

SCIENTOMETRICS, TECHNIQUES, SOURCES AND THEIR KEY POINTS TO ANALYSIS OF LIS RESEARCH: AN OVERVIEW

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Abstract:

Library and information Science is a multidisciplinary multicultural field of activity. It has the capacity to assimilate relevant ideas from different field of knowledge. Scientometrics is the science of measuring the “quality “of science. It is often done using bibliometrics which is a measurement of the impact of scientific publication. It includes all quantitative aspects of the science of science, communication in science, and science policy. It is playing an increasingly important role in facilitating the understanding of the research fields as well as the research topics within them. This is mainly highlights for Historical Evidences, Objectives, Needs, Laws, Areas of application, Techniques, Tool, Materials & Sources, Uses, Limitations, Key Points and so on.

Keywords:

Scientometrics, Laws, Areas of application, Techniques, Key Points.

1. Introduction:

The Scientometrics was established in 1978. The industrialization of science increase the quality of publication, and research outcomes and rise the computer allowed to effective analysis of data .It is not only used in most used in Library and information science also helps to improve scientific documentation information and communication activities of the subjects which is taken in to account for analysis. It is a science of measuring and analyzing science. In practice, scientometrics is often

done using bibliometrics which is a measurement of the impact of (scientific) publications. Modern scientometrics is mostly based on the work of Derek J.de Solla Price and Eugene Garfield. The latter founded the institute for Scientific Information which is heavily used for scientometric analysis. Methods of research include qualitative, quantitative and computational approaches. One significant finding in the field is a principle of cost escalation to the effect that achieving further findings at a given level of importance grow

exponentially more costly in the expenditure of effort and resources.

1.1. Historical Evidences:

The term Scientometrics originated as a Russian term for the application of quantitative methods to the history of science. The term was introduced and came into prominence with the journal launch named "Scientometrics". It deals with analysis and graphical representation of science and technology information. In other words, it tells us "Who is doing what and Where" Modern scientometrics is mostly based on the work of Derek J. de Solla Price and Eugene Garfield. The latter created the Science Citation Index and founded the Institute for Scientific Information which is heavily used for scientometric analysis. A dedicated academic journal, Scientometrics, was established in 1978.

- **Librametrics**as, "Quantitative analysis of various facets of library activities and library documents by the application of mathematical and statistical calculus to seek solution to library problems."
- **Bibliometrics**as "the study of the use of documents and patterns of publication in which mathematical and statistical methods have been applied."
- **Informetrics**was used as a generic term to mean the use and development of a variety of measures to study and analyze several properties of information in general and documents in particular. "It covers bibliometrics and scientrometrics.

- **Scientometrics** is the study of measuring and analyzing science, technology and innovation.
- **Webometrics/Cybermetrics**as the study of the quantitative aspects of the construction and use of information resources, structure and technologies on the www drawing on bibliometrics and informetric approaches."
- "**Webometrics**displays several similarities to informetric and Scientometrics studies and the application of common bibliometrics methods."
- **Altmetrics**In scholarly and scientific publishing, non-traditional metrics proposed as an alternative to more traditional citation impact metrics, such as impact factor and h-index.

1.2. Definitions:

- Scientometrics is the quantitative study of the disciplines based on published literature and communication.
- This could include identifying emerging areas of scientific research, examining the development of research over time, or geographic and organizational distributions of research.

2. Objectives:

- To measure monthly-wise / Year-wise distribution of contributions and the average number of contribution per month.
- To analyze the authorship pattern.

- To determine the volume-wise productivity of articles/publications.
- To identify the ranking of authorship pattern
- To estimate the degree of collaboration among authors.
- To study the subfield-wise distribution of citation journal.
- To identify geographical distribution of journal preferred for publication.
- To observe the length of pagination.
- To identify the profession type of author.

2.1.Scope of the Study:

- To get a comparative picture of Indian research performance.
- To know the status of India among the various countries of the world.
- To arrive at future course of projections in authorship pattern, language and country of publications.
- To apply the empirical laws of Lotkas; Bradford.

2.2.Needs of the Study:

- Scientometric studies have increasingly been used over the last few years. These studies are useful to understand the evolution of literature or trends in particular fields or within a geographical area.

2.3.Why Scientometrics?

- Nearly all writings about science start with the statement that it is a driving force of our modern society and a starting point for breakthroughs in our knowledge of the world. The funding of science is an important part of investment in the world's future.

2.4.Why Use Scientometrics?

- Demonstrating the importance and impact of your own research and/or that of your research group
- Identifying areas of research strength and weaknesses
- Identifying top performing journals in a subject area
- Identifying top researchers in a subject area

2.4.1. Purpose of Scientometrics:

The purpose of the study is mentioned below:

- Quantitative analysis of science and technology performance
- Quantitative analysis of the cognitive and organizational structure of science and technology
- To know how a certain science or technology has evolved in a certain period of time

3. Laws of Scientometrics:

- **Lotka's law** of scientific productivity,
- **Bradford's law** of scatter,
- **Zipf's law** of word occurrence.

