A scoping review on the practices of open innovation

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Abstract

The growing pressure for innovation has led companies to seek new ways to manage and acquire knowledge. Thus, innovation management is a critical activity for all companies and open innovation is a means that aims to commercially exploit innovation opportunities. The literature on open innovation has grown, however, there are still research gaps in terms of practices, their operationalization and results in organizations. This article aims to identify the main OI practices, characteristics and barriers for its implementation and its impact on the company's performance. As a result, this study helps managers to implement OI practices, taking into account their barriers and contextual factors, in addition to generating research opportunities

1. Introduction

Firms must constantly improve their innovation management to develop and maintain their competitiveness in the economic setting [1-2]. Usually, innovations are produced and commercialized only within the company's boundaries (a.k.a. closed innovation). In closed innovation, firms use only their internal skills and control the innovation process. This logic, however, creates excess of labour and fails to recognizing the profitable opportunities. This is why there is a trend in shifting towards more open innovation approaches, in which firms rely on external partners to develop innovative ideas [3-4-5-6]. Therefore, an innovation management model called Open Innovation (OI) was identified and it can be understood as a model based on the use of external resources, such as knowledge and technology, for the adoption of new products and processes [7-8-9].

Despite the relevance of OI, prior works are mostly based on theoretical considerations. However, understanding the strategic management of companies' OI is important for theory and practice [10-11-12-13]. There are still unanswered questions regarding OI, mainly, on how companies are adopting it [14-15]. OI allows companies to integrate and market complementary resources that increase profits and, eventually, increase firm performance [16]. Thus, the general idea is that OI is beneficial to the firm performance, however, companies can use one, two or all OI practices, to a greater or lesser extent. Detecting the main contextual factors that influence firm performance is still a challenge for research, as well as evaluating the effect of different OI practices on firm performance. From a contingency perspective, the degree of impact of OI on performance should be considered context-dependent. Although several studies have addressed contextual factors, knowledge about the practices that make an OI effective influenced by contextual factors is still fragmented [17-18-19].

OI has become one of the most researched topics in innovation management. Academic interest is evidenced by the growing number of publications on the subject and, in practical terms, it is identified by the growing number of articles that describe the adoption of OI in companies. Despite the large amount of literature on OI, there is a lack of systematic organization of previous research [20].

Thus, considering the gap in the literature and the theoretical and practical importance of studying OI practices, influenced by contextual factors and the impact on firm performance, this article aims to identify the main OI practices, characteristics and barriers for its implementation and its impact on the company's performance. The method used for this research was the scoping review, since we sought to reinforce the proposed study and justify the research differential, based on the identification of gaps and perspectives. The purpose of a scoping review is to map the body of literature into a subject area and to provide a descriptive overview of the reviewed material, without making a critical assessment of individual studies [21-22]. The contribution of this study is two-fold. First, from a theoretical point of view, we raise content about OI and present research gaps and opportunities. Second, in practical terms, this research helps managers in decision making in the implementation of OI in companies and in the effective conduct of practices and anticipation of barriers.

The reminder of the paper is structured as follows. Section 2 provides a conceptual basis on the two main

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elements of this research: (i) OI and (ii) impact of innovation on firm performance. Section 3 describes the literature review methodology. Section 4 presents the descriptive results of the bibliometric analysis. Then, a conclusion is presented in section 5, with analyzes and discussions on practices and barriers to implementation and proposals for future studies.

2. Background

2.1. Open innovation

Innovation has been widely mentioned as the main process driving economic growth of firms and a recurring classification refers to the innovation management model that can be defined as closed or open [8-23-24-25]. Open innovation (OI) is an important topic in innovation management and proposes a change from a closed model in management, based mainly on internal R&D, to an open model, with intentional inputs and outputs of knowledge and technology [10-26-27-28].

OI enables companies to integrate external know-how (inbound process), as well as utilize internal knowledge in external markets (outbound process), from bilateral to multiple actors relationships [1- 11-29-30]. One of its most often used definition is: 'the use of purposive inflows and outflows of knowledge to accelerate internal innovation, and to expand the markets for external use of innovation, respectively' [31].

