

Strategic Open Innovation model:mapping Iberdrola network

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Abstract

Companies are increasingly obliged to collaborate with each other if they want to be innovative, and this growing transfer of knowledge takes place in a context of Open Innovation. To study these scientific-technological collaboration networks within an Open Innovation context, the case study of Iberdrola, a Spanish business group dedicated to the production, distribution and marketing of energy, has been chosen. Two methods have been used; the bibliometric method to analyze the Iberdrola scientific network, and patent data analysis, to analyze the technological network. This has been achieved by using the Scopus and PatSeer databases, and refining the data with VantagePoint software. It was found that in both cases collaboration takes place with the university, other companies, and research centers. Iberdrola has an extensive scientific and technological collaboration network throughout the world. Both scientific and technological collaboration, despite it not being common practice in companies, nevertheless, it can be concluded that Iberdrola is committed to such collaboration in following with the guidelines of its organizational model based on Open Innovation.

Keywords: *Open Innovation; bibliometric analysis; patent analysis; network analysis.*

1. Introduction

Companies cannot claim to possess all the necessary knowledge needed to develop their innovation work and, therefore, are obliged to collaborate with each other if they want to survive. (Bogers, 2011; Chesbrough, 2003). In this context, Open Innovation has appeared in the last thirteen years. The expression “open innovation” is used to show how organizations work together for innovation praxis, notably the relevance and merit of running knowledge inflows and outflows (Anderson & Hardwick, 2017). Due to the increasing complexity of knowledge, more and more alliances and collaborations are formed between companies, universities and research centers to achieve a scope (Bogers, 2011). In this context, Iberdrola, a Spanish business group dedicated to the production, distribution and marketing of energy, is a company where Open innovation is contemplated within its organizational philosophy (Tejedor-Escobar & Martínez-Cid, 2009). Iberdrola promotes the launch of R&D projects in different areas, such as smart grids, alternative and renewable energies and ensuring universal access to energy services, among other things. The company practices an open R&D model and collaborates with universities, technology centers and institutions through programs and agreements to leverage complementary assets and capabilities, and to accelerate the commercialization of innovation (Iberdrola, 2020).

Unlike a conventional literature review, the bibliometric method provides an innovative quantitative process, having been widely used in scientific research as an analytical tool to help academics understand the behavior of science within a given field of research; also known as scientometrics, it allows us to capture and map scientific knowledge (Leydesdorff, 2001; Persson, Glänzel, & Danell, 2004; Zemigala, 2019).

According to the OECD (Organization for Economic Co-operation and Development, 2009), patents provide a uniquely detailed source of information of inventive activity, which is why patents are important for evaluating the performance of industry research and development (R&D) (Griliches, 1990). Hence, patent data analysis makes it possible to capture, analyze and map quantitatively technological developments carried out by an organization or related to a particular technology.

Therefore, the aim of this article is to identify the scientific-technological collaboration pattern of Iberdrola and to examine this collaborative network in a context of Open Innovation, in order to contrast the organizational philosophy established in the Iberdrola company and its collaborative reality.

2. Methodology

The research process is adapted from Bildosola et al. (Bildosola, Río-Bélver, Garechana, & Cilleruelo, 2017) and is based on 3 steps intended to define and analyze the scientific and

technological collaborations of the Iberdrola company. Figure 1 shows the research approach, revealing that each step has its input and output, creating a flow of information that allows the set objectives to be achieved. In each step the specific technique used is identified. However, the objective of this research process is that it can be applied to other case studies.

