CHAPTER - 1
INTRODUCTION

Bibliometrics was one of the research methods used in Library and Information Sciences. Bibliography was a study regarding various aspects of literature and it identifies the pattern of publication, authorship, and Current Science coverage. It helps in understanding active change in the growth of knowledge in the areas undertaken for research. In the present day Bibliometrics has become so advanced and possesses national, international and interdisciplinary characters. According to Alan Pritchand, “it is an application of mathematical and statistical methods to look into other media of communication.” According to D.T. Howkins, “it is a quantitative analysis of the bibliographical features of body of literature.”

Nicholas and Ritchie in their book entitled “Literature on Bibliometrics”, stated that bibliometrics provide information about the structure of knowledge and how it was communicated. More recently, Sengupta had defined this term as the “Organization, classification and quantitative evolution of publication patterns of all macro and micro communications along with their authorship by mathematical and statistical calculus.” There are many scientists who use the concept with different terms, but the concepts were either an addition or extension of ideas. One similar name that was not frequently used was “statistical analysis” of the literature by Cole and Eales in 1917, while Hulme preferred to use the term ‘Statistical Bibliography’ in 1923.

In 1948, the great Indian Library Scientist S.R. Ranganathan, introduced the term ‘Librametry’ which was the first to be mentioned in the
history; he simplified it and put it order the services of Librarianship. The term ‘Bibliometrics’ is equivalent to Ranganathan’s ‘Librametrics’, the Russian idea of Scientometrics’, FID’s ‘Informetrics’ and few other related fields like ‘Econometrics’, ‘Psychometrics’, ‘Sociometrics’, ‘Biometrics’, ‘Technometrics’, ‘Chemometrics’, where logical and methodical application of mathematical and statistical calculus was considered indispensable to work out and resolve the obstacles that were in the concerned fields. Scientometrics is about applying quantitative methods to the history of science and obviously has several things common to bibliometrics to a significant extent.

Alfred J. Lotka (1926) published a work in which he had developed his own ideas about the frequency distribution of scientific productivity observed from a decennial index (1907-1916) of Chemical Abstracts. Applying Lotka’s law of scientific productivity, it was understood that only about six percent among the authors in a particular area of research were in position to produce more than 10 articles. Lotka’s law when applied to huge volumes of literature over a considerable time can without discrepancies generally, but statistically inaccurate. This was useful to calculating the frequency of authors’ appearance in an online catalogue.

During the same time, Gross and Gross published their citation based study as a constructive step towards acting over the decision that research articles, magazines, and periodicals in chemistry should be bought by some college libraries. In particular, 3633 citations were subjected to study from the 1926 volume of the journal of American Chemical Society. This study was taken to be the first citation analysis.
Bradford (1934) did a research on the frequency distribution of papers on journals. Bradford’s law helps in leading the librarians in determining the number of core journals in any given field. The arithmetic relationship among the journals from the core to the first zone was represented by a constant $n$ and to the second zone the relationship was represented through the constant $n^2$. Bradford brought out this relationship in the form of $1: n: n^2$.

Zipf (1949) postulated a law in bibliometrics and qualitative linguistics which are derived from the word “frequency” in a text. The law states that in a relatively lengthy text, if you list the words occurring within that text in order of decreasing frequency, the rank of a word on that list multiplied by its frequency will be equal to a constant. The equation for this relationship is: $rf = k$ where $r$ is the rank of words, $f$ is the frequency and $k$ is the constant.

Derek de Solla Price in his book *Little Science – Big Science* (1963) has elucidated on the system of communication in science that has been happening lately and presented the first orderly and systematic method to the “Modern Science” model. His work was radically different from the existing approaches and had novelty in it.

