperation - different types of collaboration partners; Simultaneous collaborative development of standards; Aspects of socialization in knowledge transfer in collaboration with partners; Facilitated processes of direct collaboration between firms in projects of innovation, development and use of common knowledge; Reputation as a successful and fair partner; Experience and competence in collaborative innovation; Satisfaction/dissatisfaction with the result; Institutionalization of cooperation.</p>	<p>(Dingler & Enkel, 2016; Galán-Muros & Plewa, 2016; Gebauer et al., 2013; Kratzer et al., 2017; Snow et al., 2011; Veer et al., 2016)</p>
<p style="text-align: center;"><u>TYPES OF MEMBERS</u></p> <p>Type of partner; Partner capabilities; Partners' needs</p>	<p>(Chen et al., 2016; Love et al., 2014; Rauter et al., 2018; Secundo et al., 2019; Usman & Vanhaverbeke, 2017).</p>
<p style="text-align: center;"><u>NETWORK ORGANIZATION</u></p> <p>Type of technological collaboration - horizontal or vertical; Type of partnership - fixed or flexible; Levels/stages of the partnership; Types of collaborations - formal vs. informal; focused on the market x focused on science; Governance mechanisms; Dynamic governance structure; Partnership uncertainty level; Coordination cost level; Level of path dependencies (interdependencies); Presence of intermediaries; Capabilities of intermediaries; Communication efficiency; R&D efficiency.</p>	<p>(Alexander & Martin, 2013; Alexy et al., 2013; Almirall & Casadesus-Masanell, 2010; Gesing et al., 2015; Holgersson et al., 2018; Hughes & Wareham, 2010; Iturrioz et al., 2015; Radziwon & Bogers, 2019; Rampersad et al., 2010; Snow et al., 2011; Veer et al., 2016; Wang et al., 2015).</p>
<p style="text-align: center;"><u>NATURE OF TIES</u></p> <p>Trust; Reciprocity; Share capital; Commitment; Credibility; Harmony; Relationship level between the organization and the partner; Fairness; Safety of the environment; History of previous and current relationships and cooperation with other agents; Power balance; Nature of the relationships (collaborative x competitive)</p>	<p>(Galán-Muros & Plewa, 2016; Ind et al., 2017; Iturrioz et al., 2015; Nucciarelli et al., 2017; Pullen et al., 2012; Radziwon & Bogers, 2019; Rampersad et al., 2010; Schiele, 2012; Scuotto et al., 2016).</p>
<p style="text-align: center;"><u>NETWORK CONFIGURATION</u></p> <p>Network centrality; Network density; Network path length; Network size; Network strength; Network heterogeneity; Structural compatibility level;</p>	<p>(Alexy et al., 2013; Cammarano et al., 2017; Di Pietro et al., 2018; Faems et al., 2010; Ferraris et al., 2018; Greco et al., 2016; Greco et al.,</p>

