

Mapping of Scientific Production on Intellectual Property: A Bibliometric Analysis

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Abstract—The purpose of this article was to analyze the profile of bibliometric production published on intellectual property in the interval of 20 years, in the period from 1998 to 2018. The research was conducted in the scientific databases of the Google Scholar platform and Scopus. The searches carried out in the databases took place through the insertion of the keywords "propriedade intelectual" (term in Portuguese) and "intellectual property" in the field referring to the "title" of the cited databases. During the searches 37,099 publications related to the topic intellectual property were identified. Among the areas of knowledge identified in the research, the one that had the most prominence in the number of publications was Social Sciences, with 1,237 articles published. With regard to the authors, the highlight in the amount of publications was to the American professor Keith Eugene Maskus, with 11 articles published. According to the survey, the journal with the highest number of publications was the Journal of Intellectual Property Rights, published by the Indian National Institute of Communication and Scientific Information Resources, with 73 articles. It is worth noting that most of these articles were written in English, in total 2,399 articles were published in that language. The country with the largest number of publications on intellectual property was the United States, with 767 articles published, 27 of which were published by the University of California, Berkeley.

Keywords—Bibliometrics, Scientific Production, Intellectual Property.

I. INTRODUCTION

Over the years, bibliometric research has played a key role in academic studies, guiding scientific production and technological development in several areas of knowledge.

A bibliometric research aims to show the development of academic studies in a specific technological area, identifying its main researchers, the institutions that present the largest volume of publications, as well as the regions and countries that excel in these academic productions.

In addition, a bibliometric research is presented as an indispensable tool in the analysis of academic scientific productions, because the data in these studies show the evolution and the advances occurred in a certain area of knowledge [16].

The bibliometric research carried out in this work is about intellectual property. Intellectual property is a protection granted to human intellectual creations, granting its inventors the right to obtain financial rewards for the use of them, for a determined period of time [2].

The protection of intellectual property enables the socioeconomic and technological development of a country by encouraging innovation, creativity, technical and scientific development and the expansion of various productive sectors of the economy [1].

For Oliveira and Boente [10] technological innovation is the primary condition for the evolution of bibliometrics studies, becoming an extremely indispensable tool to assist the researcher in the search for data that can provide support to the field of scientific production and dissemination of knowledge.

Therefore, this research aimed to analyze the academic scientific production related to the area of intellectual property in the last 20 years (from 1998 to 2018), providing researchers and academy with an overview of scientific-technological studies and advances in this area during this period.

This article is divided into five sections. The first section presents an introduction on the topics covered in this research. The second section presents a brief review of the literature related to the topics: bibliometrics and intellectual property. The third section shows the methodology used in the development of this research. The fourth section presents the analysis of the data obtained in the research. The fifth section brings the final considerations on the research.

II. REVIEW OF LITERATURE

Intellectual Property

The first manifestations on the use of the intellectual property occurred in the years of 1330, with the concession of the monopoly for the manufacture of glasses by the King of France Philippe de Valois and of 1406, with the hiring of craftsmen of Lombardy by the government of Florence, Italy, for the manufacture of products intended for the textile industry for a period of three years. During these three years, the artisans of Lombardy had exclusivity on the products developed, as well as the exemption of taxes on the production and commercialization of the same, but in contrast, they had the obligation to transfer the knowledge acquired in the manufacture of these products to the local artisans [11].

During the Middle Ages, the privileges were granted by the Monarchs, and were based exclusively on subjective criteria such as good will and sympathy. In addition, the terms of validity of the concessions varied according to the characteristics of the privileges that were granted to its inventors [9].

Other historical facts that marked the scene of international intellectual protection were: The United States Constitution of 1787 and the French Law of 1790. Both established in their articles that the protections of inventions were attributed by means of patents to their inventors [11].

The need for international protection of intellectual property was strengthened in 1873 in the city of Vienna from a manifest by exhibitors refusing to participate in an international invention show, arguing that it would not be possible to guarantee the protection of their inventions, under the risk of being improperly copied by other inventors and subsequently commercially exploited [8].

In view of this scenario, the first instruments of international protection related to intellectual property appeared: The Paris Convention (CUP), in 1883, which dealt with the protection of industrial property, and the

Berne Convention (CUB) in 1886, to copyright protection.