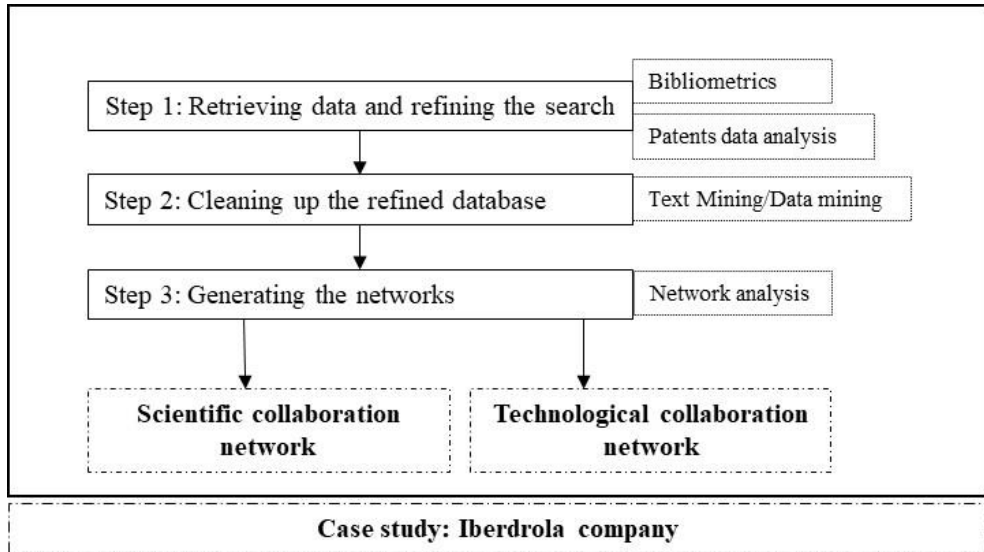


Figure 1. Research process step by step.

Step 1. Retrieving data and refining the search. The first task is to generate two specific databases concerning scientific publications and patents related to the Iberdrola company. The specific databases were generated from the Scopus scientific database and PatSeer as the patents database. Scopus is one of largest abstract and citation databases of peer-reviewed literature (75 million documents indexed) (Elsevier, 2017) and it was selected to provide scientific publications. Therefore, the query was built using "IBERDROLA" as affiliation, retrieving a total of 450 documents. The patent analysis was carried out using PatSeer, a complete global patent database and research platform containing the world's most comprehensive full-text Patent collection (Sinha, M.; Pandurangi, 2016). The search for patents has been carried out on the basis of Assignee, obtaining 131 patent families related to the Iberdrola or Iberduero company.

Step 2: Cleaning up the refined database. This second task involves the use of text mining tools. The scientific database and the patents database were imported into VantagePoint® (VP) software, text mining software that helps us identify the fields from raw data and show results through a combination of statistics.

Step 3: *Generating the collaboration network.* The networks are divided in two parts: the science collaboration network and the technological collaboration network. The networks are generated and visualized through Gephi software (Bastian, Heymann, & Jacomy, 2009).

3. Results

3.1. Scientific collaboration network

The evolution of publications of Iberdrola is represented in Figure 2. Since 1992 it has collaborated with 30 countries all over the world, and produced 450 articles. However, although the data are not constant, there is a clear upward trend, especially from 2008 (20), with peaks in 2009 (33), 2010 (31), and 2016 (31). Despite the number of publications decreasing substantially (11) in 2019, between January and February 2020 there have already been 14 publications, a clear upward trend.

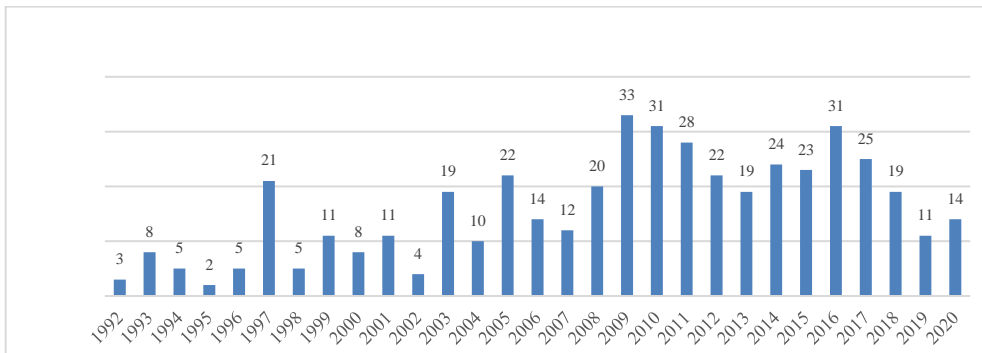


Figure 2. Evolution of publications of Iberdrola.

Regarding institutions, among Iberdrola's 10 main scientific collaborators are universities, research centers and other companies (see Figure 3). It should be noted that most of them are Spanish Universities. The Comillas Pontifical University should be highlighted, with more than 50 documents.

