

Chapter - I

Introduction

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Bibliometrics is a quantitative study of written communication and it is essential for the effective management of libraries within their budget provisions. The quantitative data is used to keep control over the cost of library collection and essential books and periodical collections that satisfy the need of the readers. Librarians began to use quantitative techniques in their day to day administration, especially to evaluate libraries and their services. This bibliometrics plays a vital role in the process of information' research. Many reasons are responsible for the development of research in bibliometrics and they are discussed here.

In recent years, there has been an explosive growth in human knowledge. In fact, the nature and tempo of growth has been such as to far outstrip the achievements of the past centuries. As science itself grown in extension and intention and the number of scientists increases. So obviously does the volume of literature generated by the scientific community. The growth of literature itself has caused a fairly widespread alarm and the term that describes their phenomenon is knowledge explosion also known as information explosion.

One of the principal goals of a library is, within its limitations, to acquire the documents, which will be most essential to the community it serves.

It could be noted that at the global level about 5 million articles are being published annually in about one lakh journals. The fifth edition of the world list of scientific periodicals shows a two hundred percent increase in the number of scientific periodicals since 1970. Prof. De Solla Price, claimed, that science literature has grown exponentially in the last three centuries with a doubling rate of approximately 15 years.

According to Ulrich's international periodicals directory, by the end of 1987, 197 countries produced 68,000 periodicals in the field of Bio Sciences ². One of the most significant effects of this unprecedented spurt in human knowledge has been its relevance to information science. The System of storage and retrieval of information is the process of scientific communication which has now become more complex than ever.

1) Price Derek JD Solla, little science, big science, Columbia university press, New York, 1963.

2) Ulrich's international periodical directory, 25th edition, Bowker's international periodicals data base, New York, 1987.

Not only the exponential growth of literature, but also the interdisciplinary nature of research and trend towards specialization has posed many problems both to the information seekers and librarians. Further, emphasis on national and international information systems have signified the need for an analysis of literature used by the scientists.³ Today the book is not the primary or the only medium of scientific communication. Since the 1950's, libraries have been handling a variety of media books, microform, art prints, periodicals, disc records, audio tapes, motion picture, films, slides, film strips, model video tapes, discs and data files in magnetic forms. Recently, the communication media of scientific communication of knowledge have been replaced by more scientific and sophisticated media, such as electronic mail, video disc, teletext, video text, on line information, retrieval satellite etc.

Thus along with the growth in the volume of knowledge, the information science has also grown phenomenally in respect of the nature and type of information functions it performs as well as techniques whereby it performs these functions.

3) Maheswarappa, B.S and Prakash. B.P, literature use pattern by the researchers in the field of Botany, journal of library and information science, Vol-7, No – 1 pp. 15 - 32.

The major focus of the study is to apply the bibliometric analysis with a view to analyze the performance of research output in astronomy. It could be noted that in the last few years, bibliometric analysis has been increasingly used to calculate the research performance of the scientists and the growth of the various disciplines of science. This study has resulted in a special attention on the performance of research output in astronomy. It aims to examine the emergence of research areas, research groups and countries with a view to map the cognitive or intellectual structure of research. Further, this study spells out the relationship between authors, institutions, journals and articles and other means of insisting the peer review procedure⁴

Bibliometric studies prove that bibliometric indicators play an important role in policy decisions and in evaluation of research performance. It is observed that there is considerable evidence that bibliometric indicators play an important role in the evaluation of research

4) J. King, A Review of bibliometric other Science indicators and their role in research evaluation. Journal of information science, Vol- 13, 1987, pp.261 - 276.

performance of individual scientists and research groups.⁵

Bibliometric studies have shown that all the pieces of published information do not have equal importance. Generally high quality output can reflect their due impact on the basis of content and utility. However, the medium and mode of dissemination of knowledge may be as important as message.⁶

The validity of the published information could be observed from their sources of publications in reputed journals. Further, the validity of the published information depends on quality and practical utility of the research output, especially in applied science area.

The analysis of utility of bibliometric studies in library usage is an important matter for subject discussion today. A great level of literature existing in library and information Science discusses the problem of identifying important literature in any particular

5) B.R. Martia, J, Ervine, Assessing basic research: The case of the Isaac Newton Telescope: Social science series 13, 1983 ,pp. 964 - 975.

6) J.A. Christenson and Sigelman L., accrediting knowledge, journals status and citation impact in social science , social science quarterly vol.- 66, No. – 4 ,1985,pp. 964-975.

Area.7 A review of studies of scientific literature indicates that librarians and information scientists would spend a great deal of time and efforts in attempting to understand the nature of scientists, use of information and literature.