Network position; Diversity of technological alliance portfolio; External search breadth; External search depth, Network formation changes; Horizontal and Vertical collaboration intensity; R&D collaboration intensity	2017; Guerrero & Urbano, 2017; Hewitt-Dundas & Roper, 2018; Iturrioz et al., 2015; Kratzer et al., 2017; Lakemond et al., 2016; Mazzola et al., 2016; Pullen et al., 2012; Radziwon & Bogers, 2019; Rauter et al., 2018; Secundo et al., 2019; Stefan & Bengtsson, 2017; Usman & Vanhaverbeke, 2017; Wadhwa et al., 2016; Wang et al. 2017; Xie et al., 2016; Zouaghi et al., 2018; Zubieli et al., 2019).
<u>NATURE OF FLOWS</u> Complementarity of objectives, complementarity of resources; Content compatibility level; Technological trajectory phase; Shared beliefs of the agents involved; Proximity between the objectives and agendas of the different stakeholders; Absence of barriers (connection; funding; cultural)	(Alexy et al., 2013; Di Pietro et al., 2018; Galán-Muros & Plewa, 2016; Iturrioz et al., 2015; Pullen et al., 2012; Scuotto et al., 2016).
EXTRA ORGANIZATIONAL	
<u>GOVERNMENT</u> Whether the company has benefited from public financial support from local, regional and central governments; Government support for R&D; Monetary support from the government; Non-monetary government support; Relevance of public support; Public subsidies types (by any administration; by its local administration; by its national government; by the European Union)	(Cano-Kollman et al., 2017; Greco et al., 2016; Greco et al., 2017; Guerrero & Urbano, 2017; Hewitt-Dundas & Roper, 2018; Love et al., 2014; Scuotto et al., 2016).
<u>ENVIRONMENT</u> Industry; Technological turbulence; Competitive environment; Market-oriented factors; Ecosystem; Region; Home countries; Country R&D intensity; Country IP protection; GDP <i>per capita</i> ; Regulatory system; Political system; Academic institutional sphere; Financial international/national support; Socio-economic system	(Alexy et al., 2013; Almirall et al., 2014; Appleyard & Chesbrough, 2017; Cammarano et al., 2017; Cammarano et al., 2017; Cano-Kollman et al., 2017; Chen et al., 2016; Cheng & Huizingh, 2014; Dong & Netten, 2017; Drechsler & Natter, 2012; Faems et al., 2010; Freel & Robson, 2017; Galán-Muros & Plewa, 2016; Gesing et al., 2015; Greco et al., 2016; Greco et al., 2017; Guerrero & Urbano, 2017; Holgersson & Granstrand, 2017; Holgersson et al., 2018; Hughes & Wareham, 2010; Lakemond et al., 2016; Mazzola et al., 2016; Nucciarelli et al., 2017; Snow et al., 2011; Spithoven et al., 2013; Stefan & Bengtsson, 2017; Veer et al., 2016; Villarreal & Calvo, 2015; Wang et al., 2015; Zouaghi et al., 2018).
<u>COMMUNITY</u> Perception of fairness and sense of community; Business and website networks used to attract desirable businesses to the community	(Gebauer et al., 2013; Snow et al., 2011)
<u>CONSUMERS</u> Consumer/customer engagement; Consumer pressure for new configurations or greater variety; Co-creation experience	(Appleyard & Chesbrough, 2017; Chesbrough, 2011; Fernandes & Remelhe, 2016; Gebauer et al., 2013; Ind et al., 2017).
<u>SUPPLIERS</u> Supplier's capabilities to support joint innovation processes; Importance of the purchasing company to the supplier	(Schiele, 2012).
<u>ENGAGEMENT</u> Level of previous experience of engagement with the type of firm; Motivation/demotivation of external collaborators	(Alexy et al., 2013; Almirall et al., 2014; Secundo et al., 2019).

Studies since 2010 have emphasized the characteristics of the relationship or the relationship network for open innovation (Alexy, George, & Salter, 2013; Almirall, & Casadesus-Masanell, 2010; Gesing et al., 2015; Hughes, & Wareham, 2010; Iturrioz, Aragón, & Narvaiza, 2015; Pullen et al., 2012; Schiele, 2012; Veer, Lorenz, & Blind, 2016; Wang, Cheng, & Shen, 2015), that is, they focus on the inter-organizational level. We can observe, therefore, that although this locus is not the core of the corpus of studies on open innovation, it is relevant for the realization of innovations. The focus of the OI determinants present in the analyzed publications can be seen in **Figure 4**.

Figure 4. Map of determinants of open innovation distributed chronologically

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Environment	Environment	Environment	Environment	Government	Environment	Government	Government	Government	Environment
Structural aspects	Community	Suppliers	Community	Environment	Structural aspects	Environment	Environment	Environment	Engagement
Functional/oper. aspects	Consumers	Structural aspects	Consumers	Engagement	Knowledge/innovation aspects	Consumers	Consumers	Structural aspects	Functional/oper. aspects
Strategic aspects	Strategic aspects	Functional/oper. aspects	Engagement	Structural aspects	Network org.	Structural aspects	Structural aspects	Functional/oper. aspects	Strategic aspects
Knowledge/innovation aspects	Network purpose and results	Knowledge/innovation aspects	Structural aspects	Functional/oper. aspects	Nature of ties	Functional/oper. aspects	Functional/oper. aspects	Strategic aspects	Knowledge/innovation aspects
Network org.	Network org.	Nature of ties	Functional/oper. aspects	Strategic aspects	Network config.	Strategic aspects	Strategic aspects	Knowledge/innovation aspects	Network org.
Nature of ties		Network config.	Strategic aspects	Knowledge/innovation aspects	Nature of flows	Knowledge/innovation aspects	Knowledge/innovation aspects	Types de members	Nature of ties
Network config.		Nature of flows	Knowledge/innovation aspects	Types de members		Network purpose and results	Network purpose and results	Network org.	Network config.
			Network purpose and results			Types de members	Types de members	Network config.	
			Network org.			Network org.	Nature of ties	Nature of flows	
			Network config.			Nature of ties	Network config.		
			Nature of flows			Network config.			
						Nature of flows			