3.1. Areas of Application of Scientometrics:

- The areas of library and information science are the following, in which the Scientometrics techniques are used.
- To design automated language processing for auto indexing, auto classification and auto abstracting.
- To develop experimental model.
- To develop norms of standardization.
- To estimate comprehensiveness of secondary periodicals.
- To forecast past, present and future publishing trends.
- To formulate an accurate need based acquisition policy within the limited budgetary provision.
- To formulate an accurate weeding and stacking policy.
- To formulate collection development and management policies.
- To formulate stacking and weeding policies.
- To identify authorship and its trends in documents on various subjects.
- To identify core periodicals in different disciplines .(through application of Bradford's law of scattering and citation analysis)
- To identify past, present publishing trends as well as forecast future publishing trends.
- To identify research trends and growth of knowledge.
- To identify users of different subjects.
- To initiate effective multivalve network system.
- To measure the usefulness of retrospective and current awareness service.
- To predict productivity of publishers, individual authors, organizations and countries.

- To study obsolescence and dispersion of scientific literature.
- To study productivity of institutions/ individuals and disciplines.
- To study trends and growth of knowledge.

3.2. Scientometric Techniques:

3.2.1. Productivity Count: It deals with books articles, words in a text, place of publication, subject matter, time and date of publication, publishing institution, authors, author's institution, etc. Nicholas and Ritchie in the book "Literature and Bibliometrics" called it as productivity count or descriptive.

3.2.2. Literature Usage Count: It deals with citation in published works, circulation, frequency of borrowing or browsing different library material, failure and success in search strategies, search option , etc. Nicholas and Ritchie called it as "Evaluative".

3.2.3. Uses of Scientometric Studies:

Historically Scientometric methods have been used to trace relationships amongst academic journal citations. The Scientometric research uses various methods of citation analysis in order to establish relationships between authors or their work. The Scientometric studies are used in

- Bibliographic control
- Comparative assessment of the secondary services
- Formulating search strategies in case of automated system
- Indexing and Thesaurus
- Library Management

- Measuring the productivity of an author based on the number of published articles. (Lotka)
- Measuring the scattering of articles on a subject in various periodicals (Bradford)
- Preparation of retrospective bibliographic and Research
- Productivity count of literature
- Ranking of words in a text based on frequency of occurrence of words
- To identify the peers, social change and the core journal, etc.

3.3. Scientometric Tools:

The Scientometric tools are very much essential for accurate analysis of literature. Various types of scientometric tools are available. These tools are used to the scientometrician. Some examples of the scientometric tools are used to access the quality of research, which helps in implementing efficient funding policy and in decision making process.

Example:

- Authormap
- Bibcouple
- Bibliometrics Toolbox

4. Materials & Sources:

- **Scientometric Portal** is a gateway to Scientometric-related materials and sources (Retrieved from Scientometric portal : <https://sites.google.com/site/hjamali/scientometric-portal>)
- **Bibexcel**. A free software designed by Olle Persson to assist a user in analyzing bibliographic data, or any data of a textual nature formatted in a

similar manner. The idea is to generate data files that can be imported to Excel, or any program that takes tabbed data records, for further processing. It can be used for co-citation, bibliographic coupling, mapping and clustering analysis.

- **BiblioTool**. It is a set of python scripts (open source) written by Sebastian Grauwin. They can read ISI data in csv format and do some analyses including co-occurrence map and bibliographic coupling.
- **CiteSpace**. A free Java-based software for visualizing and analyzing trends and patterns in scientific literature. It is designed as a tool for progressive knowledge domain visualization. Its primary source of input data is ISI WoS. But it also provides some simple interfaces for obtaining data from PubMed, arXiv, ADS, and NSF Award Abstracts. It can be used to generate geographic map overlays viewable in Google Earth based on the locations of authors.
- **CitNetExplorer**. A free java-based software tool developed by Uni of Leiden for visualizing and analyzing citation networks of scientific publications. It allows citation networks to be imported directly from the Web of Science database. Citation networks can be explored interactively, for instance by drilling down into a network and by identifying clusters of closely related publications.
- **CopalRed**. A free program written by Xavier Polanco for the analysis of scholarly publications and scientometric purposes for example for analyzing and visualizing the network structure of a scientific field.