Due to extensive research in communication of information by scientists, there is a need of a great deal of work to be done with respect to the nature of scientific literature particularly using quantitative models. Such studies mainly fall under the preview of bibliometric analysis. Generally bibliometric is the application of mathematical models to books and other mass media of communication. This type of analysis is done in this study pertaining to astronomy science research output.

The importance of bibliometric studies has been realized in the recent years and its growth has been imperative over the past two decades. This technique aims at measuring the pattern of all forms of written communication and their authors. Here the pattern of written communication denotes the sources of publications, such as journals, books, magazines, news

7) J. Halls, Important Literature of primary communication in science and technology, ASLIB, occasional publication, No - 9. London. 1982.

letters conference proceedings, patents, etc. The authorship pattern of communication denotes the number of authors participated in publishing a research output for a given area of research.

It is interesting to note that in the communication system the network of journals plays a very important role in the exchange of scientific and technical information. Further, it is observed that a journal which has been frequently used is more likely to be used is than an infrequently used one. An article in a journal which has been cited many times are more likely to be cited again than the one which has been rarely cited. An author of many papers is more likely to publish again than the one who is less prolibe. The above process is a routine activity in the publication of research output in any discipline and they can be explained with the help of bibliometric studies.

The analysis of growth of literature in bibliometric analysis is a key feature. The rational left with this analysis is that the growth of literature has made it difficult for scientists to keep in touch with the latest advancement in their disciplines. For this purpose, the library professionals have to meet the information needs of scientists in various disciplines. Due to increase in cost of publications, the policy makers have to decide. on priorities in resource allocation for scientific activities and also librarians have to decide the priority of supplying information to information scientists. The published

literature is yardstick to observe knowledge explosion in any discipline.

For this purpose the growth rate analysis of publications would yield useful results with respect to growth pattern of literature and scientific productivity of authors in that discipline. On the basis of this view, growth rate analysis could be taken to evaluate the research output performance in astronomy science.

The performance of scientific output depends on the number of researchers, motivation and infrastructure facilities available to them. In general, the above features play a significant role in output performance among the scientists of western nations. As a result more than 90 percent of the world research papers have been published in a few advanced countries of the west. Contrasting by, little attention has been paid to the scientists, output and its impact for developing countries like India.⁸ By keeping this fact in mind, in this study, scientific performance of developed nations could be analyzed in relation with India.

8) B. Kalic, Scientometric analysis of the research activities of chemists from the ruffer boskovic institute, *Scientometrics*, vol- 19, No- 1-2,1990, pp. **11** - 24.

In bibliometric analysis, the study of collaboration in research is a major feature. Generally collaboration in research appears to take place when two or more investigators work together on a project and contribute resource and effort both intellectually and physically⁹

Collaboration in research increase with increase in the number of contacts a scientist has with other scientists. Further, it has been influenced by other factors relating to the nature of research project, availability of research grants, magnitude of instrumentation, popularity and rate of expansion of the area in scientific research. This study corresponds of analyze the nature of collaborative endeavor in astronomy science.

Ranking of journals constitutes one of the ways of classifying the literature. It can be a useful tool for the librarians in subscribing the journals in a particular subject with a consideration that more a journal is cited, the more its popularity .

9) K. Subramaniyam, bibliometric studies of research collaboration: A review, journal of information science vol 6, 1983, p.34.

and importance. Hereby it reflects the importance of circulation.¹⁰

In this study, an attempt is made to rank the journals according to their impact in astronomy science. This type of analysis helps to understand the core literature that segments are potentially useful to the information seekers.

This can serve as a useful policy instrument to determine the research allocation in those sources, which show progressive trends.

Another aspect of bibliometric study is citation analysis along with identification of impact factor. It is one of the tools to identify the frequently used journals, books, government publications, etc, in a library. Hence the knowledge of comparative importance of library materials may be of great help in the selection and acquisition of documents within the limited budget. The analysis of the impact of journals is a tool in assessing the quality of a given publication or contribution of an individual or group of researchers. In order to identify the

10) LN. Sengupta, ranking of periodicals in the held of medical science from the Indian scientists point of view: An analysis takes for 1954 -58, IASLIC bulletin, vol.- 15, No.- 3, 1970, pp.120 - 144.

core literature in astronomy science, the impact factor is worked out to show the performance of research output in that discipline.

It could be seen clearly from the above discussion that bibliometric analysis is an important tool in analyzing the research performance in any discipline. By keeping this view in mind, the researcher intends to undertake this study on research output performance in astronomy science: A bibliometric analysis. This study attempts to analyze the performance of astronomy science research output in terms of its content and coverage growth rates, areas of research concentration, author productivity, and authorship pattern. Performance of research institutions in promotion of astronomy science research and citation analysis in terms of impact factor is also noted.