The concept of ageing and the idea of becoming outdated and unnecessary inextricably intertwined with the growth of science. As a result, a model based on mathematical calculation that was considered hugely significant and growing rapidly was recommended.
Later on, more multifaceted and composite models evolved. Goffman and Nevill (1964) came up with a concept called “intellectual epidemics” as a framework for scientific communication. According to this model, the spreading of ideas among the community of scientists was compared to how the influenza virus spreads in a community. This model how disease spreads and also foretells the time when the disease would escalate to the maximum from which it is thought to gradually die away. Goffman and Nevil used this model to explain the dissemination of information within the scientific community.

The beginning of 1980’s the concept of Bibliometrics saw a significant development into a clearly defined scientific field with several associated scientific communication structures.

The primary reason behind this development was evident with large bibliographic Databases that are provided in machine readable form and the rapid increase in the growth of computer science and technology. This provision helped to establish the metrics of science outside the United States of America. The technology of the 1990’s became the turning point. Thereafter, the funding of large projects became one of the common and efficient ways of financing research in scientometrics. From ‘Little Scientrometrics’ the field has grown up to be called “Big Scientometrics.”

Bibliometrics as a technique has a wider scope as it could be applied to identify the current research practices in a subject, authorship and association in research, core periodicals, outdated literature and the dissemination of literature in assessing the all-inclusiveness of secondary periodicals by scientists, citation studies, etc. Further, bibliometrics helps in
the identifying the upcoming research areas that were specifically of great interest to the community of the modern scientists.

The acceptance and the use of the bibliometric practices in various fields caused the growth of literature. The bibliometric techniques are currently pursued very actively; consequently, it has been revealed that a significant number of the articles published in Library and Information Science periodicals consists of maximum number of articles on bibliometrics. These techniques are put to use for several purposes like deciding and fixing of various scientific pointers, assessing the scientific output, and selecting journals for libraries, and predicting the efficiency and the productivity of Nobel Laureates.

Human knowledge achieved a profound growth. The growth of literature itself has raised an alert and it was considered as a matter of huge significance. This came to be called as the “information explosion.” Across the globe, five million articles are being published every year in about one lakh journals.

The vital of bibliometric areas are

a) To quantify research and their growth.

b) To identify comprehensiveness of secondary periodicals.

c) To identify users and authors of secondary periodicals.

d) To quantify the usefulness of adhoc and retrospective SDI services.

e) To identify the core journals in different disciplines to formulate a need based acquisition policy.

f) To initiate effective multi-level network system.

g) To regulate inflow of information and their communications.

h) To develop norms for standardization.
i) To predict productivity of publishers, individual author organization, country or that of an entire discipline.

This term became widely popular with the emergence of the journal named Scientometrics by T. Branin 1977 first published in Hungary and Cuweully from Amsterdam. The journal aims at publishing all the studies regarding the quality of science as an exclusive scientific field. Scientometrics was an integral element in the sociology of a science and can be of tremendous use while making several policies in science. It includes studying about the number of scientific activities it involves quantitative studies of scientific activities, including publication and has some features common to bibliometrics. Scientometrics was the branch of the ‘Science of Science’. Nalimov and Mulchenko (1969) define this term, “as a sub-field which applies quantitative methods to the study of science as an information process.”

Haitun considers “Scientometrics” as a “scientific discipline,” which carries out reproducible measurements of scientific activity and shows its objective quantitative regularities. According to him, Scientometric Methods comprises statistical and thesaurus methods and numerous references to citation and terms. Scientometrics are used to assess scientific events and happenings, primarily by generating statistics on scientific publications listed alphabetically in database. They are tools that could be adapted according to the need and they were used to provide insights related to the scientific communities to do scientific/strategic, technical, technological or competitive checking to plan out and bring about research programs and to effectively assess the research done. They were highly indispensable tools for critically examining the research output, locating studies and piloting foresight studies in science and technology.
The immediate forerunner to Scientometrics is Bibliometrics. Several other fields followed immediately with the inclusion of the term ‘metrics.’ There are many metric fields that deal with the development and application of measurement in the area. They include Bibliometrics, Scientometrics, Informetrics, Librametrics, and Webometrics. Regarding the etymology of the term 'metrics', Sengupta (1992) in one of his papers, stated that the term metrics is “derived either from the Latin or Greek word “metricus” or “metrikos” respectively, each with the same meaning – measurement.”