Over the past decade, the OI field has attracted more attention among researchers and managers, which is demonstrated by the growing number of publications in this area of research [32-33]. Since then, thousands of publications approached OI, its practices and challenges. In the academic area, OI has become one of the most popular topics and has been proposed as a new paradigm for innovation management [2-34-35-36-37]. As OI became popular in practice the academic field started investigating the concept [8-11-14-31]. Similarly, the manufacturing industry, stimulated by globalization and the need for technology, began to invest more in OI to improve productivity and meet customer demands [38]. The access to external sources of knowledge has enabled many companies to improve their performance [39].

2.2. Impact of open innovation on firm performance

Firm performance has become a relevant concept in strategic management research. Although it is a very common notion in academia, there is still a gap in its definition and measurement [40]. Through performance management, the company can identify opportunities in relation to metrics and implement strategies to improve performance [41]. In this context, innovation is a survival strategy in which companies obtain competitive advantages in the current market, thus, innovative companies can improve their performance [42-43-44-45].

Open innovation and firm performance are complex associations. OI generally has a positive impact on the firm performance [46-47]. Some studies point out that innovation is positively related to the firm performance, while others have a negative association. Likewise, the contingencies of each company and the relationship need to have more in-depth studies [48]. Several studies have analyzed the effects of OI on the firm performance, however, the literature has not yet reached a consensus on effects on the firm performance, nor on the definition of the firm performance indicators in OI studies [49-50].

3. Method

For the planning and formulating the search problem, as suggested by Thomé et al. [51], an initial wide search for OI was conducted to obtain a better clarification of the research. This search indicated that scholars agreed that companies are still facing difficulties in implementing OI, particularly in terms of OI practices [14-52-53-54]. Some studies brought evidence of the positive impact of OI practices on firm performance; others, conversely, demonstrated a negative impact. Thus, OI suffers from a gap in the literature of sufficient methodology and measurement instruments and evidence of how a choice of a OI practice affects other practices [53-55-56].

This gap in the literature raised the following research questions:

RQ1. "What are the main practices of OI, their characteristics and barriers?"

RQ2. "Which firm performance measures are most impacted by OI practices?"

To answer these research questions, a scoping review was carried out. Scoping review uses rigorous and transparent methods to comprehensively identify and analyze all relevant literature pertaining to a research question and to provide an overview [21-22]. The review process consisted of three steps: (i) data collection, (ii) data analysis, and (iii) synthesis [58].

For the data collection stage, the scientific articles were identified using the keywords "Open innovation", "Methods ", "Practices", "Barriers" and "Contextual factors", based on the research questions, and the databases used were Scopus and Web of Science (WOS), as suggested by Randhawa et al. [7], Rosa et al. [59] and Spender et al. [60] in the OI theme. To validate

the keywords used in the initial search, an adherence check was performed at this stage. For this purpose, three articles with high citations within the portfolio were and their keywords were compared with those used in this research. No need for additional keywords was verified. The search period in these databases was March 2021. There was no temporal delimitation of the publications. The software used to register and select the articles was Mendeley.

The data collection step is divided into database selection, keyword selection, abstract review, full-text review, and backward or forward 'snowball'[51], as adapted in Table 1. Snowball refers to using an article's reference list or article citations to identify additional articles [61]. Therefore, using references from 56 articles, we examined the titles of articles included in the reference lists and to identify whether the articles were relevant, we searched for keywords in those articles. An addition of 12 publications was obtained in this process.

For the data analysis step, a content analysis was performed, the articles were analyzed using descriptive methods, for this, we examine the year of publication, journals and authors. Then, the corpus was qualitatively explored, and two axes were defined for analysis: (i) OI practices and (ii) firm performance. To enrich the understanding of these practices for the implementation of OI, mention of the impact of contextual factors on OI practices was also analyzed, as suggested by the literature.

Finally, in the synthesis stage, a conclusion was made based on future research opportunities.

