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## **Toward a Concept of Bibliometrics**

### **Abstract:**

This paper proposes to establish *Bibliometrics* as a discipline that develops its measuring units on the bases provided by the fields of *Bibliography*, *Information Sources* and *Library and Information Science*, the foundation of the former disciplines.

**Key words:** Bibliometrics, Bibliography, Information Sources, Library and Information Science.

### **Introduction:**

The conceptual and theoretical foundations of the science of Bibliometrics rely on the following hypotheses:

Bibliometrics finds its epistemological roots in Bibliography.

Bibliometrics, as applying Bibliography, constitutes a factor of measurement and evaluation of information sources.

Bibliometrics consists in a method, or set of methods, that can be employed to evaluate research.

These three hypotheses constitute the main pillars needed to formulate the concept of *Bibliometrics*.

### **1. Theoretical Foundations of Bibliometrics**

From its beginnings to our day, Bibliometrics has been very closely related to both Bibliography and Information Sources. It is, moreover, a relation of dependence, since bibliometric studies measuring scientific production are carried out on the basis of the results obtained from analyses of information sources.

The field of Bibliometrics itself has, from its very origin, pointed to Bibliography as the main basis of its development. Indeed, researchers themselves have not hesitated to refer to the field of Information Sources as the medium in which bibliometric techniques are applied. These techniques are, in turn, very closely related to statistical methods.

What we understand today as Bibliometrics was first named *Statistical Bibliography* by Hulme,<sup>1</sup> in 1923. Such term answered the need of accounting for the increasing volume of publications –so large that it was beginning to overwhelm researchers. In this way, Bibliography is supplemented by the utilization of methods proper to statistics in order to analyze scientists' information needs. This same criterion of Statistical Bibliography is maintained by Raising, in 1962.

## 2. Bibliometrics and Bibliography

Nevertheless, it was Otlet<sup>2</sup>, in 1934, who first applied the term *Bibliometrie* to the technique pursuing the quantification of science and scientists. A pioneer in Information Science and its theory, Otlet insists in the difference between Bibliometrics and Statistical Bibliography, on the basis that, from the very origin, science was measured or quantified by applying statistical methods to information sources.

López Yepes underlines Otlet's ability to organize knowledge, and his on-going pursuit of a synthetic explanation of how concepts are formed and grow. He credits Otlet, above all, for his ability for rational organization<sup>3</sup>.

Otlet's standpoint is that Bibliographics establishes itself as a general science that collects and classifies systematically the totality of data relative to the production, conservation, circulation and use of writings and documents of every sort.

In his *Treatise of Information Science*, Otlet puts forward a number of ideas about Bibliometrics, most notably:

a) *In any order of knowledge, measure is a superior form that this knowledge takes. Measures about books and documents can be constituted into a coordinate ensemble, Bibliometrics.*

b) *Measures relate to objects, phenomena or facts, relations or laws. They concern particulars (metrics, proper) or ensembles (statistics, which deals with what is, or should be, unity and normalization). Measures of the main relations of a science become indexes (geographers, for example, when considering the relationship of water and rain to land, have created the aridity index).*

c) *When doing Bibliometrics, we must take into account the findings of metrics (in general) and sociometrics (in particular). The maxim "omnia in mensura", everything in due measure, has been erected as the main guideline of any science that tends to develop from the quantitative to the qualitative stage.*

After, Otlet analyzes the reasons why sciences like astronomy, biology, sociology and others tend have a quantitative character. They establish methods of measurement that obtain results. As to books, the author points out that:

1) *Things related to books are hardly ever measured: neither in terms of their material and operative reality nor in terms of their subjective and intellectual one. Efforts in this direction are, therefore, desirable.*

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<sup>1</sup>Hulme, E.W. *Statistical bibliography in relation on the growth of modern civilization*. London: Grafton, 1923.

<sup>2</sup>Otlet, P. *Tratado de la Documentación*. Translation into Spanish by Maria Dolores Ayuso. Murcia: Universidad de Murcia, 1996.