According to J.M. Tague-Sutcliffe (1992), “Scientometrics was the study of the quantitative aspects of science as a discipline or economic activity. It was a part of the sociology of science and has application to science policymaking. It involves quantitative studies of scientific activities, including, among others, publication, and so overlaps bibliometrics to some extent.”

Scientometrics as an exclusive study field got established in 1978, with the advent of the journal *Scientometrics* started by Tibor Braun who defined the contents of *Scientometrics* as, “Scientometrics includes all quantitative aspects of the science of science, communication in science, and science policy.”

Brookes (1990) elucidates on the concept and the use of scientometrics saying, “The term scientometrics, nurtured by Tibor Braun, has become fruitful in science policy studies. Its techniques have been developed by small groups of scientists working with single-minded enthusiasm in compact research units notably in Budapest and Leiden. But other research units in Europe, East and West, are beginning to make contributions to scientometric studies. The term has now established a significant role in the social sciences. Applications have so far been restricted to exploitation of
the citation data provided by ISI but further refinements are now being critically examined.

The main objective behind scientometrics is to assess the products of science communication. Scholars research, discover, gather information and transmit them to various systems of knowledge that enable them to perceive, explore, and mold their environment. Gaining expertise and acquiring skills by applying the accumulated knowledge and the constant renewal of scientific truths necessitates extensive research, often accomplished in a formal academic setting.

The affordable price of the PC with Internet connectivity as a bundle offer in developing countries including India, brought scientometrics to the desktop. Katz and Hicks (2009), in view of such a liberalized environment, in their article entitled, ‘Desktop Scientometrics,’ defined that, “Scientometrics was a unique research area and scientometricians are a unique breed of scientists who endeavor to quantify national and international systems of innovation to help policy shapers weave the political and economic climate required to nurture an R&D community in hopes of deriving long term economic and social benefits.”

Subscribing to this concept of science and scientometrics, Leydesdorf (2001) expressed that, “The strength of the scientometrics program is its positive definition of science as an area of inquiry. The scientometric approach has often been reproached for its ‘objective’ pretensions. In my opinion, these pretensions are articulated with respect to particular methods and results, and one should not on this basis refute the challenge of scientometrics at the epistemological level, that is the claim that scientific developments are amenable to measurement.”
Bibliography necessarily appended to reports and research publications as well, facilitate the measuring process. Scientometrics, dominantly interdisciplinary in nature, has a broader Bibliometric base.

Scientometrics makes use of the publications of scientists to respond to the queries made by investors and social scientists considering research and science as potential research objects. Scientific publication is pivotal to the growth and development of scientific communities and moreover was available to a significant extent in the online databases. Counting the research productivity (papers, citations) was the very first stage of scientometrics. Bibliometric laws was a fundamental necessity of Scientometric approach at the higher level.

Scientometric indicators provides with policy-makers with authentic information that goes beyond mere observations and reports. These indicators have been taken as the parameters of evaluation and analysis pertaining to the area of science policy making. The focus has been shifted in the recent years over two ways of measuring scientific information: practical and strategic. The practical way deals with facilitating search of information to users. With regard to the strategic use of information, it means keenly watching over developments happening in science and the analysis of the dynamic nature of science. In certain studies, statistics of the survey were generated with regard to the following indicators:

- Number of papers
- Number of Authors
- Growth
- Time Series
- Collaboration rate
- National Collaboration rate
- Specialization Index
- Visualization of Collaboration network.