The Paris Convention of 1883 originally involved 14 countries and was based on three principles: 1) the independence of the granting of patents between the signatory countries, which determined the validity of patent concessions only at the national level; 2) that of equal treatment for nationals and foreigners, which assured all signatory countries the same advantages as those provided for in their legislation; 3) and the right of priority, which guarantees the applicant for a patent of invention or a model of utility, the right to deposit it in other signatory countries, within a maximum period of 12 months, counted from the date of your first deposit [6].

In the international arena, another important instrument for the protection of intellectual property was the Patent Cooperation Treaty (PCT), signed in Washington, USA, on June 19, 1970, to develop the patent system and technology transfer among member countries. Through the PCT it is possible to simultaneously claim the protection of a patent of invention in several countries by submitting a single international patent application.

Intellectual property is a driving force for the technological, economic, scientific and social development of a country. Through its protection mechanisms, it is possible to ensure and guarantee the rights of ownership of various human inventions.

Bibliometrics

According to Silva et al. [14] *"The term bibliometric is derived from the fusion of the suffix 'metric' with bibliography, information, science and library respectively, are analogous or very close in nature, objectives and applications"*.

According to Vanti [18] *"bibliometric studies are also used to evaluate the productivity and quality of the scientists' research, by measuring them based on the numbers of publications and quotations of the various researchers"*.

Bibliometrics as a method has the advantage of *"softening the elements of judgment and producing quantitative results that tend to be the sum of many small judgments and judgments made by various people"* [13].

A bibliometric research allows the identification and description of a series of patterns in the production of scientific knowledge. In addition, it serves to estimate with quality and quantity, the production of published scientific articles on a particular theme, highlighting the main authors (researchers and institutions) involved in this process, who collaborate for the enhancement of science [4].

In Table 1 shows some of the main bibliometric indicators [17]:

Table. 1: Adapted from Splitter, Rosa and Borba (2012).

INDICATORS	CONCEPTS
Lotka's Law	Investigates the frequency distributions of the author of articles of a certain theme/area.
Bradford's Law	It investigates the frequency distributions of the number of articles published by periodicals of a certain theme/area.
Zipf's Law	It investigates the frequency distributions of the vocabulary of texts of a certain theme/area.
Number of publications by author, journal, institution or subject	Investigates the volume of publications of authors, periodicals, institutions or subjects of a certain area.
Number of co-authors/collaborators	It investigates the dynamics of the volume of research carried out in a collaborative way, either between individual or group research, or national and international.
Co-publications: publication with authors of different countries, institutions	It investigates the cooperation between representatives of entities and countries, in joint research, with the purpose of creating a matrix that shows the main partners and provides the description of the scientific network.
Number of citations	It investigates the impact of articles, journals and researchers on the basis of the number of citations.
Affinity Index	It investigates the relative rate of scientific exchange (between countries, institutions) by means of quotations.
Scientific links	Investigates and measures the influence of networks between different scientific communities.
Co-citations	It investigates the number of times that two or more articles are quoted simultaneously in one article.

For Vanti [18], The Bradford Law or Dispersion Law allows, "by measuring magazine productivity, to establish the nucleus and areas of dispersion on a given subject in the same set of journals".

The most popular indicators in bibliometric articles are based on counting the number of articles, journals, authors, authorships, institutions or quotes. Affinity indices, scientific links, and co-citations are rarely used,

as well as the frequency distributions used in the Lotka, Bradford, and Zipf Laws [17].

Traditionally, bibliometric studies are developed from information obtained from large databases, such as the Web of Science, Scopus, among others.

At the beginning of the 21st century, two phenomena occurred that modified the way researchers are using bibliometric indicators. One of them was the development of the open Google Scholar search engine, from 2004, by Google and the creation of Microsoft Academic Search, created in 2006 and relaunched as Microsoft Academic, in 2016. In addition to the two search engines mentioned, there is also the free software Harzing's Publish or Perish, created by the Australian researcher Anne-Will Harzing, and developed based on the Google Scholar platform. All these search mechanisms have been helping researchers in the development of bibliometric researches, allowing the use of several types of bibliometric indicators related to a particular theme. The second phenomenon responsible for this change, in the form of the use of bibliometric indicators by researchers, was the indexing of journals in large international databases, which has been occurring over the years individually or collectively [15].

