CHAPTER II

REVIEW OF LITERATURE

2.1 INTRODUCTION

In any research investigation, review of related literature is a primary component which enables the investigator to understand the earlier research interests, research patterns and the magnitude of the research output in a field of knowledge. As far as the field of ‘Bibliometrics’ is concerned, the literature on the subject is constantly growing. A number of articles, books and conference volumes on the development of Bibliometrics have been published.

A common research tool is a bibliometric method which has already been widely applied in scientific production and research-trend studies in many disciplines of science and engineering (Almind & Ingwersen\(^1\), 1997; Cronin\(^2\), 2001; Moed, Debruin, & Vanleeuwen\(^3\), 1995). The popularity in the adaptation of bibliometric techniques in various disciplines stimulated stupendous growth of literature on bibliometrics and its related areas.

Conventional bibliometric methods generally evaluate the research trend by investigating the publication outputs of different countries (Rahman, Haque, & Fukui\(^4\), 2005), research institutes (Rajendram, Lewison, & Preedy\(^5\), 2006), journals (Dannenberg\(^6\), 1985), subjects (Rajendran, Ramesh Babu, & Gopalakrishnan\(^7\), 2005) and research fields (Davis & Gonzalez\(^8\), 2003, Krishnamoorthy, Ramakrishnan, & Devi\(^9\), 2009).
Therefore the literature available in this field, in this Chapter, has been reviewed based on the significance and the recent literature on the various aspects of bibliometric research under the following sub headings:

- Earlier and Continued activities
- Country’s output
- Journals
- Scientometric Profile
- Authorship Pattern
- Citation analysis
- Databases related
- Mapping the literature
- Bibliometric laws

2.2 EARLIER AND CONTINUED ACTIVITIES

The first review on bibliometric empirical laws was done by Fairthrone\textsuperscript{10} in 1969. The second important one was published by Hjerpe\textsuperscript{11} in 1980, which contained more than 200 references on bibliometrics. The most comprehensive historical review was published by Hertzel\textsuperscript{12} in the Encyclopedia of Library and Information Science in the year 1987.

The International Society for Scientometrics and Informetrics (ISSI) has been organising a series of international conferences on bibliometrics, biennially since 1987. So far ten international conferences have been held at different places in the World, which brought out the research productivity of the bibliometricians.\textsuperscript{13-22}. 
2.3 COUNTRY’S OUTPUT

Schoepflin and Glanzel (2001)²³ described the development of the field of bibliometric and scientometric research and analysed by quantitative methods to clarify that bibliometrics evolving from a soft science field towards rather hard (social) sciences (Schubert-Maczelka hypothesis).

Garg and Padhi (2002)²⁴ analysed laser research in India (1970-1994) which showed that India improved considerably during 1985-1994 as compared to 1970-1984. Further the study indicated that the proposition of mega authored papers increased during 1990-1994 and international collaboration was mainly with the USA.

DeArnenas, Lomnitz and Licea (2002)²⁵ conducted a bibliometric analysis in the area of health science in Mexico, on the assumption that journal impact factors are correlated with accumulated productivity and that the number of citations is related to the visibility of a given contribution.

Markusova, Wilson and Davis (2002)²⁶ studied the literature in biodefence area. The goal of their project was to trace changes in biodefence research and activities of its main players, Russia and the US. They found that during ten year period (1999-2000), the growth of publications increased by 25%. They concluded that there was a sharp decline in Russian publications. The leading organisations in these areas were the former military research institutes, and then affiliated with the Ministry of public health of Russia. They also found that collaborative papers comprised of 16% of Russia’s Biological Weapons Papers. Of these collaborative papers, about 70% were with the US.
Zanetto (2002)\textsuperscript{27} examined the development of scientific and technological literature in Brazil on a 25-year period. It was found that the growth rate of Brazilian scientific production exceeded the international average, showing a six-fold increase in 25 years period before 2002. Concluded that Brazil’s innovations capability was still unsatisfactory and in contrast to its scientific production was failing to grow significantly.

Wilson and Osareh (2003)\textsuperscript{28} examined the development of Iranian Scientists research work and the development of science and technology (S&T). A scientometric analysis of Iranian S&T publications using the Science Citation Index is presented and discussed possible shortcomings of this approach.