Science was established through this method. It was another term to the experimental method – a method of approach to the establishment of scientific facts or truth. Today, the world was experiencing an extraordinary output of scientific research, subsequently resulting in enormous publications in the form of articles and technical reports. According to Tijssen (1992), “The methodology of science views scientific knowledge and its development through the presentation of objects described in a scientific publication. Scientific publication is by no means an invariable piece of information that can be published, stored, retrieved and delivered on request. A scientific publication is a kind of written material containing information with respect of scientific activities either in its physical form, or its electronic equivalent in a computerized database.” Social scientists consider scientific publication as a web of science produced under social conditions.

Science has been radically changing the lives of people in so many essential ways. Scholars and other enthusiasts around the world eagerly seek to increase the scientific capacity with firm hope of developing Individuals, groups, and nations increasingly seek to augment scientific capacity social, material, and personal well-being. There was a commitment to strict logical reasoning, application of diverse strategies, and the diligent use of evidence. Research is a systematic way of examining the facts of a subject matter for the sake of contributing to the growth of knowledge.

The surprising thing to observe is the presence of research approaches and techniques that have been put to practice and diverse ways in which
evidence from different fields across science are coming together. One of the developments that emerged out of such convergence was evaluating the scientific productivity. This was followed for a few decades and the concept underwent several changes and further developed as Scientometrics.

India plays a significant role as a forerunner, model, and a leader to the developing countries. It has its bearing on many levels. It was also reflected on the scientific levels. India has a space program and a nuclear program strongly designed, developed, and built by itself. India has contributed a lot to the green revolution. This strong, independent scientific and technological background was evident from the fact that India occupies fourteenth rank worldwide becoming the only developing country in the top fifteen. India’s annual number of publication grew from 9450 in 1990 to more than 11,300 in 2000, a growth of 20 per cent. India produces 11 papers per million inhabitants per year. India’s leading position in scientific production was because of its massive population.

India produces 10,000 scientific papers which was higher than the average. India publishes more than 25,500 papers between 1990 and 2001 in the field of physics. India specializes in physics with an index of specialization of 1.35. Despite such accomplishments, India’s scientific production was not yet up to the international standards.

The Academy was established in 1934 by Professor C. V. Raman (Nobel Laureate) and was approved as a Society under the Societies Registration Act, on 24 April 1934. The opening ceremony happened on 31 July 1934 with 65 Founding Fellows. Following the inauguration, the fellows who were present assembled for the meeting where C. V. Raman was declared its President, where the structure of the Academy was approved and
adopted. The maiden volume containing the details of the Academy "Proceedings" came out in two parts during the month of July 1934. From that point onwards, the "Proceedings" were categorized thematically in the journals with the inclusion of new journals. The Academy presently has 1010 Fellows, 52 Honorary Fellows, and 53 Associates on its rolls.

The Indian Academy of Sciences takes hard efforts within its capacity to facilitate the growth, support and defend the cause of both pure and applied science. The Fellows belonging to the Academy are expected to shoulder the responsibility of advocating research and spreading the knowledge to the immediate community around by holding meetings, seminars, and through analyzing the publications.

The Academy acknowledges the healthy association between the any creative work and the system of education and holds that the path to innovations and discovery was a consequence of properly developing the potential amongst the younger generation. The Academy upholds the belief that the attitude of being responsible in the society underlies any scientific activity whether it was undertaken individually or as a corporate team absolutely coincides with the fact that the liberty of an individual and the quest knowledge and truth cannot be compromised on dogmatic adherence to any particular belief or philosophy.