In Brazil, the lack of indexation of Brazilian journals (areas of administration, accounting sciences, tourism, among others) in the collection of large databases has discouraged the creation of a culture of more sophisticated bibliometric indicators by the Brazilian scientific community until the beginning of the 21st century [15].

III. METHODOLOGY

"The method materializes as the set of several steps or steps that must be followed to carry out the research and which configure the techniques" [5].

The methodology used in this research had a quantitative and descriptive character, which initially had a bibliographical survey on the subjects bibliometrics and intellectual property, carried out through researches in scientific articles, dissertations, theses, seminars and periodicals of the area.

Then, bibliometric researches were carried out in the scientific production databases of the Google Scholar and Scopus platforms, from articles published in periodicals and annals of indexed congresses related to the subject of intellectual property. The time cut used in this research comprised the period from 1998 to 2018.

Bibliometric research is widely used to quantify the processes of written communication related to a particular topic [12].

The quantitative technique seeks the theoretical basis in bibliometric laws and principles, detailing and outlining the paths that must be taken to map the scientific production [19]. Filho, Junior and Siqueira [7] affirm that

the principle of bibliometrics is to analyze the scientific activity by the quantitative study of the publications.

Bibliometric studies also allow the measurement of the content of theses, articles published in annals and periodicals, among others, by means of analyzes referring to authors, citations and methodology [3].

The bibliometric research developed in this work had the following process steps: definition of the research theme; choice of databases; elaboration of search criteria; data collection and analysis of the results obtained.

As for the search criteria used in the academic production databases, keywords were inserted in the "title" field of the cited databases, obeying the time interval established by the research (between 1998 and 2018). The keywords used in the research were: "propriedade intelectual" (term in Portuguese) and "intellectual property".

After the data collection, the data were transported to a spreadsheet, where they were processed, organized and tabulated, generating statistical graphs related to the bibliometric indicators related to the topic addressed in this research.

IV. DATA ANALYSIS

Figure 1 shows the volume of articles related to the theme "propriedade intelectual" (term in Portuguese) published in the Google Scholar platform database from 1998 to 2018.

According to the data collected, 1,908 publications were identified over the analyzed period (20 years). This is equivalent to an average of 95.04 articles published per year. These figures show that studies in this area in Portuguese-speaking countries, especially in Brazil, have grown over the years, arousing the interest of researchers and institutions for the subject.

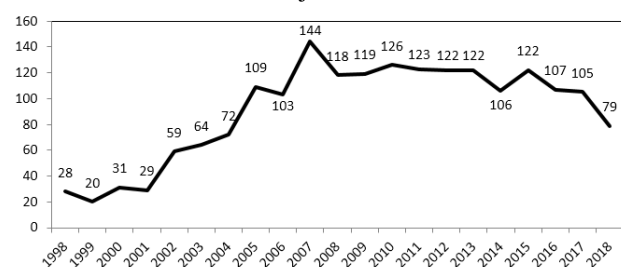


Fig.1: Number of publications with the title "propriedade intelectual" (term in Portuguese) in the Google Scholar database. Prepared by the authors (2019).

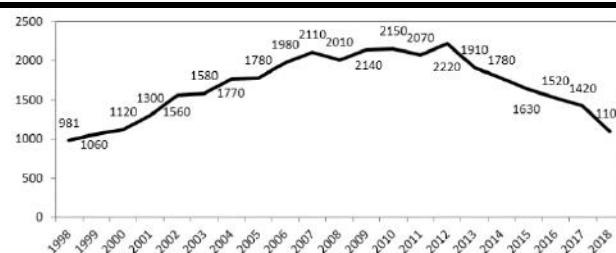


Fig.2: Number of publications with the title "intellectual property" in the Google Scholar database. Prepared by the authors (2019).

Figure 2 shows the volume of articles related to the theme "intellectual property" published in the Google Scholar platform database from 1998 to 2018.

Based on the data collected, a total of 35,191 publications were identified during the period covered by the term intellectual property written in the English language. This corresponds to an average of 1,759.55 publications per year. These figures show the interest of researchers and institutions in this area worldwide, showing the relevance of this theme to the scientific community.

Table 2 shows the authors with the highest indexes of publications related to intellectual property in the Scopus database within the analyzed period.

Table. 2: Authors with the highest indexes of publications on intellectual property in the Scopus database. Prepared by the authors (2019).