Table 1. Bibliographic portfolio

Keyword selection	**Databases**	
"Open innovation" AND "Methods*" OR "Practices" OR "Barriers" OR "Contextual factors*"	Scopus	WOS
	1,805	1,255
Publishing analysis criteria		
Articles identified, eliminating duplicates	2.021	
Title review (aligned with the theme)	624	
Abstract review	187	
Full-text review	56	
Snowballing	68	

4. Results

The research analyzed the bibliographic portfolio (BP) in relation to the most relevant journals and authors and the year of publication. As for the journals, were highlighted the journals European Journal of Innovation Management, Technological Forecasting and Social Change and International Journal of Innovation Management, which present more than 5 publications each. Based on the 68 articles that compose the BP, 152 authors were identified, of which 10 presented more than 2 articles published. It should be noted that the author Vanhaverbeke, W. presents the largest number of publications (4 articles) in BP and it is also important to highlight the author Chesbrough, the creator of the term open innovation, with 3 articles in the BP. For the years of publication of articles in the BP, it appears that the theme is recent since the first publications in 2006, in the first citation of the term. However, it should be noted that as of 2017 there was an increase in publications on this topic, with 8 articles, reaching its peak in 2020, with 16 articles. This fact demonstrates the growing relevance of OI, some studies have suggested that OI collaborations are the next big opportunity for companies to improve. its creativity and fuel innovation [26].

Table 2 presents the main OI practices classified by the literature, categorized in the three OI processes. The first OI process, inbound (I), is in the search and adoption of knowledge and technology from outside the limits of the company, to seek the growth of the company. The second process, outbound (O), refers to the transfer of technology and knowledge outside the company, the commercialization of technology is the main objective of this process. The third process, called coupled process (C), combines the previous processes, working together with partners [3-50-62-63]. According to the table, twenty-one practices were identified, nine classified as I, seven as O and five as C, of which IP In-licensing and Acquisition stands out in number of citations, followed by Out-licensing. Through the analysis of the BP literature, it is possible to identify that many works identify the OI process, but do not classify the specific practice used. Of the 68 works in the portfolio, 40 classified the OI processes studied and only 16 specified defined OI practices.

These data are corroborated by the literature, some works in the literature divide the practices of OI. Inbound modes are adopted more often and more intensively than outbound modes. In this process, the most intensively adopted OI practices are collaborative innovation, IP licensing and acquisition and co-creation with clients in R&D projects [56]. Research on OI in practice and its managerial challenges is still scarce and this could be one of the reasons why OI still represents a big challenge for organizations. Although a considerable number of theoretical contributions on OI have been published, the empirical evidence on how and to what extent adoption of OI practices occurs is still limited [35-64-65].

Table 2. OI practices mentioned in the literature

Process	Literature references	Practice	Literature references

I	[2-3-4-8-11-14-33-34-53-55-56-59-66-68-69-70-71-72-73-74-75-76-77-78-79-80-81-83-84-85-87-89-90-91-92]	Supplier collaboration	[54-62-66]
		University collaboration	[52-53-54-62-6]6-88]
		Government collaboration	[53-62-66]
		IP In-licensing and Acquisition	[3-53-54-56-62-66-68-76-84-86]
		Consumer and customer co-creation	[53-54-56-66-68]
		Idea and start-up competitions	[56-66]
		Crowdsourcing	[53-56-66-75]
		Specialized services from OI intermediaries	[53-66]
		Contracting with external R&D service	[53-54-56-76]
O	[1-2-4-8-11-14-55-56-59-66-68-69-70-71-72-73-74-75-76-77-78-80-82-83-84-85-89-92]	Out-licensing	[1-52-56-62-68-75-76-86]
		Divest	[1-52-62]
		External technology commercialization	[52-53-56-62]
		Joint venture activities with external partners	[1-53-66-76-84-86]
		Participation in public standardization	[53-56-66]
		Corporate business incubation and venturing	[53-66]
		Spinoffs	[52-53-66-68-76-86]
C	[3-4-8-11-14-66-67-68-72-73-74-75-76-84-85-89-91]	Co-patent	[52-53-62-75-84]
		R&D Alliance	[53-62-84]
		Manufacturing Alliance	[62-67]
		Joint technology development	[52-53-54-67]
		Innovation networks and Innovation clusters	[54]