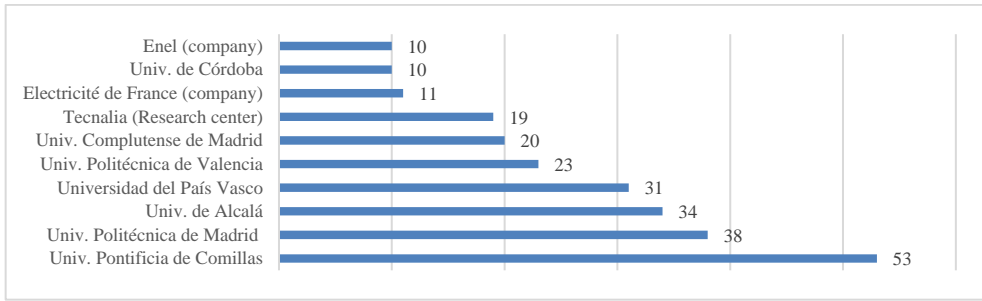


Figure 3: Top scientific institutions

Analyzing the countries collaboration network (see Figure 4), it was found that the United Kingdom (32) has the strongest co-authorship relation with Iberdrola, followed by the USA (28) France (27), Germany (26) and Italy (26), however, it also collaborates with 24 other countries. Iberdrola's commitment to the collaboration of science is clear, with an obvious commitment to internationalization.

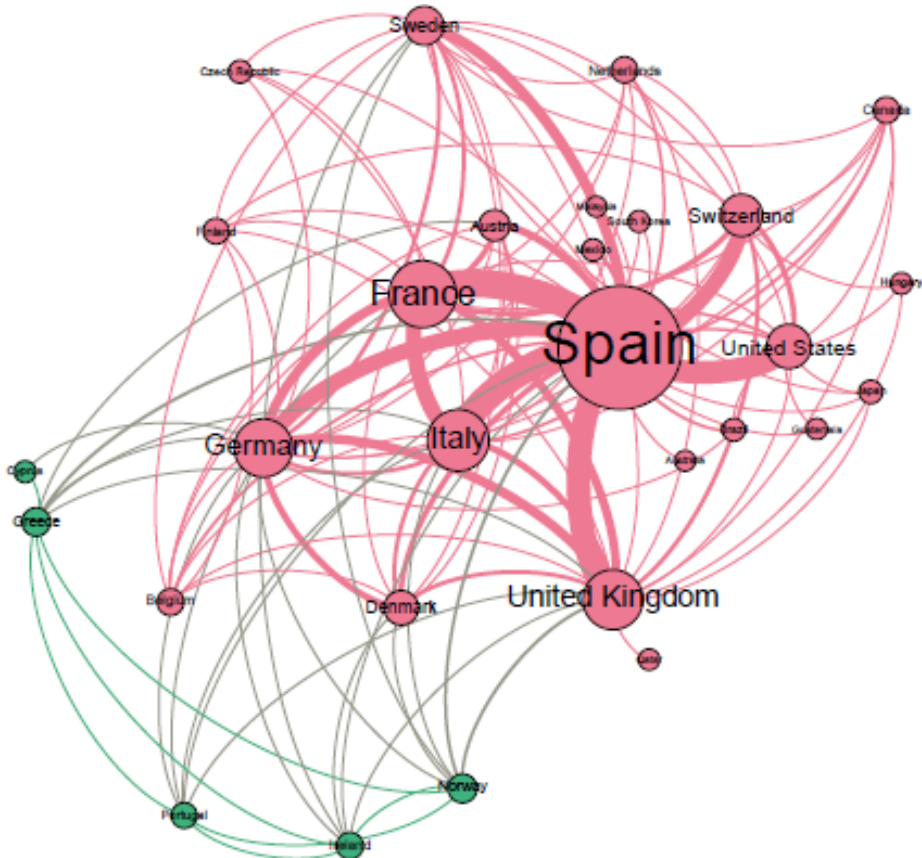


Figure 4: Scientific collaboration among countries.

In order to identify Iberdrola's scientific collaboration activities, an effective method is a network analysis. The network was plotted through Gephi software and the main affiliations that collaborate with Iberdrola were identified. The analysis has been carried out using matrix of co-occurrences and plotted in a network where the affiliations have at least one collaborative publication (see Figure 5).