AUTHORS WHO PUBLISH THE MOST	AMOUNT
Maskus, K.E.	11
Naghavi, A.	9
Andersen, B.	8
May, C.	8
Saggi, K.	8
Cook, T.	6
Fromer, J.C.	6
Potkonjak, M.	6
Yang, C.H.	6
Bader, M.A.	5
Boldrin, M.	5
Chu, A.C.	5
Drahos, P.	5
Forman, L.	5
Granstrand, O.	5
Lemley, M.A.	5
Ostergard, R.L.	5
Rossi, F.	5
Samuelson, P.	5
Yang, D.	5

The highlight with regard to the number of articles published is for the American author Keith Eugene Maskus, professor of economics at the University of Colorado in Boulder, USA, with 11 articles published. The author has several articles published in the area of intellectual property and currently his research focuses on the international economic aspects of the protection of intellectual property rights.

Other authors that deserve attention in relation to the number of articles published in the area of intellectual property in the base of Scopus were: Alireza Naghavi, with 9 articles; Edward B. Anderson, Christopher May and Kamal Saggi, with 8 articles published each.

Table 3 shows the broader areas of published articles on intellectual property in the Scopus platform database. The highlight in relation to the number of publications was for the areas of Social Sciences, Business; Management and Accounting; Economics, Econometrics and Finance; Engineering; and Engineering.

Table. 3: Areas with the largest number of publications on the subject of intellectual property in the Scopus database. Prepared by the authors (2019).

AREAS THAT PUBLISH MORE ABOUT "INTELLECTUAL PROPERTY"	AMOUNT
Social Sciences	1237
Business, Management and Accounting	607
Economics, Econometrics and Finance	509
Engineering	440
Computer Science	313
Medicine	192
Arts and Humanities	182
Biochemistry, Genetics and Molecular Biology	113
Environmental Science	105
Agricultural and Biological Sciences	97
Engineering	82
Decision Sciences	82
Chemical Engineering	72
Materials Science	64
Pharmacology, Toxicology and Pharmaceutics	58
Earth and Planetary Sciences	44
Energy	42
Immunology and Microbiology	40
Multidisciplinary	38
Mathematics	37
Psychology	31

Table 4 shows the journals that had the largest number of articles published on the subject of intellectual property in the Scopus database. The highlights with regard to the number of articles published were for the periodicals: Journal of Intellectual Property Rights, with 73 publications; and IntelktualNayaSobstvennost, with 61 articles published.

The Journal of Intellectual Property Rights is a legal journal covering intellectual property law and is published by the Indian National Institute of Communication and Scientific Information Resources. This journal was created in 1996 and publishes articles on case studies, patent reviews, technical notes on current issues of intellectual property law, literature reviews, world literature on intellectual property rights, national and international news, book reviews and conference reports covering topics on trademarks, patents, copyrights, trade secrets, and Internet laws.

IntelktualNayaSobstvennost is a Russian newspaper, which publishes articles related to engineering and technological media. The articles identified in this research have a correlation between the subject intellectual property and the areas cited.

Table. 4: Periodicals with the largest number of publications on the subject of intellectual property in the Scopus database. Prepared by the authors (2019).

PERIODICS MOST INTERESTED IN INTELLECTUAL PROPERTY	AMOUNT
Journal Of Intellectual Property Rights	73
IntelktualNayaSobstvennost	61
International Journal Of Intellectual Property Management	32
IIC International Review Of Intellectual Property And Competition Law	29
Research Policy	28
World Patent Information	28
Queen Mary Journal Of Intellectual Property	25
International Journal Of Technology Management	22
Prometheus United Kingdom	18
Journal Of World Intellectual Property	15
Technovation	15
Actual Problems Of Economics	13
Research In Developmental Disabilities	12
Espacios	12
International Journal Of Cultural Property	12

Journal Of Development Economics	12
Computer Law And Security Review	10
Journal Of International Economics	10
Ntut Journal Of Intellectual Property Law And Management	10
California Management Review	09

Table 5 shows the most prominent educational institutions in relation to the volume of articles published in the area of intellectual property. In the relation of these institutions it is possible to identify institutions of great renown in the academic environment, such as: The University of Oxford, Stanford University and Michigan State University.

The highlight of the number of publications was one of the most important and prestigious public universities in the world, the University of California, Berkeley, United States.