*Green – Extra organizational level; Orange – Intraorganizational level; Blue – Interorganizational level

Interconnecting the locus of the determinants of open innovation and the underlying theories used in the different works present in Figure 3, we could observe that the papers that used the RBV presented determinants with equal weight in the intraorganizational and inter-organizational levels (Alexander & Martin, 2013; Drechsler & Natter, 2012; Faems et al., 2010; Veer, Lorenz, and Blind, 2016), showing a greater multiplicity between the level of the theoretical lens and the proxies and variables used. However, in works that use theories linked to psychology, a more focused perspective on micro aspects is observed. Most articles that use this theoretical lens have their determinants focused on the characteristics and capabilities of external actors - extra-organizational level (Gebauer, Fuller, & Pezzeri, 2013; Gesing et al., 2015) – and characteristics of internal actors – intra-organizational level (Lifshitz-Assaf, 2018; Zubieli, Fryges, & Jones, 2019).

The articles that employ the Theories of Learning and Knowledge Management bring a more comprehensive perspective of the determinants, focusing on different characteristics and capacities of the organization, thus concentrating on the intraorganizational level (Cammarano, Caputo, Lamberti, & Michelino, 2017; Lakemond et al., 2016; Malhotra, & Majchrzak, 2014; Santoro et al., 2018; Wang, Cheng, & Shen, 2015). The papers concentrated on the Theories of Network show a perspective of determinants focused on the relationship between open innovation actors, networks configuration, and organization, thus focusing on the inter-organizational level (Rampersad, Quester, & Troshani, 2010; Scuotto, Ferraris, & Bresciani, 2016; Wang et al., 2017; Xie, Fang, & Zeng, 2016).

Finally, the articles focused on Marketing Theories, for the most part, bring a more comprehensive perspective, focused on all levels analyzed - extra-organizational, intra-organizational and inter-organizational - (Ind, Iglesias, & Markovic, 2017; Nucciarelli et al., 2017). The other works, belonging to the group Other Theories, have as a common point the focus on determinants that represent characteristics and capacities of the relationships between the agents involved in open innovation, therefore, focused on the inter-organizational level (Almirall & Casadesus-Masanell, 2010; Iturrioz, Aragón, & Narvaiza, 2015; Pullen et al., 2012).

Figure 4 reiterates the focus of research at the intraorganizational level, with works developed every year of the analysis period. However, there is a focus of research at the intraorganizational level, with this level having the most substantial amount of work developed in seven of the ten years analyzed (except in 2011, 2012 and 2015). The determinants of this level have always been approached from a multiple perspective over the years, with works addressing, on average, three categories at the intra-organizational level. By investigating the phenomenon of open innovation,

the category of determinants' aspects of knowledge and innovation' proved to be present in most years (except in 2011), demonstrating a congruence between the phenomenon investigated and its intra-organizational determinants.

The other levels, both the extra organizational level and the inter-organizational level, receive less attention from the research analyzed. The extra-organizational level has a high number of categories since its determinants represent characteristics of the various actors involved in open innovation. It shows the level approached, on average, by the least amount of papers. The 'environment' category shows greater prominence, being present in all years. Therefore, the relevance of the characteristics of the environmental and institutional context in which open innovation is developed is emphasized. In terms of stakeholders, the consumer group stands out.

The inter-organizational level focused on relationships/network of connections between the stakeholders involved in open innovation, also presents a large number of categories, subdivided, according to Cova, Prévot, and Spencer (2010). In terms of the determinants of the inter-organizational level, the category 'network configuration' stands out, focusing on the characteristics and attributes of the network of relationships between the actors.

3.3 Identifying gaps

Some gaps emerged from the review. Although few underlying theories have been used (RBV, theories linked to psychology, theories of learning and knowledge management, theories of network), there is a lack of coherence and a prevailing theoretical basis. A single typology is not adopted for the characteristics and determinants of open innovation in different contexts and applications, with different terminologies according to the underlying theory. For example, the actors involved in the open innovation process, depending on the underlying theoretical lens, are called partners (Alexander & Martin, 2013; Alexy et al., 2013; Gesing et al., 2015), stakeholders (Ferraris et al., 2018; Santoro et al., 2018) or participants/members of a specific group (Gebauer et al., 2013).