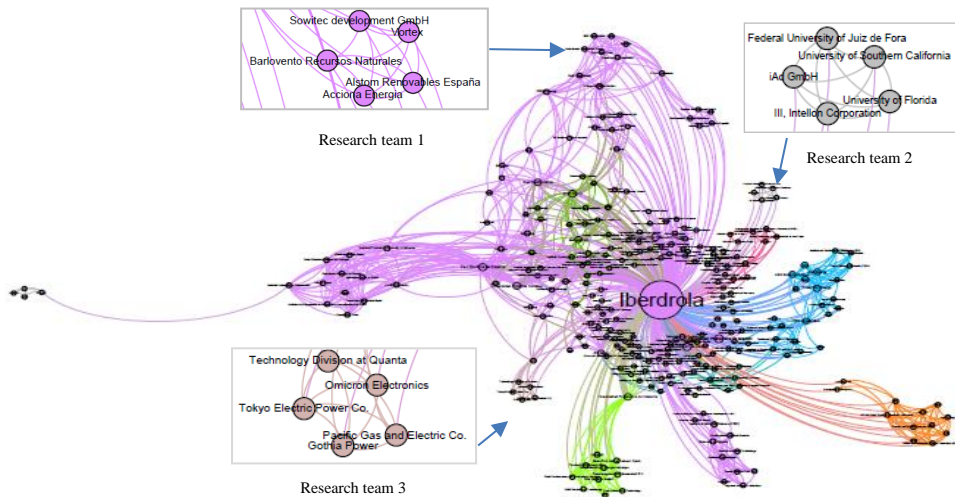


Figure 5. Scientific collaboration network of Iberdrola.

As shown in Figure 5, Iberdrola's scientific collaboration network is very extensive and productive. The network shows that Iberdrola collaborates with different research groups, formed by universities, prestigious research centers and major companies in the energy sector. The company is focusing its collaborative efforts on new renewable energy technologies, smart grids and smart mobility. Some of the small groups are analyzed below: research team 1 is formed by Alstom Renovables, Acciona, Vortex, etc. and researches issues related to renewable energy resources. Research group 2 is made up of the Universities of Florida, California, Juiz de Fora, Intellon and iAd GmbH, and their research topic is related to Electric power. The research stream of the third group selected (Omicron Electronics, Technology Division at Quanta, etc.) is operating practices with damaged equipment prevention.

3.2. Technological collaboration network

Technological collaboration is analyzed by using patent data. For this, the PatSeer database is used, being a global patent database. The search has been carried out on patent families. A patent family (PF) is a collection of patent applications covering the same or similar technical content. For the period from 1982 to 2019 a total of 131 PFs were detected.

In order to reflect inventive performance, the top assignee or applicants are from Spain and the USA, such as, Angel Iglesias S.A (Electronic and Communications: 14PFs), New York State Electric & Gas (NYSEG) (Energy supplier: 13PFs), Energetix (Energy supplier: 12 PFs) and Enertron S.A. (Renewable energies: 5PFs). Regarding the priority country, or the country where they were invented, Spain dominated with 84 PFs, the second country is the USA with 23 PFs, followed by Germany (8 PFs), Russia (6 PFs) and South Africa (4PFs).

As far as technological cooperation between applicants is concerned, an applicant collaboration network was generated and plotted with Gephi. During the process of cleaning up the patent database, six Iberdrola entities have been identified: Iberdrola, Iberdrola Ingeniería y Consultoría, Iberdrola Ingeniería y Construcción, Iberdrola Generación Nuclear, Iberdrola Renovables Energía and Iberdrola Generación. As shown in Figure 6, the main entity in the collaboration network is Iberdrola, and the collaborative work takes place between energy sector companies and are clustered in small workgroups around the main node, which is Iberdrola. (Angel Iglesias S.A.- NYSEG – CSIC- Enertron; Energetix-Rochester gas electric- NASA; Artech Hermanos- Escuela de Ingeniería Bilbao- Red Eléctrica Española), both national and international, which in turn have the most patents along with Iberdrola. In addition, it is worth mentioning the collaboration with scientific transfer entities such as the University of the Basque Country through the Faculty of Engineering in Bilbao, or the Higher Council for Scientific Research, or NASA. There are other subgroups within the main group that represent small clusters because they work with highly specific technology.