<sup>3</sup>López Yepes, José. La construcción epistemológica de la Ciencia de la Documentación. *Teoría de la Documentación*. Pamplona: Eunsa, 1978, p. 31-32.

2) *Book sciences must introduce the idea of measurement to the research they promote. Inasmuch as books are objects of psychology, sociology and technology, their phenomena are susceptible of being measured.*

3) *Bibliometrics will be the part of Bibliology that deals with the application of quantity or measure to books (arithmetic or mathematical bibliology).*

4) *Every element dealt with by Bibliology should, in principle, be measurable. It is advisable that research should treat data precisely, that is, in the form of numbers, thus passing from a qualitative or descriptive stage to a quantitative one.*

Otlet proposes a number of bases for the field of Bibliometrics, by bearing in mind a number of factors affecting or surrounding a text. These include language, spaces it contains, and coefficients referred –among other things- to formats and unit prices, as well as those borrowed from statistics, including comparison indices. He also pays attention to the frequency with which a given author or work is read; from this data, a “utility frequency” curve can be drawn, by considering the number of editions of a text published as a function of its author, of its content, or of the social context in which it appears.

Despite its importance in relation to books, Otlet believes that the discipline of Statistics fulfills a mission that is different to that of Bibliometrics:

*Book statistics is often confused with Bibliometrics, perhaps because, until this day, it has been applied mainly to enumerating the quantity of books produced (editions). However, the use of statistics begins now to expand to the number of copies printed, book circulation, libraries, bookstores, prices, etc. In addition, many works have been written on book statistics. They have dealt with absolute values, as well as coefficients. Of course, we should not exaggerate the significance of these numbers, for the lists they present are far from being complete, precise or comparable. On the other hand, the coefficients we may obtain are only measures that compare all sort of variations, as a function of a wide range of variables. Yet, holding existing figures as provisionally valid, they must show us the way to more exact and complete numbers...*

It is clear that, for Otlet, while Bibliometrics measures the content of a book, statistics deals with the continent and its circumstances.

After what has been exposed, there can remain little doubt that it was Otlet who brought about the initial breakthroughs in the field of Bibliometrics. After him, we would have to wait some years before reading another treatise on this discipline. Nevertheless, in the opinion of subsequent researchers, such as Raising, Price, Carpintero and Tortosa, Bibliography is affirmed as the basis of Bibliometrics. They also agree to define the latter as the quantitative study and analysis of bibliographic materials, facilitating the quantification of bibliographic information susceptible of being analyzed. This is equivalent to considering Bibliometrics as a method of applying quantitative processes to written works and their behavior<sup>4</sup>.

Bibliography aims at the compilation of repertories, as well as the study of their use. It gives notice of existing bibliographic materials –documents or texts that have been located using different systems. Hence, Bibliography provides an account of bibliographic materials of the present as well as the past<sup>5</sup>.

From the bibliographic description of documents, Bibliometrics borrows the information it needs to carry out its studies: author(s), general title of the periodical or

<sup>4</sup>Pritchard. A. Statistiscal biography on bibliometrics. *Journal of Documentation*, 1969, vol.25, n°.4, p. 348-349.

<sup>5</sup>Simón Díaz, José. *La Bibliografía: concepto y aplicaciones*. Barcelona: Planeta, 1991.

monograph, publication year, type of document (article, monograph, biography...), language, abstract –if the bibliography is analytical- and key words or descriptors.

To summarize, bibliographic references provide researchers with a great quantity of information, without which they would not be able to do their bibliometric analyses.

### **3. Information Sources**

Scientific communication must have access to a variety of communication channels. In general, however, for a message to circulate there is need only of a producer or emitter, a receiver and a communication channel. This channel is, of course, the subject-matter of the discipline of Information Sources.

The producer or emitter can be an organism, an institution or an individual. They initiate the vehicle of communication (the message) that will reach a receiver –another organism, institution or individual. The message may, in turn, be transformed into one or more other messages that will circulate in the same fashion, always creating new messages that originate scientific growth.