We also observed a need for further clarification as to the characteristics and configurations of the open innovation analyzed, better typifying the outcomes generated. Such information would allow us to categorize better and understand the background, requirements, types, and duration of the collaboration, actors involved, and other details for the generation of the various outcomes of this type of innovation, highlighting the motivating particularities of each of the results.

Our systematic review further demonstrates that research is primarily focused on one level of analysis, intra-organizational level. Despite the relevance of the capabilities, competencies, and structure of the focal organization, the decisive point for classifying an innovation as open innovation is the network of relationships between the company and other actors (Chesbrough, 2006). However, the perspectives that cover this central point, inter-organizational and extra-organizational levels, are poorly developed in the literature. Little is known about the nature, organization, governance, configuration, members/actors involved, and results of this network. Almost nothing is known about motivations, characteristics, and drivers of engagement of stakeholders involved in open innovation.

The analyzed literature exposes the primordial understanding of open innovation as a process, its different phases, and challenges. In general, the research deals with the process perspective as a black box, not taking into account the necessary mechanisms and procedures and the difficulties encountered during the development of collaboration in the generation of innovation. It is noted that the determinants found in our systematic review focus on characteristics that preceded the open innovation process and/or on the outcomes generated by this process (see details of the determinants in Figure 3).

4 Final Remarks

The purpose of this review was to extend the discussion on open innovation in a collaborative context, by consolidating the research developed on open innovation in a collaborative context, identifying the main characteristics and levels of analysis of this literature, as well as pointing out the main gaps between different scopes of research.

When analyzing the publications under a systematized and validated methodology, which allowed a wide and holistic scan of the published studies, it was possible to observe that this is a literature that has attracted an increasing number of researches, these being mostly empirical, with quantitative methodology and with delimitations unclear about the characteristics of the open innovation investigated.

Regarding the levels of analysis used, the results indicate a concentration of studies with determinants at the intraorganizational level, revealing a focus on the characteristics, structure, strategies, and functional aspects of the organization. Given the specifics of open innovation, it is fundamental to further deepen the other levels of analysis (inter-organizational and extra-organizational).

Finally, by surveying the identified gaps, we were able to point out potential avenues for the development of future research, among which the following stand out: (i) Research that defines a clear theoretical basis for open innovation, better defining its conceptual elements;(ii) research with greater detail and clarification of the outcomes generated by open innovation allows a better knowledge of the generators of the different results; (iii) research focused on the level of inter-organizational analysis, extending and deepening knowledge about the relevant factors of the relationship network; (iv) research aimed at the investigation of open innovation as a process, understanding how it occurs.

As mentioned earlier, studies of this nature are important because they contribute to the formation of a solid basis on which to build and refine the theory and improve the practice and the empirical perception, in this way, it is believed that such objective was achieved, and the contribution was provided.