The Indian output on Air Pollution research was analysed quantitatively by Parameswarn, Ramesh Babu and Gopalakrishnan (2003)\textsuperscript{29}. The various bibliometric indicators have been used in the analysis, with regard to the authorship pattern, Relative Growth Rate, Doubling Time, ranking of core journals and core research institutions in India.

AIDS literature in Central Africa, analysed quantitatively by Macias – Chapula and Mijangos-Nolasca (2003)\textsuperscript{30} which indicated a high pattern of collaboration through multi authorship.

2.4 JOURNALS

Arunachalam and Garg (1986)\textsuperscript{31} examined the papers published over a period of 2-years from the 5 countries, such as Indonesia, Malaysia, Philippines, Singapore and Thailand, and covered in Science Citation Index during 1979 and 1980 and citations to them in the international literature of science as seen from
SCI 1979-1983, which reveals that despite the relative economic affluence, science in these countries is still on the periphery.

Baburajan (1988)\textsuperscript{32} described the importance of scientific journals as a primary source of current information especially in the field of Engineering and allied Sciences. A bibliometric analysis of Institute of Electrical and Electronics Engineers Transactions on Computers, the most authentic in its field, is made choosing 4 volumes published during 1982-1985 as samples. The main features analysed were nature and scope of papers, distribution by subject, source of contribution by country and institution, authorship pattern, currency and length of papers.

Zhuk et al (1990)\textsuperscript{33} discussed the scientometric study of the information flow in the field of ‘plasmochemical synthesis’ and ‘polymer membranes’ recorded through Datastar and STN. The results show that the first paper on ‘plasmochemical synthesis’ was published in 1976. The very high growth rate of the published literature is the result of an increasing interest in the two fields as well as of a theoretical basis created in the 1970's.

Ullah (1994)\textsuperscript{34} investigated the contribution of Indian hydrologists and experts in water resources to 100 volumes of the Journal of Hydrology, for the period 1981 to 1993, with regard to major disciplines, authorship patterns of articles, research collaboration, institution wise output and authors' identification. A large number of contributions come from Indian authors with a large proportion of the output coming from a few organisations. Indian hydrologists are principally concerned with groundwater related issues.

The contributions to an issue devoted to ‘Scientometrics in India’, asserts that patents are a useful source of scientific and technological information as examined by Gupta (1999)\textsuperscript{36}. Attempted a bibliometric analysis of patents in order to identify technological trends in the area of fullerenes and to study other parameters such as growth of patenting activity, and active players in the field from industry, academia and government research institutions.

Narendra Kumar and Ramesh Babu (1999)\textsuperscript{37} analysed the literature published in ‘ILA Bulletin’ during the year 1986-1996 discussing authorship pattern, citation pattern, subjects covered, ranking of the contributors, nature of contributions, bibliographic forms, of cited documents etc.,

Wagner-Dobler (2001)\textsuperscript{38} examined the series of collaboration trends indicated through co-authorship since 1800 in mathematics, logic and physics. In physics, the share of co-authored papers expanded in the second half of the 19\textsuperscript{th} Century, in mathematics in the first decades of the 20\textsuperscript{th} century and in logic in the second half of the 20\textsuperscript{th} century. Sub disciplines of mathematics, physics, and logic showed large differences in their respective propensities to collaborate.

Das (2001)\textsuperscript{39} observed the collaboration pattern in computer science research in India. The study covers 1408 research papers published in international journals on computer science contributed by Indian scientists from 1991 to 2000. The domestic and international collaboration patterns have been studied and reported that USA, Canada and Germany were the collaborative countries. Among
the Asian countries, Indian collaborated mostly with Japan followed by Singapore and found that India had the potential of carrying out computer science research of international standard.

Cronin (2001) revealed the idea of a unified citation index to the literature of science was first outlined by Eugene Garfield in 1955 in the journal ‘Science’. Science Citation Index has since established itself as the reasonable standard for scientific information retrieval. It has also become the database of choice for citation analysts and evaluative bibliometricians throughout the world.

Garg and Padhi (2001) studied the publication trends in laser science, covering 3174 papers published in journals in the field of laser science and technology indicate that only 401 papers were single authored and the rest 2773 were co-authored papers. Out of 2773 papers, 687 were written in local (inter-departmental), domestic (inter-institutional) and international collaboration.

