025-0572 - Open innovation: An analysis of publications, citations and scientific collaboration between 2003 and 2011

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Abstract: Nowadays the idea are created inside and outside in the organizations. The main objective of this article is to understand the publication patterns of open innovation, focusing on aspects related publications, citations and scientific collaboration, between 2003 and 2011. For this, the authors performed a bibliometric study with content analysis.

1. INTRODUCTION

Open innovation, a term coined by Chesbrough in 2003, which represents mainly the generation of ideas and use internal and external entities, has been a topic of interest in research (ZIEN, BUCKLER, 1997; CHESBROUGH, 2006; DOGSON, GANN, SALTER, 2006).

Increased pressure for innovation has led companies to seek new ways to manage and acquire knowledge. The motivating factors vary from company to company (HENKEL, 2006) and how each one uses the knowledge gained also generates different results regarding the ability to innovate.

This research aims to analyze the literature of open innovation in a structured way in order to identify possible patterns of publications, as well as select works representative regarding your citations.

The work is divided into three sections, which were research methodology, results and conclusions. In the methodology section, the steps are described for selecting the sample for analysis and the indicators to be analyzed. The results are presented the main findings and conclusions are strengthened most representative analysis as well as possible limitations are cited in the research.

2. RESEARCH METHOD

The research method used in this work was to study by means of bibliometric analysis of publications and citations. According to Tata and Prasad (2005), analysis of publications allows identifying the profile of the journals, as well as areas related to the subject of research. As for Neely (2005), the bibliometric study carried out by means of citation analysis allows to map the most referenced authors and works.

Due to the increasing number of journals in the early 70's was created or JCR impact factor (Journal Citation Report), which is a performance indicator of journals (GLANZEL and CURRENCY, 2002).

2.1. Sample

We performed a search in the database ISI Web of Science, using the topics "open innovation" or "open innovations". This search resulted in 374 papers, including articles, reviews, abstracts, news and editorial material. We chose to examine only articles are peer-reviewed by the referees, reducing the sample to 172 jobs, which involved 314 authors, 27 countries and 65 periodicals. After reading the abstracts, 12 articles were excluded because they did not fit the theme of research, resulting in the final sample of 160 articles.

The data were processed in the software Sitka (SCHILDT, 2002) and networks were designed with the help of the software UCINET (BORGATTI, EVERETT, FREEMAN, 2002).

2.2. Indicators of publications

The first indicator was the publication per journal and year, which identified the journals that published most of these developments as well as the publications over time. The

second indicator of publications was the keywords, which enabled the identification of areas related to research.

2.3. Indicators of citations

The first indicator was the citation ranking of the five most cited papers in the period. The second indicator was the most cited papers of the sample, with analysis of their content. The third indicator was the citation of articles for references. The references of the articles may be important to the research work that, for some reason did not appear in the search. Examples of such work are the books that are left out in choosing to examine only articles.

2.4. Indicator of cooperation

The indicator was discussed cooperation to collaboration among countries for publications of the articles analyzed, which allowed the identification of the work published individually and those who worked in partnership with others.

3. RESULTS

The following sections are intended to present the results obtained with bibliometric study.

3.1. Indicators of publications

The 160 articles were published in 55 journals, which indicate that there is a multidisciplinary area (average of 2.9 articles per journal). The editorial scope of this relationship journal covers topics such as management, technology, economics, science, strategy, among others (see Table 1).

Table 1

Publications by journal and year.