Publication of scientific journals was considered a significant activity among the other activities conducted by the Academy since 1934. This program strictly adheres to the principle that no journal published by the Academy should compete with the related journals and be in competition for circulation, coverage, and popularity. It was resolved that the Academy will work together will other related organizations and that all the papers submitted would have to go through a thorough examination by subject experts.
The Academy Proceedings came out as a first edition in July 1934 as a monthly and later the number of issues had become bimonthly. In 1973, a new physics journal entitled Pramana was introduced. Four years later, the publications got significantly expanded including two units of Proceedings thematically split into several journals belonging to the fields like mathematics, chemistry, earth and planetary sciences, plant sciences, animal sciences, and modern biology. Some other journals were introduced in material science, astrophysics and astronomy. A decade later, the Academy took the burden of regaining the popularity of the Journal of Genetics. This paper had been in circulation for a long time. Another journal that was added recently called “Resonance” aims at enhancing and enhancing the value of education and teaching. Due to the combined effort of the Academy and the Current Science Association the journal began to be published once in fourteen days since 1932. The Academy publishes eleven journals presently inclusive of all the significant research domains in science and technology. The Academy holds the records of being largest scientific publisher across country. In addition to the regular journals, special publications relating to the current news or events that are considered important are frequently released.

Due to the combined efforts of the Indian Academy of Sciences and the Association, Current Science one of the leading journal containing sources across the various streams of science was published from India. The circulation started in 1932 by the leading figures such as CV Raman, Birbal Sahni, Meghnad Saha, Martin Foster and S.S. Bhatnagar. The objective of the journal is to provide a medium communicating important issues that are related to science and scientific activities. In addition to the complete research articles, shorter research communications, the journal publishes review articles, scientific correspondence and commentaries, news and reviews on the recently published research papers, opinions on scientific
activity, articles on universities, Indian laboratories and institutions, interviews with scientists, personal information, book reviews, etc., are all included in the journal. This also provides a forum to deliberate on problems and challenges encountered by the scientists and an active channel of correspondence for the experts in the field across the world. Scientists, scholars, and the researchers across the world are reading and following the *Current Science* journal and the circulation was rapidly increasing. Several editions have been published by the Current Science Journal with various themes that are being actively pursued by the scientific community and this became a wonderful channel through which the articles and the research efforts of scientific community are approved and recognized. Some of the special sections that have gained wide acclaim and acceptance are remote sensing, waves and symmetry, seismology in India, nanomaterials, AIDS, Alzheimer's disease, molecular biology of ageing, cancer, cardiovascular diseases, Indian monsoon, etc. Some of the popular scientists and experts have contributed to this journal. The Impact Factor of the journal for the year 2013 is 0.833.
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Problem formulation suggests listing down the objectives of proposal or study, which means narrowing down the ideas and writing that involves stating clearly and precisely what the researcher aims to do. The first step in stating was identifying the same creatively and objectively, so that the formulated problem which was expressed should not be misunderstood. The first essential condition for expressing the problem is an in depth study of the subject matter. Once the problem was identified and selected for research, the researcher should find out various sources to collect information about the problem.

The objective of the current study is to do a scientometric analysis of the research publications and the articles in the Journal of Current Science on. Publication was an important channel for the dissemination of knowledge, and when a researcher’s work was published it gets recognition and approval from the community of scientists. Scientists are able to move up to the next higher level, in their career when their works are recognized professionally; so it was a matter of pride for them. The efficiency of a researcher or scientists was determined according to the publications that he/she has, and their work was acknowledged by others only when it comes out published. So, the process of “publication” serves as a standard for measuring the performance level of an individual.

Hence, it was evident that bibliometric analysis is an indispensable tool in analyzing any academic and scientific field. Considering all this, the researcher proposes to conduct a study on research publications by the scientists in “Scientometric Analysis of Journal of Current Science”. The present study focuses attention on Scientometric study in terms of the pattern of publication, authorship, growth rate, area of research concentration and author productivity.
The researcher has formulated the following testable hypotheses and from the statistical analysis of the collected data their validity is tested.

1. The journal’s source of citation of Science occupies a predominant place while comparing other sources of citation.
2. There was a significant level of variation in article publication in various publications of Current Science.
3. There has been an increasing trend in collaborative authorship pattern in recent years.
4. The implications of Price’s law are related to author productivity in article publications.
5. Authors of ‘Journal of Current Science’ have a tendency to cite latest literature relevant to their field.