Vinkler (2003) revealed the relative indicators are preferably used for comparative evaluation of thematically different sets of journal papers. The Relative Publication Strategy and Relative Subfield Citedness (RPS/RW) function referring to a set of papers selected was found to be identical with the Mean Expected Citation Rate and Mean Observed Citation Rate (MECR/MOCR) function.

Koley and Sen (2003) studied 457 citations appended to 26 research articles published in the four issues of the Indian Journal of Physiology and Allied Sciences. The ratio of Indian to foreign citations is found to be almost 1:6 of the total citations, 4.59 per cent are author self citations and 2.84 per cent are journal self citations. The citing articles one is single-authored, 10 are two-authored, 9
three-authored, 4 four-authored and one each five-authored and six-authored. No collaboration was noticed in the case of 23 citing articles. The remaining 3 articles were the results of two-institution collaboration.

Kalyane and Sen (2003) examined the researches on ‘eminent individual scientist’ as a unit of information generation has opened up diversified vistas in understanding the process of R&D innovation communications. Quantitative documentation on Tibor Braun encompasses his papers (single-authored 40 and multi-authored 140) during 1954-1995.

Narnag (2004) analysed comparative study of articles published in Indian Journal of Pure & Applied Mathematics. The results indicate that the number of contributions is increasing in successive volumes. The study analysed the distribution of contributions, authorship pattern, citation analysis, geographical distribution of contributions and number of pages in each volume.

Moed (2005) examined the differences in the structure of written communication system of different field of scholarships. Analysed the journal coverage of ISI’s databases and identifies why raw data from the databases cannot be used straightway in citation analysis.

Jena (2006) analysed the journal “Indian Journal of Fiber and Textile Research” for the period 1996-2004. The trend of publications such as the year wise distribution of articles, bibliographical distribution of citations, authorship pattern, citation pattern, average length of articles, number of tables and figures used, time lag, geographical distribution of authors and subject analysis have been studied.
2.5 SCIENTOMETRIC PROFILE

Amudhavalli and Florence (2001)\textsuperscript{48} analysed the publication data can be sued in the identification of emerging research areas and in the evaluation of the research performance of individual scientists, research groups or organisations.

Kim and Kim (2000)\textsuperscript{49} examined the research performance of chemists at Seoul National University (SNU), the most prestigious university in Korea, using the numbers of articles appearing in journals and the numbers of citations received by those articles covered by Science Citation Index SCI CD-ROM, 1992-1998.

Kim (2001)\textsuperscript{50} explored the research performance of Korean physicists, comparing Korean-authored papers versus internationally co-authored papers, indexed in SCI during 1994-1998 and using the number of citations received by internationally co-authored papers covered by the SCI CD-ROM.

Swarna, Kalyane and Vijai Kumar (2002)\textsuperscript{51} examined the technical reports as one of the media to record the scientific information generated by scientists and engineers, of Bhabha Atomic Research Centre (BARC) publications. The scientometric analysis of these reports has been carried out for physical bibliographic characteristics, authorship collaboration, inter-divisional collaboration, inter-institutional collaboration activities and content analysis.

Munnolli and Kalyane (2003)\textsuperscript{52} analysed 312 papers by Ram Gopal Rastogi published during 1954 to 1992 and reported the various domains of study, research collaborations, and highest productivity during the study period were examined.
Kademani et al (2006)\textsuperscript{53} analysed 724 papers published by the scientists of Analytical Chemistry Division at Bhabha Atomic Research Centre (BARC) during 1972-2003 in diverse domains. The highest number of publications was produced in 1997 and 2003. The most prolific authors were M. Sudersanan and P.K. Mathur. The core journals preferred for publishing were: Indian Journal of Chemistry and Journal of Electrochem Society of India. Top raking journal publishing analytical chemistry research were from India, UK and Switzerland.

2.6 AUTHORSHIP PATTERN

A new method for author group formation and decay processes is proposed. With the help of a special mathematical model time distribution of authors and their publications was established and group productivity, composition and stability, annual change of the total number of short-term and long-term authors, their renovation, as well as the time dependence of these quantitative was determined by Trofimenko (1987)\textsuperscript{54}

Shailendra Kumar (1992)\textsuperscript{55} investigated the collaborative pattern of authors in history of science in India from 1905 to 1986. He observed that single authors made more than 86% of contributions in the literature.