Journal	Year								
	2003	2004	2005	2006	2007	2008	2009	2010	Total
R & D Management				6	1		11	13	31
International Journal of Technology Management				3		1		14	18
Research Policy			2	2		2	1	8	15
Research-Technology Management		1	1	2	1	2	3	5	15
Technovation					1	1	3	3	8
California Management Review	1				2			2	5
Information Technology & People							3		3
Journal of Product Innovation Management						1		2	3
Journal of Universal Computer Science							2	1	3
MIT Sloan Management Review	1				1		1		3
Organization Science				1	1			1	3
Technology Analysis & Strategic Management						1		2	3
Asian Journal of Technology Innovation						1	1		2
Data Base for Advances in Information Systems							1	1	2
Food Technology						1	1		2
Industry and Innovation						1	1		2
Management Decision						2			2
Management Science						1	1		2
Technological Forecasting and Social Change							1	1	2
Academy of Management Review								1	1
ACTA Astronautica							1		1
Argumenta Oeconomica							1		1
Behaviour & Information Technology							1		1
British Food Journal							1		1
Cereal Foods World								1	1
Decision Support Systems							1		1
Economic Development Quarterly								1	1
European Urban and Regional Studies								1	1
Harvard Business Review							1		1
IEEE Transactions on Engineering Management						1			1
Industrial and Corporate Change							1		1
Industrial Marketing Management								1	1
Innovation-Management Policy & Practice							1		1
Innovation-The European Journal of Social Science Research							1		1
Interactive Learning Environments							1		1
International Journal of management Reviews								1	1
International Journal of Semantic Web and Information Systems							1		1
Journal of Business Research								1	1
Journal of Business Venturing						1			1
Journal of Engineering and Technology Management						1			1
Journal of International Management							1		1
Journal of Management Information Systems							1		1
Journal of Management Studies							1		1
Journal of World Business							1		1
Online Information Review								1	1
Organizational Dynamics								1	1
Public Management Review								1	1
Regional Studies						1			1
Review of Policy Research								1	1
Science and Public Policy								1	1
Scientometrics								1	1
Strategic Entrepreneurship Journal								1	1
Strategic Organization							1		1
Universia Business Review							1		1
Wirtschaftsinformatik						1			1
Total	2	1	3	14	7	19	47	67	160

The four journals that published more than ten articles were:

- R&D Management: publishes articles for academics and managers in the areas of innovation and research and development. The works have social, economic and environmental. Impact factor: 0,928.
- International Journal of Technology Management: aims to develop, promote and coordinate the science and technology management addressing issues such as competitiveness, cooperation, knowledge, information technology, globalization, among others. Impact factor: 0,419.
- Research Policy: seeks to analyze theoretically and empirically the interactions between innovation, technology or research with organizational processes economic, social and political. Impact factor: 2,261.
- Research-Technology Management: periodic technological innovation, focusing on research and development of new products. Impact factor: 0,507.

Although the first publications date from 2003, was from 2006 that they actually began to increase. This increase was in part the increase in publications in general, but also partly by the growth of interest in innovation and cooperation issues together.

Figure 1 shows the network of keywords that appeared in the sample more than 12 times (20 keywords). This filter was made of citations respecting the nomination 10 to 10% of the sample suggested by the software manual Sitks.

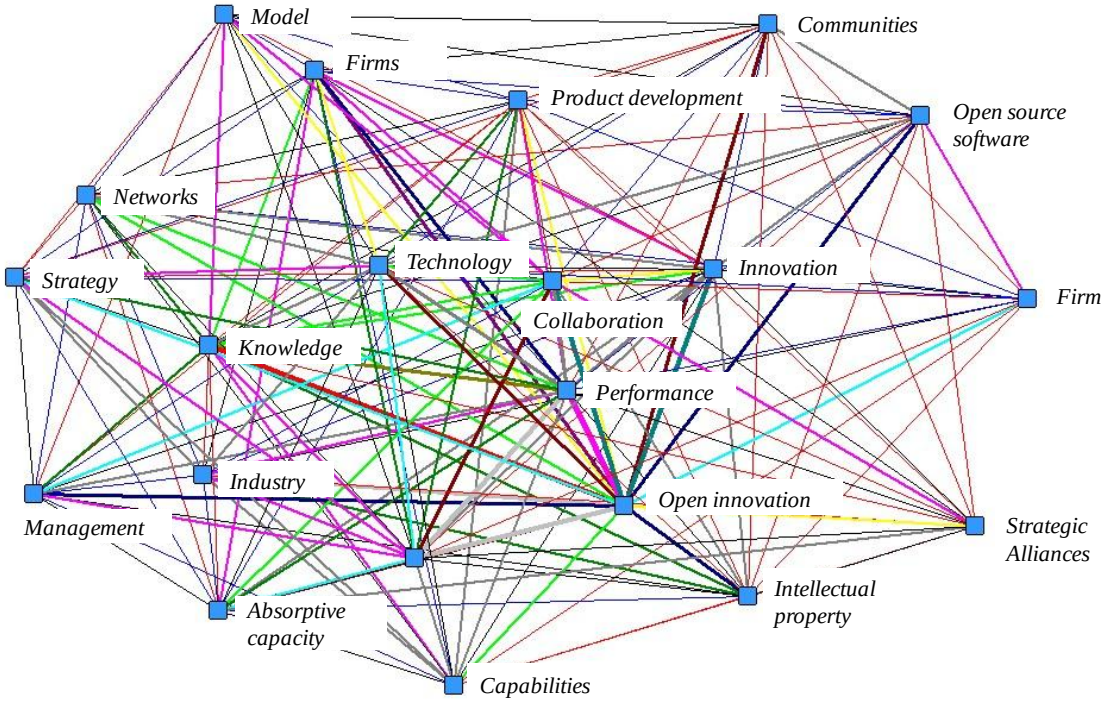

Figure 1. Keyword network.