Regarding other entities of Iberdrola, Iberdrola Generación Nuclear and Iberdrola Ingeniería y Consultoría are beneficiaries of the patents without collaboration. However, Iberdrola Generación collaborates with Universidad Politécnica Madrid, and Iberdrola Ingeniería y Construcción collaborates with Iberdrola Renovables Energía and Scientific research centers, such as University of Salamanca and Coruña.

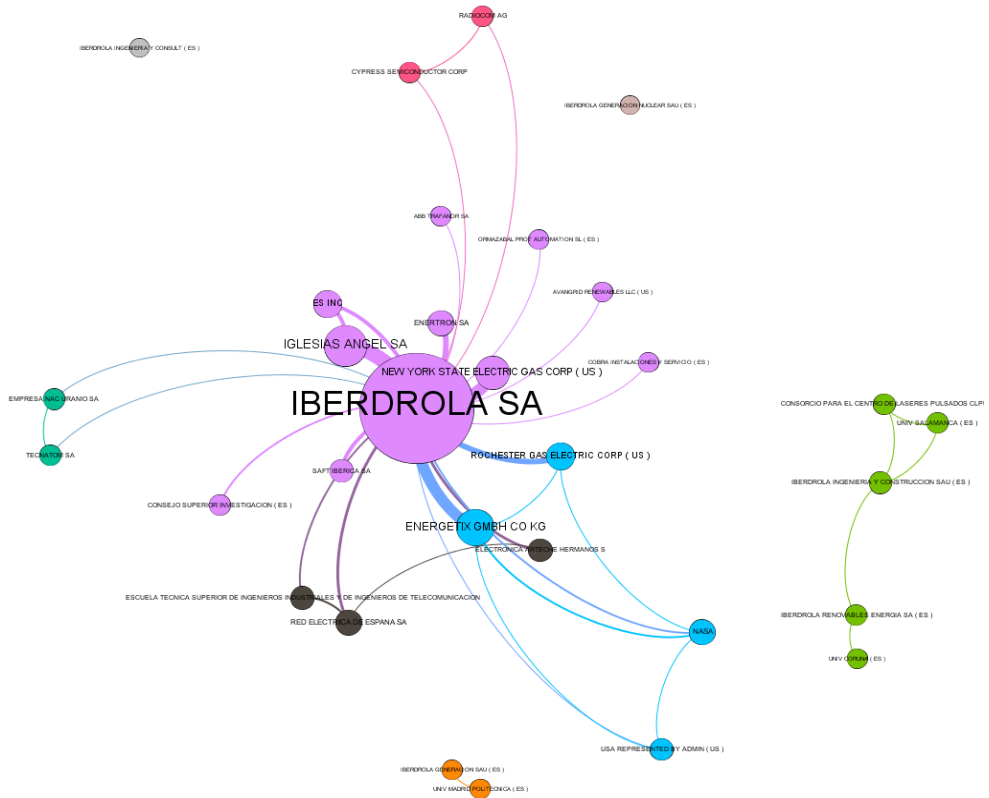


Figure 6. Technological collaboration network.

4. Conclusions

Open Innovation is an organizational model associated with Industry 4.0, which promotes knowledge transfer between different organizations. In the case of Iberdrola, which following its philosophy of Open Innovation, it shares its scientific knowledge with important entities from all over the world, clearly committed to internationalization in its collaborations. This active tendency to scientific development jointly with other entities allows Iberdrola to achieve its organizational objective linked to its philosophy of Open Innovation. In terms of technological collaboration, it can be said that Iberdrola shares much of the technological development carried out with other large companies in the energy sector. This is an important step, taking into account the industrial secrecy associated with patents, consequently, they have become "coopetitors", a term defined by Gnyawali and Park (Gnyawali & Park, 2011)

as the search for competition and collaboration between two or more companies at the same time. However, it is important to note that there is little collaboration with scientific entities, such as universities and technology centers, in the development of these innovations. It should also be noted that Iberdrola collaborates in both science and technology with entities such as the Red Eléctrica Española, the University of the Basque Country and NASA, among others.

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