References

- Alexander, A. T., & Martin, D. P. (2013). Intermediaries for open innovation: A competence-based comparison of knowledge transfer offices practices. *Technological Forecasting & Social Change*, 80(1), 38-49.
- Alexy, O., George, G., & Salter, A. J. (2013). Cui bono? The selective revealing of knowledge and its implications for innovative activity. *Academy of Management Review*, 38(2), 270-291.
- Almirall, E., & Casadesus-Masanell, R. (2010). Open versus closed innovation: a model of discovery and divergence. *Academy of Management Review*, 35(1), 27-47.
- Appleyard, M. M., & Chesbrough, H. W. (2017). The dynamics of open strategy: from adoption to reversion. *Long Range Planning*, 50(3), 310-321.
- Battistella, C., de Toni, A. F., & Pessot, E. (2017). Practising open innovation: a framework of reference. *Business Process Management Journal*, 23(6), 1311-1336.
- Bianchi, M., Cavaliere, A., Chiaroni, D., Frattini, F., & Chiesa, V. (2011). Organizational modes for open innovation in the bio-pharmaceutical industry: an exploratory analysis. *Technovation*, 31(1), 22-33.
- Bogers, M., Chesbrough, H., Heaton, S., & Teece, D. J. (2019). Strategic Management of Open Innovation: A Dynamic Capabilities Perspective. *California Management Review*, 62(1), 77-94.
- Bogers, M., Zobel, A.-K., Afuah, A., Almirall, E., Brunswicker, S., Dahlander, L., Frederiksen, L., Gawer, A., Brem, A., Nylund, P. A., & Hitchen, E. L. (2017). Open innovation and intellectual property rights: How do SMEs benefit from patents, industrial designs, trademarks and copyrights? *Management Decisions*, 55(6), 1285-1306.
- Cammarano, A., Caputo, M., Lamberti, E., & Michelino, F. (2017). Open innovation and intellectual property: a knowledge-based approach. *Management Decision*, 55(6), 1182-1208.
- Cammarano, A., Michelino, F., Lamberti, E., & Caputo, M. (2017). Accumulated stock of knowledge and current search practices: The impact on patent quality. *Technological Forecasting & Social Change*, 120(C), 204-222.
- Cano-Kollman, M., Hamilton III, R. D., & Mudambi, R. (2017). Public support for innovation and openness of firms' innovation activities. *Industrial and Corporate Change*, 26(3), 421-442.
- Caputo, M., Lamberti, E., Cammarano, A., & Michelino, F. (2016). Exploring the impact of the open innovation on firm performances. *Management Decision*, 54(7), 1788-1812.
- Chatterji, A. K., & Fabrizio, K. R. (2014). Using users: when does external knowledge enhance corporate product innovation? *Strategic Management Journal*, 35(10), 1427-1445.
- Cheng, C. C. J., & Huizingh, E. K. R. E. (2014). When is open innovation beneficial? The role of strategic orientation. *Journal of Product Innovation Management*, 31(6), 1235-1253.
- Chesbrough, H. (2006). Open innovation: A new paradigm for understanding industrial innovation. In *Open Innovation: Researching a New Paradigm*, ed. H. Chesbrough, W. Vanhaverbeke, and J. West, 1 – 12. New York, NY: Oxford University Press.
- Chesbrough, H. (2011). Bringing open innovation to services. *MIT Sloan Management Review*, 52(2), 85-90.