Note: The thicknesses and colors represent the intensity of the relationship.

The stronger connections with the keyword search in this study (open innovation) were:

- Knowledge: was strongly present in the analyzed articles. Although difficult to measure the attainment of knowledge is the subject of interest to those who innovate through collaboration.
- Performance: the texts related to the goals expected in the relations of partnership. Verifies the existence of the interaction between innovation actors.
- Innovation: mainly related to processes that involve high technology. Search for new technologies and sharing of costs and risks.
- Product development: Articles appeared heavily studied indicating an interest in investing entities together in research and development. What does each entity with the knowledge acquired in the partnership which may increase or decrease its capacity to launch innovative products.

3.2 Indicators of citations

Based on the total sample, Table 2 shows the ranking of the five most cited articles from 2003, the year the group has 160 articles to be named.

Table 2

Ranking of the five most cited articles from 2003 to 2010.

Year	Most cited articles				
	1	2	3	4	5
2003	Chesbrough (2003a)	-	-	-	-
2004	Chesbrough (2003b)	Chesbrough (2003a)	-	-	-
2005	Chesbrough (2003a)	-	-	-	-
2006	Chesbrough (2003a)	Chesbrough (2003b)	Chesbrough (2004)	-	-
2007	Chesbrough (2003a)	Chesbrough (2003b)	Cooke (2005) / Christensen, Olesem, Kjaer (2005) / Jacobides e Billinger (2006)	Henkel (2006)	Dodgson, Gann, Salter (2006) / Fleming e Waguespack (2007) / Chesbrough (2004) / Lichtenthaler e Ernst (2006)
2008	Chesbrough (2003a)	Chesbrough (2003b)	Chesbrough e Crowther (2006)	Cooke (2005)	Henkel (2006) / Christensen, Olesem, Kjaer (2005)
2009	Chesbrough (2003a)	Henkel (2006)	Chesbrough e Crowther (2006)	Piller e Walcher (2006)	Chesbrough e Appleyard (2007)
2010	Chesbrough (2003a)	Chesbrough e Crowther (2006)	Cooke (2005)	Henkel (2006)	Piller e Walcher (2006) / Jacobides e Billinger (2006) / Christensen, Olesem, Kjaer (2005)

The articles that more appeared in the ranking were: Chesbrough (2003a), which introduced the concept of open innovation, Chesbrough (2003b), which identified that intellectual property should be managed by the logic of open innovation, Henkel (2004), which identified different among the factors motivating firms to innovate; Chesbrough and Crowther (2006), which identified the direct applicability of the concepts of open innovation in companies; Cooke (2005), which identified a strong influence of the parameters in the industry to innovate.

Table 3 presents the list of eleven papers with at least twenty-five publications.

Table 3

List of articles with at least 25 citations.