CONCEPTUAL STUDIES

Before designing a study on bibliometrics, it is essential to trace out the content and meaning of the term bibliometrics. It helps to explain the concepts in an operational situation.

Pritchard defines bibliometrics as branch of information theory that attempts to analyze quantitatively the properties and behavior of recorded knowledge.¹

The importance of bibliometrics was realized by S.R. Ranganathan. In this connection, he attributes its importance as necessary for librarians to develop librametry on the lines of biometry, econometry and psychometry, since many of these matters are connected with library work and service involving large numbers.²

Fairthorne holds the view that bibliometrics is the quantitative treatment of the properties of recorded

1. Pritcahrd,a.statical bibliography of bibliometrics, journal of documentation , vol.-25,No.-4,1969,pp.348 –349.

2.Ranganathan.S.R.,librametry and its scope DRTC Seminar. Paper D.a.1969.

discourse and behavior pertaining to it.³ Ravichandra Rao also emphasized Ranganathan's concept of library. He explains the term bibliometrics as the study of statistical distribution of the processes relating to the activities of library staff and library readers¹⁰ whereas Britain attributes the meaning of bibliometrics in terms of strictly conferred to the study of the nature, use and non-use of documents only.⁵

Sengupta explains the term bibliometrics as organizations, classifications and quantitative evaluation of publication patterns of all macro and micro communications along with their authorship by mathematical and statistical calculus.⁶

3) Fairthorne, Robert, A. Empirical hyperbolic distributions C Bradford - Zipf - Mandelfrot for bibliometric distribution and production, journal of documentation Vol.- 25, No.- 4, 1969, pp. 319 - 343.

4) Ravichandra Rao Lk., bibliometrics : Its theory and practice, DRTC, Seminar 13, 1981.

5) Britain, J.M, Information and its users: A review with special reference to social sciences. Bata university press, 1970.

6) Sengupta, LN. bibliometric research, S B A, Publications ,New Delhi, 1988.

There are a number of bibliometric laws. J.E. Howely and C.M. Turnur are of the view that the bibliometric laws are empirically founded on statistical distribution. They are not innate natural laws, but essential behavioral patterns of users and authors.¹³ Bibliometric laws, however, cannot be considered as natural laws for the behavior patterns of authors. Users are subject to constant change, and to the model formulated in bibliometrics resembles macro economic models rather than models developed in exact science. Bibliometric analysis primarily consists of applying quantitative techniques in library and information system.

The objectives behind bibliometrics studies are as follows:

- 1) Identification of core literature, the segment potentially most useful.
- 2) Ranking of publications in zones, diminishing importance.
- 3) Establishing a transition point between zones of higher and lower utility.
- 4) Tracing the spread of ideas analog on to the statistical techniques used in the study of epidemics

2) Howley J.E and Turner C .M., The dissemination of information, Andre division, London. 1978.

- 5) Classifying segment of literature by reference to the inter-connections shown in citations given by publications.

The other studies in bibliometrics are citation index, citation analysis and so on. Citations in articles and other Research reports are used for a number of reasons. They are

- 1) Paying homage to pioneers
- 2) To giving credit for related works
- 3) Identifying methodology, equipment etc
- 4) Providing background reading
- 5) Correcting one's own work
- 6) Correcting the works of others
- 7) Criticizing the works of others
- 8) Substantiating claims
- 9) Alerting researchers to forth coming work
- 10) Providing leads to poorly disseminated poorly indexed or uncited work
- 11) Authenticating data and classes of facts, physical constants, etc.
- 12) Identifying original publications in which an idea or concept was discussed
- 13) Identifying the original publication describing an eponymic concepts
- 14) Disclaiming work or ideas of others . and

15) Disputing priority claims of others.⁸

Citation index is an ordered list of cited articles each of which is accompanied by a list of citing articles. The citing articles are identified by a source citation and the cited article is identified by a reference citation. According to librarian's glossary citation index, it is a list of articles that subsequent to the appearance to the original articles, refer to cite that article.⁹

The original paper is called source of citing paper while the references found in it are called cited papers.

The above discussion brings to light the term bibliometrics. It explains the studying of documents by applying statistical technique. Through statistical technique one can study the distribution of literature, growth rate, doubling time, authorship pattern, collaboration, author productivity, ranking of journals, citation analysis in terms of impact factor and so on.

16) Weinstock, Melvin, citation indexes. In encyclopaedia of library and information science, marcel dekker, New York, 1971, pp.16 - 41.

17) Garfield, E, science citation index: A new dimension in indexing, science, 1964, pp. 144 - 149.