- Chesbrough, H. (2017). The future of open innovation. *Research-Technology Management*, 60(1), 35-38.
- Chesbrough, H., Lettl, C., & Ritter, T. (2018). Value creation and value capture in open innovation. *Journal of Product Innovation Management*, 35(6), 930-938.
- Cova, B., Prévot, F., & Spencer, R. (2010). Navigating between dyads and networks. *Industrial Marketing Management*, 39(6), 879-886.
- Crossan, M. M., & Apaydin, M. (2010). A multi-dimensional framework of organizational innovation: a systematic review of literature. *Journal of Management Studies*, 47(6), 1154-1191.
- Di Pietro, F., Prencipe, A., & Majchrzak, A. (2018). Crowd equity investors: an underutilized asset for open innovation in startups. *California Management Review*, 60(2), 43-70.
- Dingler, A., & Enkel, E. (2016). Socialization and innovation: insights from collaboration across industry boundaries. *Technological Forecasting & Social Change*, 109, 50-60.
- Dong, J. Q., & Netten, J. (2017). Information technology and external search in the open innovation age: New findings from Germany. *Technological Forecasting & Social Change*, 120(C), 223-231.
- Drechsler, W., & Natter, M. (2012). Understanding a firm's openness decisions in innovation. *Journal of Business Research*, 65(3), 438-445.
- Faems, D., Visser, M., Andries, P., & Van Looy, B. (2010). Technology Alliance Portfolios and Financial Performance: Value-Enhancing and Cost-Increasing Effects of Open Innovation. *Journal of Product Innovation Management*, 27(6), 785-796.
- Feranita, F., Kotlar, J., & De Massis, A. (2017). Collaborative innovation in family firms: past research, current debates and agenda for future research. *Journal of Family Business Strategy*, 8(3), 137-156.
- Fernandes, T., & Remelhe, P. (2016). How to engage customers in co-creation: customers' motivations for collaborative innovation. *Journal of Strategic Marketing*, 24(3-4), 311-326.
- Ferraris, A., Santoro, G., Bresciani, S., & Carayannis, E. G. (2018). HR practices for explorative and exploitative alliances in smart cities: Evidences from smart city managers' perspective. *Management Decision*, 56(6), 1183-1197.
- Fisher, G. J., & Qualls, W. J. (2018). A framework of interfirm open innovation: relationship and knowledge-based perspectives. *Journal of Business & Industrial Marketing*, 33(2), 240-250.
- Fjeldstad, O. D., Snow, C. C., Miles, R. E., & Lettl, C. (2012). The architecture of collaboration. *Strategic Management Journal*, 33(6), 734-750.
- Freel, M., & Robson, P. J. (2017). Appropriation strategies and open innovation in SMEs. *International Small Business Journal: Researching Entrepreneurship*, 35(5), 578-596.
- Galán-Muros, G., & Plewa, C. (2016). What drives and inhibits university-business cooperation in Europe? A comprehensive assessment. *R&D Management*, 46(2), 369-382.
- Gebauer, J., Füller, J., & Pezzeri, R. (2013). The dark and the bright side of co-creation: Triggers of member behavior in online innovation communities. *Journal of Business Research*, 66(9), 1516-1527.
- Gesing, J., Antons, D., Piening, E. P., Rese, M., & Salge, T. O. (2015). Joining Forces or Going It Alone? On the Interplay among External Collaboration Partner Types, Interfirm Governance Modes, and Internal R&D. *Journal of Product Innovation Management*, 32(3), 424-440.
- Greco, M., Grimaldi, M., & Cricelli, L. (2016). An analysis of the open innovation effect on firm performance. *European Management Journal*, 34(5), 501-516.
- Greco, M., Grimaldi, M., & Cricelli, L. (2017). Hitting the nail on the head: Exploring the relationship between public subsidies and open innovation efficiency. *Technological Forecasting & Social Change*, 118(C), 213-225.
- Guerrero, M., & Urbano, D. (2017). The impact of Triple Helix agents on entrepreneurial innovations' performance: An inside look at enterprises located in an emerging economy. *Technological Forecasting & Social Change*, 119, 294-309.
- Hewitt-Dundas, N., & Roper, S. (2018). Exploring market failures in open innovation. *International Small Business Journal: Researching Entrepreneurship*, 36(1), 23-40.
- Hughes, B. & Wareham, J. (2010). Knowledge arbitrage in global pharma: a synthetic view of absorptive capacity and open innovation. *R&D Management*, 40(3), 324-343.
- Huizingh, E. K. R. E. (2011). Open innovation: state of the art and future perspectives. *Technovation*, 31(1), 2-9.
- Ind, N., Iglesias, O., & Markovic, S. (2017). The co-creation continuum: from tactical market research tool to strategic collaborative innovation method. *Journal of Brand Management*, 24, 310-321.
- Iturrioz, C., Aragón, C., & Narvaiza, L. (2015). How to foster shared innovation within SMEs' network: social capital and the role of intermediaries. *European Management Journal*, 33(2), 104-115.
- Janeiro, P., Proença, I., & Gonçalves, V. C. (2013). Open innovation: factors explaining universities as service firm innovation sources. *Journal of Business Research*, 66(10), 2017-2023.
- Kratzer, J., Meissner, D., & Roud, V. (2017). Open innovation and company culture: Internal openness makes the difference. *Technological Forecasting & Social Change*, 119, 128-138.