Article	Journal	Citations	Objectives	Conclusions
Henkel (2006)	Research Policy	45	innovations that study Linux	found that companies have different motivations to open its innovation system, which is independent of the branch in which it operates
Cooke (2005)	Research Policy	38	analyzing the origins and nature of innovation in today's society	identified a strong influence on the type of industry in the parameters of firms
Chesbrough (2003a)	MIT Sloan Management Review	112	analyzing open innovation versus closed innovation	the author demonstrated applications of closed and open innovation, and found that many companies are in a time of transition from one to the other
Christensen, Olese, Kjaer (2005)	Research Policy	28	analyze the concept of open innovation, in a dynamic industry	the authors confirmed the proposition that the form of management of technological innovation influences the company's position as to its ability to innovate
Chesbrough e Crowther (2006)	R & D Management	45	identify companies that are not of high technology and concepts used in open innovation	research has shown that some concepts of open innovation, such as growth in revenues and new products have application in companies that are not high-tech
Piller e Walcher (2006)	R & D Management	30	explore the design and implementation of "toolkits for idea competition" as a method for developing new products and evaluate their performance through indicators such as quality of ideas generated	the authors found that the internet is an effective means of integrating the user in the process of developing new products, which may provide a process
Dodgson, Gann, Salter (2006)	R & D Management	27	test the concept of open innovation at Procter & Gamble	research has shown that new technologies of data mining, prototyping and visual representation helps innovation at Procter & Gamble
West e Gallagher (2006)	R & D Management	25	analyze the innovation strategy of firms in the area of software	the authors identified three main difficulties in implementing innovation abeta: creatively exploring internal innovation, incorporating external innovation in internal, external make innovation happen in continuous flow
Chesbrough (2003b)	California Management Review	37	understand the logic of open innovation	the author shows that the leading companies that wish to retain their ability to innovate, they must manage their intellectual property through the logic of open innovation
Jacobides e Billinger (2006)	Organization Science	27	examine the properties of the neighborhood organization and consider how it can shape their "capabilities"	the authors indicated that, before understanding the behavior of a company as to its neighborhood, one must know very well the company internally
Chesbrough e Appleyard (2007)	California Management Review	25	understand the relationship between the concept of open innovation and the theory of business strategy	the authors found that the concept of open innovation fits with the current theory of business strategy as the competitve forces and power in the value chain
Total		439		

In Figure 2 you can check the citation network of articles for references, with a minimum of twenty citations to both articles and references.

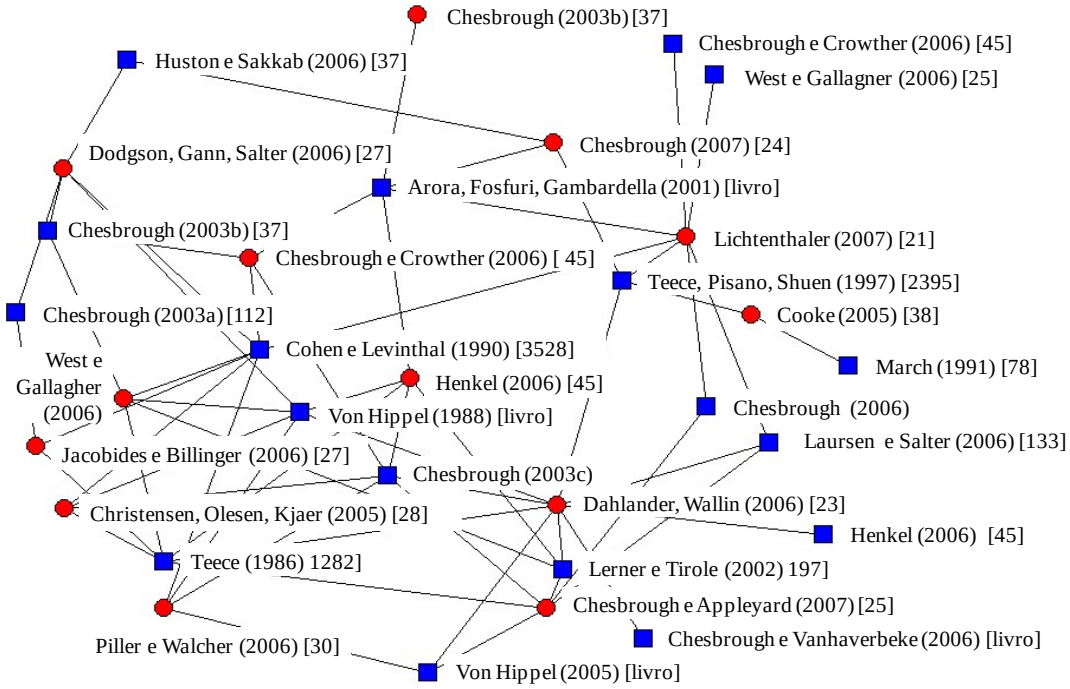

Figure 2. Article to reference network.

Note 1: The circles represent the articles and references to articles.

Note 2: The information in parentheses represents the year and between brackets the number of citations received for the work.