Table. 5: Educational institutions with the largest number of publications on the subject of intellectual property in the Scopus database. Prepared by the authors (2019).

UNIVERSITIES THAT MOST PUBLISH ABOUT THE THEME	AMOUNT
University of California, Berkeley	27
George Washington University	20
University of Washington, Seattle	18
University of Toronto	17
University of London	17
Australian National University	16
University of Oxford	16
University of Colorado at Boulder	15
Stanford University	15
Yale University	14
Duke University	14
Zhejiang University	13
City University of Hong Kong	13
Alma Mater Studiorum Università di Bologna	13
Maastricht University	13
Michigan State University	12
London School of Economics and Political Science	11
National Taiwan University	11
Cornell University	11
Max Planck Institute for Innovation and Competition	11

Table 6 shows the countries that had the largest number of publications on intellectual property on the Scopus platform. The ranking of the five countries with the

highest number of publications is led by the United States, followed by the United Kingdom, China, India and Australia. It is worth mentioning that Brazil occupies one of the last positions in this ranking, with only 42 publications.

Table. 6: Countries with the largest number of publications on the subject of intellectual property in the Scopus database. Prepared by the authors (2019).

COUNTRY THAT ARE MORE INTERESTED IN INTELLECTUAL PROPERTY	AMOUNT
United States	767
United Kingdom	256
China	152
India	144
Australia	122
Germany	100
Canada	98
Italy	65
Taiwan	65
Japan	62
France	58
Netherlands	50
Russian Federation	50
Spain	45
Switzerland	45
South Korea	43
Brazil	42
Hong Kong	37
Sweden	32
South Africa	31

Regarding the language of the publications, it is observed in Table 7 that the highlight is for the English language, in view of the universality of this language. In addition to publications in the English language, there are also publications in several languages, which shows that the subject of intellectual property has a worldwide scope and arouses the interest of researchers worldwide.

Table. 7: Languages with the largest number of publications on the subject of intellectual property in the Scopus database. Prepared by the authors (2019).

COUNTRY LANGUAGES THAT MOST PUBLISH ON INTELLECTUAL PROPERTY	AMOUNT
English	2399
Chinese	39
Spanish	38
French	31

Russian	18
German	16
Portuguese	16
Ukrainian	10
Japanese	10
Italian	06
Polish	04
Korean	02
Slovenian	02
Hebrew	01
Hungarian	01
Lithuanian	01
Persian	01

V. CONCLUSION

Scientific knowledge is an important mechanism for the technological evolution of a country and a society. The measurement of this knowledge through bibliometrics allows to evaluate the performance of researchers, institutions and periodicals, taking into account quantitative and qualitative metrics.

This bibliometric research aimed to map scientific articles and other academic productions related to the subject intellectual property, published in the bases and data of Google Scholar and Scopus, in the temporal cut of 20 years, more precisely between the years of 1998 to 2018.

The theme of ownership was chosen for this research as one of the main propulsive springs for the technological, economic and social development of a country, increasing its competitiveness in the national and international market, assuring to the companies the protection of its investments and combating piracy.

In this bibliometric research 37,099 publications were identified related to the subject intellectual property. The largest volume of publications occurred in 2012, with 2,342 published articles, 122 on the Google Scholar platform and 2,220 on the Scopus platform. These articles were selected and analyzed for authors, areas of knowledge, journals where they were published, institutions represented in the articles, countries that published the articles and languages in which they were written.

As for the authors, the highlight in the number of publications was to the American professor Keith Eugene Maskus, with 11 articles published.

Regarding the areas of knowledge identified in the research, it is observed that the Social Sciences area obtained the largest number of publications, with 1,237 articles published.

Among the journals identified in the research, it was verified that the Journal of Intellectual Property Rights, published by the Indian National Institute of Communication and Scientific Information Resources, presented the largest number of publications, with 73 articles published.

The institution with the largest volume of publications in the area of intellectual property identified in this research was the University of California, Berkeley, United States, with 27 articles published. It is worth mentioning that the United States was the country with the largest number of publications, with 767 articles published. In addition, most of the articles published in the two databases, related to intellectual property, were written in English, in total 2,399 articles were published in that language.

The results of this research point to a significant increase in the number of publications related to intellectual property, highlighting the importance of the topic to the scientific community and contributing to the world's technological and economic development.

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