- Lakemond, N., Bengtsson, L., Laursen, K., & Tell, F. (2016). Match and manage: the use of knowledge matching and project management to integrate knowledge in collaborative inbound open innovation. *Industrial and Corporate Change*, 25(2), 333–352.
- Lamberti, E., Michelino, F., Cammarano, A., & Caputo, M. (2017). Open innovation scorecard: a managerial tool. *Business Process Management Journal*, 23(6), 1216-1244.
- Lauritzen, G. D., & Karafyllia, M. (2019). Perspective: Leveraging Open Innovation through Paradox. *Journal of Product Innovation Management*, 36(1), 107–121.
- Lee, S. M., Olson, D. L., & Trimi, S. (2012). Co-innovation: convergenomics, collaboration, and co-creation for organizational values. *Management Decision*, 50(5), 817-831.
- Lifshitz-Assaf, H. (2018). Dismantling Knowledge Boundaries at NASA: The Critical Role of Professional Identity in Open Innovation. *Administrative Science Quarterly*, 63(4), 746–782.
- Lopes, A. P. V. B. V., & Carvalho, M. M. (2018). Evolution of the open innovation paradigm: towards a contingent conceptual model. *Technological Forecasting & Social Change*, 132(July), 284-298.
- Malhotra, A., & Majchrzak, A. (2014). Managing Crowds in Innovation Challenges. *California Management Review*, 56(4), 103-123.
- Marullo, C., Casprini, E., Di Minin, A., & Piccaluga, A. (2018). ‘Ready for Take-off’: How Open Innovation influences startup success. *Creativity and Innovation Management*, 27(4), 476-488.
- Marullo, C., Di Minin, A., De Marco, C., & Piccaluga, A. (2020). Is open innovation always the best for SMEs? An exploratory analysis at the project level. *Creativity and Innovation Management*, 29(2), 209-223.
- Mount, M., & Martinez, M. G. (2014). Social Media: a tool for open innovation. *California Management Review*, 56(4), 124-143.
- Nucciarelli, A., Li, F., Fernandes, K. J., Goumagias, N., Cabras, I., Devlin, S., Kudenko, D., & Cowling, P. (2017). From value chains to technological platforms: The effects of crowdfunding in the digital game industry. *Journal of Business Research*, 78, 341-352.
- Paulo, A. F., Carvalho, L. C., Costa, M. T. G. V., & Galina, S. V. R. (2017). Mapping open innovation: a bibliometric review to compare developed and emerging countries. *Global Business Review*, 18(2), 291-307.
- Pellegrini, L., & Lazzarotti, V. (2019). How governance mechanisms in family firms impact open innovation choices: A fuzzy logic approach. *Creativity and innovation management*, 28(4), 486-500.
- Pullen, A. J. J., Weerd-Nederhof, P. C., Groen, A. J., & Fischer, O. A. M. (2012). Open innovation in practice: goal complementarity and closed NPD networks to explain differences in innovation performance for SMEs in the medical devices sector. *Journal of Product Innovation Management*, 29(6), 917-934.
- Randhawa, K., Wilden, R., & Hohberger, J. (2016). A bibliometric review of open innovation: setting a research agenda. *Journal of Product Innovation Management*, 33(6), 750-772.
- Radziwon, A., & Bogers, M. (2019). Open innovation in SMEs: Exploring inter-organizational relationships in an ecosystem. *Technological Forecasting & Social Change*, 146, 573-587.
- Rampersad, G., Quester, P., & Troshani, I. (2010). Managing innovation networks: Exploratory evidence from ICT, biotechnology and nanotechnology networks. *Industrial Marketing Management*, 39(5), 793–805.
- Alvesson, M., & Sandberg, J. (2011). Generating research questions through problematization. *Academy of Management Review*, 36(2), 247-271.
- Santoro, G., Vrontis, D., Thrassou, A., & Dezi, L. (2018). The Internet of Things: Building a knowledge management system for open innovation and knowledge management capacity. *Technological Forecasting & Social Change*, 136, 347–354.
- Schiele, H. (2012). Accessing supplier innovation by being their preferred customer. *Research-Technology Management*, 55(1), 44-50.
- Scuotto, V., Ferraris, A., & Bresciani, S. (2016). Internet of Things: applications and challenges in smart cities. A case study of IBM smart city projects. *Business Process Management Journal*, 22(2), 357-367.
- Spender, J.-C., Corvello, V., Grimaldi, M., & Rippa, P. (2017). Startups and open innovation: a review of the literature. *European Journal of Innovation Management*, 20(1), 4-30.
- Wang, C.-H., Cheng, C.-H., & Shen, G. C. (2015). The effect of inbound open innovation on firm performance: Evidence from high-tech industry. *Technological Forecasting & Social Change*, 99, 222-230.
- Wang, C.-C., Sung, H.-Y., Chen, D.-Z., & Huang, M.-H. (2017). Strong ties and weak ties of the knowledge spillover network in the semiconductor industry. *Technological Forecasting & Social Change*, 118, 114–127.
- West, J., & S. Gallagher. (2006). Challenges of open innovation: The paradox of firm investment in open-source software. *R & D Management*, 36(3), 319-331.
- Xie, X., Fanga, L., Zeng, S. (2016). Collaborative innovation network and knowledge transfer performance: A fsQCA approach. *Journal of Business Research*, 69 (11), 5210–5215.
- Zubielqui, G. C., Fryges, H., & Jones, J. (2019). Social media, open innovation & HRM: Implications for performance. *Technological Forecasting & Social Change*, 144, 334–347.