- **Interdisciplinary Research (IDR).** It's a free tool to measure and map interdisciplinary research. It creates overlay maps of science, as a method to explore the degree of interdisciplinary of a set of publications.
- **IN-SPIRE.** Commercial software for exploring and visualizing textual data, including Boolean and “topical” queries, term gisting, and time/trend analysis tools. It can be used to explore technical and patent literature, marketing and business documents, web data, accident and safety reports, newswire feeds and message traffic, and more.
- **Headstart.** A free open-source software to visualize readership data from Mendeley. It presents users with the main areas in the field, and lets them zoom into the most important publications within each area. It is intended to give researchers that are new to a field a head start on their literature review (hence the name). It has been developed by P. Kraker.
- **HistCite.** Free software developed by E. Garfield to aid researchers in visualizing the results of literature searches in the Web of Science. It lets you analyze and organize the results of a search to obtain various views of the topic's structure, history, and relationships. It visualizes the citation network in a historical manner.
- **Loet Leydesdorff.** A set of free DOS-based pieces of software to parse, transform and analyze bibliometrics data obtained from sources such as Scopus, ISI, and Google Scholar for analyses such as coauthorship, international, institutional, inter-city collaboration networks, co-word, co-citation and bibliographic analysis and so on. Although they do not include visualization tools, they prepare the data for the creation of relational databases and visualization by other tools such as Pajek. ISI.exe reads isi data in txt format and generates files suitable for creating relational database.
- **Network Workbench.** A free Java-based large-scale network analysis, modeling and visualization toolkit for biomedical, social science and physics research. It includes specific features for bibliometric studies.
- **Publish or Perish.** A free software program that retrieves and analyzes academic citations Google Scholar and calculate No of papers, citations, average No. of citations per paper and per author and per year as well as hindexs, g-index, and some more metrics.
- **SAINT:** (Science Assessment Integrated Network Toolkit). It is open source software for scientometrics analysis and one of the few packages that can be used to convert ISI data into relational database (dbm or accdb or sqlfiles). There is a forum to discuss the issues related to SAINT.
- **SciMAT.** SciMAT (Science Mapping Analysis Tool) is a java-based open source (GPLv3) free software tool developed to perform a science mapping analysis under a longitudinal framework. SciMAT reads bibliographic data in different format and creates a relational database in Sqlite 3 format and allows you to do different analyses. The advantage is that you can amend the data in the knowledgebase as you wish.

- **Sci2 Tool.** A free Java-based modular toolset specifically designed for the study of science. It supports the temporal, geospatial, topical, and network analysis and visualization of scholarly datasets at the micro (individual), meso (local), and macro (global) levels. It has several visualization features.
- **Scientometric Project.** A set of open source Python scripts for some scientometric data analyses written by Theresa Velden.
- **Vantage Point.** A commercial powerful text-mining tool for discovering knowledge in search results from patent and literature databases. It has visualization capabilities.
- **VOSviewer.** A free Java-based program, primarily intended to be used for analyzing and visualizing bibliometric networks. It can create maps of publications, authors, or journals based on a co-citation network or to construct maps of keywords based on a co-occurrence network.

5. Uses & Characteristics of Scientometrics:

- Scientometrics helps researchers in other subjects to contribute more.
- Scientometrics points out the stronger and weaker area of research.
- Helps not only the focused organization level of research, but also participation of the nation can also be measured.
- The forms of transmission help the researchers to publish their research output which are mainly preferred by the users.

- The geographical distribution of information without approaching wider range information sources.
- The subject dispersion study helps not only the researchers but also the library in procuring information sources and also for obsolescence study purpose.
- The authorship pattern helps the scientists and researchers to collaborate their study irrespective of any geographical and language differentiation.

5.1.Limitations of Scientometrics:

Scientometrics may be gaining in importance and popularity because they are objective and relatively easy to calculate and understand but they still have a number of limitations including:

- Scientometrics were initially based on the model of publishing articles in peer-reviewed journals. This is not the norm for many disciplines particularly in the arts, humanities and social sciences.
- Citation patterns vary from subject to subject.
- Only a tiny proportion of published research is covered by resources.
- Self-citations can be distort in metrics.
- Review articles tend to be more highly cited than standard articles.
- Citations to a paper may not reflect its quality.
- Metrics do not tend to account for the age of a researcher

6. Key Points to remember when conducting ScientometricsAnalyses:

- Always compare like with like, for example:
 - ❖ Groups and individuals in the same or similar discipline
 - ❖ Groups and individuals in the same stage of their academic career
 - ❖ Journals in the same discipline or category
 - ❖ Similar size institutions
- Be aware that some disciplines rely less on publishing in journals than others and will therefore fare less favorably.
- Don't rely on a single Scientometric tool; results can vary depending on the tool used because the content covered by each tool varies, as does the depth of coverage and discipline coverage.
- Put the data in context using a combination of metrics and other qualitative information where appropriate.

7. Conclusion:

Library and information Science is a multidisciplinary multicultural field of activity. It has the capacity to assimilate relevant ideas from different field of knowledge. Development of metrics science may be described as 21th century. Among different metrics Scientometrics is the most interesting genre of research in the field of library and information science. Scientometrics provides an understanding how research ideas emerge, evolve or disappear as a topic, good measure of quality of published works, and the most promising areas of research.

- Scientometrics is a major sub-discipline of quantitative research.

This is a tool used by the library and information science professionals for studying the communication processes, information flows, and others for better understanding and effective management and dissemination of information.

- Scientometric techniques are being used for a variety of purposes like determination of various scientific indicators, evaluation of scientific output, selection of journals for libraries and even forecasting the potential of a particular field.
- Scientometrics is a type of research method used in library and information science
- It is a quantitative study of various aspects of literature on a topic and is used to identify the pattern of publications authorship and secondary journal coverage with the objective of getting an insight into the dynamics of growth of knowledge in the areas under consideration

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