Fruit of the author's scientific creation, the document contains the message emitted by this author. Information sources are made up of documents, regardless of their medium, and provided that there exists the possibility that the information they contain be interpreted. This is how their defining function of informing and communicating is achieved.

An obstacle that those carrying out bibliometric analyses have to face is the sheer abundance of documents conveying information which is both specialized and addressed to the general public. Before the impossibility of accessing all of them, they must have recourse to the work of those who treat the Information Sources. Be them multidisciplinary or specialized, they group the documents that, once analyzed, provide data or bibliographic fields that facilitate the accounting, analysis and statistical treatment that are employed in Bibliometrics.

### **4. Bibliometrics as Inter-disciplinary and Multi-disciplinary Science**

A subject is interdisciplinary when it borrows material from disciplines of its same scientific branch; it is multidisciplinary when it lends or borrows knowledge or techniques to, or from, beyond its general field.

Bibliometrics, as an interdisciplinary subject, takes on an auxiliary or instrumental role in measuring the different fields that make up its general branch of science, that is, disciplines integrating the curriculum of Library and Information Science. These subjects act like links of a chain, in that, should one of them fail, the others could hardly function together in a satisfactory way.

Let us clarify this point by means of an example. Bibliometrics collaborates regularly with the field of Information Sources, in order to detect lacunae in bibliographic collections, maintain the collections, and facilitate corrections and the occasional removal of objectionable materials. Moreover, its analyses rely on descriptive fields of primary documents that have been developed by the area of Documentary Analysis: cataloguing, classification or indexation. When unable to find a given document –due to the increasing quantity of them- it has recourse to bibliography

and information sources, either printed or mechanized, in order to obtain the necessary documents needed to analyze a given topic or its researchers.

Recent developments in the methods of Library and Information Science have contributed significantly to the consolidation of Bibliometrics. In turn, the latter has also played an important role in the exposure and application of Information Science, thus establishing a symbiosis between the two sciences.

Bibliometrics is also a multidisciplinary science. It borrows statistical methods to carry out its analysis; it serves itself of the surveys and tests elaborated by sociologists and, finally, uses computer science to process data by means of spreadsheets, statistical applications and databases. Originated in other fields of study, all these tools serve Bibliometrics in its goal of analyzing the work of scientists and researchers in the different branches of knowledge.

## 5. Object of Bibliometrics

As we pointed out in the Introduction, Bibliometrics finds its epistemological basis in Bibliography; it works as a measurement factor of the information sources and, finally, it appears as a method (or ensemble thereof) to be used by the scientific inquiry. Hence:

Bibliometrics studies the organization of technological sectors from the standpoint of the information sources.

It measures scientific growth by applying statistical methods to the production of scientists. In this way, it establishes the degree of development of the different disciplines.

It performs studies on information consumption based on the documents used by scientists.

These analyses are carried out by use of bibliographic references of publications contained in bibliographies and information sources, during a set time period. These bibliographic instruments provide enough data about the primary documents to allow for meaningful bibliometric research.

## 6. Toward a Definition of Bibliometrics

Bibliometric studies can be considered from the standpoint of the field of Information Sources. This discipline, as we have argued, constitutes its principal basis. In this way, researchers select the sources most appropriate for the development of their work.

In addition, catalogues of journals and sources that contain summaries of the books or articles analyzed may be used, in order to locate references made of the authors' work. This is the method of measurement proper to Bibliometrics: citation analysis. The possibility of interpretation of these quantitative measures opens up new ways for the study of the different sciences.

Keeping this premises in mind, as well as the reasoning that has been put forward in this paper, we propose the following definition of our discipline:

Bibliometrics is *the ensemble of methodological knowledge that will serve the application of quantitative techniques in order to evaluate the processes of production,*

*communication and use of scientific information. Its goal is to contribute to the analysis and evaluation of science and research.*

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