Wilkes et al (2002)\textsuperscript{56} have reported investigations on Nursing Research published by Australian authors from 1995-2000 in 11 Nursing journals from Australia, UK and USA.

Farahat Hashem (2002)\textsuperscript{57} revealed the pattern of authorship in 19 Egyptian journals of agricultural science. Multiple authorship was found to be the predominant trend in the field and co-authored papers accounted for 79% of the sample. The most common form for multiple authorship involved were three
persons. Considerable variation was found among sub-fields and co-authorship was found to be most common in social science related agricultural disciplines.

Glanzel and Thijs (2004)\textsuperscript{58} studied the basic regularities of author self-citations. The regularities are related to the ageing, to the relation between self-citations and foreign citations and to the interdependence of self-citations with other bibliometric indicators. The results of the paper confirm the common notion of such effects only in part. The authors show that at the macro level multi-authorship does not result in any exaggerate extent of self-citations.

Yoshikane and Kageura (2004)\textsuperscript{59} discussed the pattern of research collaboration through observing co-authorship networks. Those studies mainly analyse static networks, and most of them do not consider the development of networks. On the basis of an analysis from two viewpoints, growth in the number of collaborating partners and change in the relationship strength with partners, the characteristics of four different domains, such as electrical engineering, information processing, polymer science and biochemistry have been compared.

Surendra Kumar and Kumar (2004)\textsuperscript{60} examined the chronological documentation list prepared for the purpose along with author and subject indexes. In this study, productometric analysis of contributions of National Research Centre for Soybean, Indore has been carried out for the period 1987 - 2001 in terms of number of research articles produced by its scientists.

The study highlights the authorship trend and collaborative research in chemistry in India during 1996-2000 was quantitatively analysed by Kannappanavar and Swamy (2004)\textsuperscript{61}. The study found that team research is preferred in the field of chemistry rather than solo research. The degree of
collaboration is calculated and it is found that of collaboration varies from year to year.

Udofia (2005)\textsuperscript{62} compared the author collaboration in the periodical literature of African Trypanosomiasis. The study was based on the literature published during 1990-2000 in Tropical Diseases Bulletin and Tsetse and Trypanosomiasis Quarterly (TTQ) using the counting method. It is found that both the annual rates and the cumulation of author collaboration for the period for each of the ten years was high although the figures obtained for 1992-1995 and 1998-2000 were higher than those for 1990-1991 and 1996-1997.

Rao and Gupta (2005)\textsuperscript{63} explained the Indo-German collaboration in Science and Technology, through the co-authored publications during 1996-2000. The collaboration is under two broad streams, bilateral and multilateral. The study provides an analysis of co-authored papers by main fields and sub-fields and the impact of such collaboration in different fields of Science and Technology. The paper identifies the major institutions involved in collaborative research in the two countries. The study reveals the extent of commonality of subject interest between the two countries. The analysis showed that the bilateral papers were maximum in physics followed by chemistry, biomedical research, etc. However the impact factor of bilateral papers was highest in biomedical research followed by physics, chemistry, etc.

Mahapatra and Padmanav (2006)\textsuperscript{64} discussed the growth of scientific research literature on Orissa published during 1985-2004. Includes 875 research papers from 40 different journals. Analyses the data by their authorship pattern, category of journals, place of origin, length of papers and productivity of journals
2.7 CITATION ANALYSIS

Dutta, Das and Sen (2003) studied the 2800 citations appended to 152 articles published during 2001 in eight scholarly journals published by National Institute of Science Communication & Information Resources. In all, 7426 authors were figured in the citations. On average, there are 18 citations per article and 3 authors per citation. The high percentage of multi-authored citations clearly indicates the dominance of team research in the concerned fields. On average, journal articles account for about 79 percent of the citations.