Although several benefits can be identified, adopting OI practices requires big changes in the business model [93]. Some aspects contributing to the effectiveness of OI remain poorly researched. Understanding OI barriers can afford to managers knowledge to avoid negative attitude with OI [2-35-37-67]. Generally, firms tend to consider organizational change the most significant challenge. The management of external relationships with partners is also an important challenge with cultural and organizational differences [8-15-34-66-76-94-95]. Other barriers have also been pointed out in the literature, for example, the management challenges [35-93]; lacking resources [76]; low knowledge absorptive capacity [96]; few indicators to measure its impact [97] and a firm's use of intellectual property (IP) and this is a topic as it is perceived as one of the major barriers to OI by many managers [3-65-76-77]. The study by Oumlil and Juiz [2] considers six categories of barriers for the implementation of OI: environmental, managerial and organizational, individual, cultural, innovative and processual. Similarly, the work of De Oliveira et al. [32] identified six thematic categories of critical success factors for OI implementation which are: Leadership, Internal innovation capability, Network and relationships, Strategy, Technology management and Culture. In the same sense, Bigliardi and Galati [20] identify four main barriers: knowledge, collaboration, organizational and financial and strategic.

In that same context, Table 3 presents the references that identify a OI practice and present contextual factors that can influence in the studied OI practice, or even serve as a barrier to implementation. In the analysis of the table, it can be seen that the variables company size and industry sector are the most cited in BP studies. Only 17 studies showed an association between OI practices and contextual variables.

Company size influences 20 of the 21 OI practices (as displayed in Table 3), therefore, it is the most prominent contextual factor. Regarding the 21 OI practices, 'IP in-licensing and acquisition' and 'out-licensing' seemed to be the most frequently reported in association with company size. The study by Lichtenthaler [10] states that while firm size has a strong positive impact on the degree of openness, the sector does not have a big influence. Likewise, the work of Inauen and Schenker - Wicki [3] points out that, there are statistically significant correlations between company size and cooperation intensity. Moreover, firms with the largest revenue engaged the most in outbound OI. The study by Van De Vrande et al. [34], focuses that, once a large size is reached, the companies may be better able to formalize their OI practices. Small firms often lack resources to develop and commercialize new products in-house and, as a result, are more often inclined or forced to collaborate with other organizations. The study by Crema et al. [98] focuses that, older and larger companies tend to follow more likely a diversification strategy with respect to young and small firms. In the same context, the work of Rippa et al. [94] indicates that small firms are in need of help to manage their innovation process when they open their boundaries. Industry sector often affects the depth and breadth of OI, e.g., firms in high-tech industries are more likely to adopt OI [81-99]. Oltra et al. [54] suggested that 'supplier collaboration' and 'consumer and customer co-creation' do not seem to affect firm performance. However, depending on the sector in which the company operates. In opposition, company location is the least cited contextual factor (5 citations), possibly because studies conducted in a specific region are less likely to be replicable. However, comparative studies of OI in different locations are important to understand the impact of this factor on OI practices. Although many studies have described the geographic nature of innovation flows, few ones have quantitatively measured the effect of location on such flows [88]

Overall, this analysis of practices, barriers and contextual factors of companies provide arguments to answer RQ1.