This network not only rescues the work of the sample, but the entire list of referenced works for them. This includes books and other databases. Some studies show as many articles as references, as well as belonging to the sample are also one of the most cited references, as is the case of work: Chesbrough (2003a e b); Chesbrough and Crowther (2006); Henkel (2006); West and Gallagher (2006). The books that have appeared on the network were: Arora, Fosfuri, Gambardella (2001), who sought to understand and demonstrate the implications of public policy and business in the technology marketplace; Chesbrough (2003c), which showed differences between the concepts of open innovation versus closed innovation; Chesbrough (2006), that sought to develop a guide for companies in transition process of ideas generation and use of internal to external; Chesbrough and Vanhaverbeke (2006), that sought to develop research in the paradigm of open innovation, in order to help companies in transition; Von Hippel (1988), which explored the various sources of open innovation; Von Hippel (2005), who studied the process of democratization of innovation.

Three references receives more than a thousand of citations, and they are Teece (1986), who tried to identify causes and explain why innovative companies are often unable to obtain economic returns of an innovation; Teece, Pisano, Shuen (1997), who developed an approach of "dynamic capabilities" to explain how companies can gain and sustain competitive advantage; Cohen e Levinthal (1990), who believe that the ability of a firm to innovate depends on their ability to recognize the value of external information, assimilate it and apply it (absorptive capacity).

3.3. Indicator of cooperation

The network in Figure 3 shows the network of collaboration for the production of the 160 articles analyzed. It is observed that six countries have published their articles in our sample individually, they are South Korea, Portugal, Taiwan, Japan, France and Canada. The United States appeared in a small connection with Wales and a larger network, linking up with eight other countries, they are Singapore, Australia, England, Germany, Spain, Switzerland, Denmark and Belgium. Another country is very central Belgium, which was related to Norway, United States, England, Spain, Holland, Austria, Estonia and Denmark.

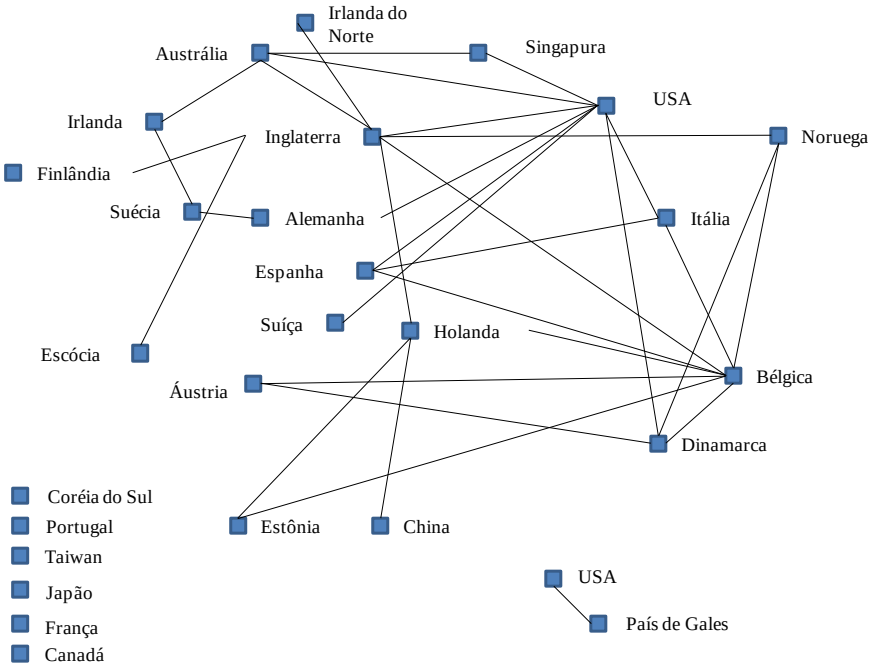

Figura 3. Cooperation network.

4. CONCLUSIONS

The 160 articles were published in 55 journals in various areas. Four journals focused about 50% of the publications, they are R & D Management, International Journal of Technology, Policy and Research-Technology Management Research. The analysis of keywords showed that the work was directly related to issues such as generation and use of knowledge, increased performance, and search for technological innovation and investment in research and development for new product development. Publications appeared in 2003, but increased significantly from 2006.

A representative work, often cited over time, was Chesbrough (2003a), which introduced the concept of open innovation for new forms of generation and use of ideas in business. Although the term open innovation has been introduced by Chesbrough in 2003, other authors have researched new forms of innovation such as Von Hippel and Teece.

Some countries have conducted their research without partnership with any other country. The countries that have jointly produced were the United States, Belgium and Holland.

A limitation of this research is to use a single database, whose effects are minimized with the citation network analysis articles for references. A possible bias generator is the choice of analysis of the most cited as the most representative, who can be influenced by self-citation.

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