Biradar and Sampath Kuamar (2003) studied obsolescence of literature, Annual Aging Factor (AAF), Mean Life (ML) and Utility Factor (UF) of periodicals in the field of chemistry. This is based on references appended to the articles published in Indian Journal of Chemical Technology during the year 1994, 1997 and 1999. Obsolescence of literature was studied and half-life of literature was found to be 11.8 years. Study also applied Brooke’s formula for identifying Annual Aging Factor (AAF) and the average value of ‘a’ was found to be 0.9754 and Mean Life (ML) and Utility Factor (UF) were calculated and found to be 16.1958 and 40.65 respectively.

Verbeek, Debakere and Luwel (2003) analysed of the geographic distribution of the science citation patterns in patents, singling out two fields of (different) technological development, namely biotechnology and information technology. This approach allows exploring the associative patterns between science creation (as emerging from the scientific literature) and technology development (as emerging from the patent literature).
Sujit Bhattacharya, Kretchmer and Meyer (2003) examined the methodology for studying the interactions between science and technology. The approach rests mostly on patent citation and co-word analysis. In particular, this study aims to delineate intellectual spaces in thin-film technology in terms of science/technology interaction. The universe of thin-film patents can be viewed as the macro-level and starting point of our analysis. Applying a bottom-up approach, intellectual spaces at the micro-level are defined by tracing prominent concepts in publications, patents and their citations of scientific literature.

Ahmed et al (2004) reports the results of a citation study on Watson and Crick's 1953 paper announcing the discovery of the double helix structure of DNA. The paper has been cited more than 2000 times since 1961 and there is no sign of any obsolescence to this article. An analysis was undertaken of the journals in which the citations appeared and of mistakes in the bibliographic citations provided by citing articles.

Glanzel and Thijs (2004) analysed the role of author self-citations within the process of documented scientific communication. Two important regularities such as the relative fast ageing of self-citations with respect to foreign citations and the "square-root law" characterizing the conditional expectation of self-citations for given number of foreign citation have been found studying the phenomenon of author self-citations at the macro level. The analysis of citation based indicators for 15 fields in the sciences, social sciences and humanities substantiates that at this level of aggregation there is no need for any revision of national indicators and the underlying journal citation measures in the context of excluding self-citations.

Glanzel, Thijs and Balazs (2004) analyses the role of author self-citations aiming at finding basic regularities of self-citations within the process
of documented scientific communication and thus laying the methodological groundwork for a possible critical view at self-citation patterns in empirical studies at any level of aggregation. The study consists of comparative analysis of the ageing of self-citations and of non-self citations, interdependence between self-citations and foreign citations is analysed and interrelation of the share of self-citations in all citations with other citation-based indicators is studied.

The application of bibliometric techniques in the social sciences attempts to clarify some of the topics mentioned against the application of the SSCI for evaluation purposed by Leeuwen (2005)\textsuperscript{72}. Further it covers topic like the existing publication and citation culture within the social sciences, the effect of variable citation windows and the (geographical) origin of citation flows.

Nederhof (2005)\textsuperscript{73} examined the research performance monitoring of the social sciences and the humanities using citation analysis. Main differences in publication and citation behavior between the (basic) sciences and the social sciences and humanities are outlined. Limitations of the SCI and A&HCI for monitoring research performance are considered.

Moya-Anegon et al (2006)\textsuperscript{74} presented a domain analysis of the Library and Information Science discipline using on author co-citations analysis (ACA) and journal co-citation analysis (JCA). The techniques used for map construction are the self–organising map (SOM) neural algorithm, Ward’s clustering method and multi-dimensional scaling (MDS). The results of the study are compared with similar research developed by Howard White. This also shows that the visualization of scientific field structures is a classic of scientometric studies.
2.8 DATABASES

Databases containing bibliographic references on published scientific literature are significant for quantitative studies.

The scientometric study of literature on electrical superconductivity divided into 10 areas (e.g. power lines, electrical energy converters, generators) was attempted by Rebrova and Komarov (1989)\textsuperscript{75}. Presents statistics on the time dynamics of the number of published papers during 1979-1985, the dynamics of the growth of the publishing rate during 1971-1985, the percentage of patent literature and of reports and the volume of literature references retrieved from individual data bases.

Vaishnav and Deo (1993)\textsuperscript{76} studied the area of computerised information storage and retrieval. They described a bibliometric study in which the LISA database was analysed to discover the growth of literature of computerised library and information services, subject wise growth, authorship trend, authors publishing outlets, journal literature, its distribution and application of Bradford’s law.