Table 3. Contextual factors that influence OI practices

OI Practices	Company size	Industry sector	Plant age	Company location
Supplier collaboration	[3-4-54-62]	[3-4-54]	[62]	
University collaboration	[4-52-53-54-62]	[4-54]	[52-62]	[88]
Government collaboration	[53-62]		[62]	
IP In-licensing and acquisition	[3-8-10-34-52-53-54-76-81-84]	[3-10-34-54-76]	[52-81]	[10-76]
Consumer and customer co-creation	[4-34-53-81]	[4-34]	[81]	
Idea and start-up competitions	[99]	[99]	[99]	
Crowdsourcing	[53]			
Specialized services from OI intermediaries	[53]			
Contracting with external R&D service	[3-34-76]	[3-34-76]		[76]
Out-licensing	[1-52-54-62-81]	[1-54]	[52-62-81]	
Divest	[1-52-62]	[1]	[52-62]	
External technology commercialization	[10-52-53-62-81-97]	[10-97]	[52-62-81-7]	[10-97]
Joint venture activities with external partners	[8-53-54-67-76-84]	[54-67-76]		[67-76]
Participation in public standardization	[53]			
Corporate business incubation and venturing	[8-10-53]	[10]		[10]
Spinoffs	[8-52-53-76]	[76]	[52]	[76]
Co-patent	[52-53-62-84]		[52-62]	
R&D Alliance	[10-52-53-62-84]	[10]	[52-62]	[10]
Manufacturing Alliance				
Joint technology development	[52-53-67]	[67]	[52]	[67]
Innovation networks and Innovation clusters	[34-54-81]	[34-54]	[81]	

To help answer the RQ2 question, a search was carried out for studies that mention the OI process or practice used and the impact on company performance, as detailed in Table 4. Of the 68 articles in the BP, only 17 emphasize the practice or process of OI used and the impact on company performance. Through the analysis, it is possible to identify that of the 17 indicators proposed to analyze the impact on the company's performance, 11 are related to internal processes, such as the performance of the innovation itself, and the other perspectives are poorly studied. Furthermore, most of these studies emphasize the OI process used but not the specific practice. This analysis is supported by the literature, OI practices have a strong impact on the company's capacity for innovation and performance [4]. Most previous studies have investigated the effect of practices separately with respect to different dimensions of performance. For this reason, there is a need for a consistent rating system in determining the impact of OI [52-79-81-97-100]. There are only a few articles that test the impact of a specific OI practice on a specific performance measure [62]. Future research should further analyze the contingent effect of organizational conditions on the relationship between OI and firm performance [4-54-97-100]. Most researchers do not direct their work to investigate OI metrics or indicators, nor do they at least specify them in the context of their research [59-82].

Table 4. Impact of OI practices on firm performance

Firm Performance	**Reference**
Conquering new customers	[68]
Profitability, growth, market share, and overall performance	[54]
Financial Performance	[52-62]
Cost Reduction and Revenue Increasing.	[8]
Innovation Performance	[4-52-62-81-82-86-87-88-91-97-99]
Innovation process and radical innovation	[1]
Product and process innovations	[3-67]
Firm’s satisfaction with its OI	[66]
Organization, Success, Strategy, Inbound and Outbound collaboration, Culture and Knowledge	[59]
Patents	[68]

5. Conclusions

The objective of this work was to identify the main practices, characteristics and barriers for its implementation and its impact on the firm performance. For this reason, the method used for this research was the scoping review, as we sought to identify gaps and perspectives for future work. Although many studies on OI practices have been identified, the literature lacks a standardized and robust theoretical basis for the implementation and relationship of OI practices with contextual barriers and factors, in addition to the impact on firm performance.

Despite the results obtained, it is worth emphasizing some limitations of this study. First, its analysis is focused on OI practices and the impact on firm performance, however, future studies can analyze the BP from new perspectives, such as analysis in specific companies and sectors or OI's relationship with other emerging topics such as Industry 4.0 and servitization. Second, our research keywords do not cover the theoretical or conceptual paradigms of firm-level performance. In this way, future studies can analyze the literature on firm performance and then examine the OI, recognizing other study perspectives.

Based on the results, for future research opportunities, the work identifies some gaps related to the use of OI in practice. Thus, three main topics for future research are highlighted: (i) broad methodology to analyze specific OI practices in relation to barriers and contextual factors; (ii) analysis of the relationship between the implementation of OI practices in the company's performance, in addition to innovation performance, such as financial performance or customer satisfaction; and (iii) longitudinal studies to monitor the real impact of OI practices on firm performance.

6. References

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