Looze (1994)\textsuperscript{77} examined the application of bibliometric methods and tools for analysing data from information science and patent databases that enables access to different representations of an area that is particularly fragmented and difficult to interpret.

Indian Engineering literature extracted from the database (COMPENDEX) has been studied by Ravichandra Rao and Suma (1999)\textsuperscript{78} and found that Engineers in India published mostly in selected journals in English language.
The study of Indian literature on Information Technology and its applications in Library and Information Centres has been conducted by Bagawathi Sudha and Ramesh Babu (2000) based on “Indian Library and Information Science Literature” for the period 1990-1993. This study revealed solo research and most of the contributions were by practicing library professionals and published in journals.

Koehler et al (2000) examined the publications in CyberMetrics, Information Research, the Journal of Internet Cataloging, Libres, and the Journal of the American Society for Information Science. It was found that there exists difference among journals for distributions of authors by gender and corporate authors by region.

Semiconductor is the key element for information industry. Tsay, Jou and Ma (2000) investigated the growth of semiconductor literature based on the database INSPEC. Well-established bibliometric techniques, such as Bradford-Zipf's plot and Lotka's law have been employed to further explore the characteristics of semiconductor literature. Quantitative results on the literature growth, form of publication, research treatment, publishing country and language, author productivity and affiliation were reported. Further, from the Bradford-Zipf's plot, 25 core journals in semiconductor were identified and analysed.

Indian’s contribution to research in agriculture and related fields based on analysis of publications indexed in CAB Abstracts published during 1990-1994 were analysed by Arunachalam (2000). The author attempted to map the agricultural research in India and tries to answer the questions such as which institutions are carrying out the research, in which journals Indian research works get published.
Parameswaran and Smitha (2001)\textsuperscript{83} analysed the contents of LISA during 1994-1998 which revealed that maximum number of articles are found to be published in the subject of Communication and Information Technology and majority of the publications are by single authors.

Marshakova-Shaikevich (2001)\textsuperscript{84} analysed an issue dedicated to the memory of the Russian 'father of scientometrics', Vassily Vassilievich Nalimov (1910-1997). Aims to show some possibilities of bibliometric methods applied to the subject index of Chemical Abstracts and to the permuterm subject index of Science Citation Index.

Kolpakova et al (2001)\textsuperscript{85} studied the Government Reports (NTIS) to establish the trends in the development of optical technology and instruments. The results show that optical technology has been developing rapidly during the period 1986-1996. The results also prove the suitability of bibliometric studies as a tool for identifying technology development trends.

Vijay Kumar et al (2002)\textsuperscript{86} analysed on the publications of Ahmed Hassan Zewail, Nobel laureate in Chemistry who had collaborated with one or two colleagues and published 246 papers during 1976-1994.

Kumar and Gupta (2003)\textsuperscript{87} reviewed the different approaches for studying the growth of scientific knowledge, as reflected by publications. They explored the applicability of selected models in the growth of world research output in the form of articles, patents and books in the field of Chemical Sciences.

Sangam and Keshava (2003)\textsuperscript{88} examined the growth of social science literature included in the Wilson Social Science Abstracts for the period of 1983-
1998, which determined the relative growth rate, and doubling time for the publications.

To map semiconductor literature by author co-citation analysis and in order to highlight major subject specializations in semiconductors, Tsay, Xu and Wu (2003)\(^89\) identified authors and their relationships within these specialties and within the field. Data were collected from the INSPEC database from 1978 to 1997.

Claude et al (2004)\(^90\) studied the distribution of articles involving artificial neural networks (ANN) in the field of medicine and biology and covered in the ISI (Institute for Scientific Information) database during the period 2000-2001 was analysed. The parameters considered were the number of articles, the total impact factor, the ISI journals category, the source country population, and the gross domestic product.

Mahapatra and Rudranaryan (2004)\(^91\) analysed the project work of “Orissan Studies: A Bibliographic Compendium of Research Papers on Orissa in English from 1983 to 2002”. Tribal studies is one of the major subject areas covered in the bibliography. The genuine interest generated in order to ascertain the growth of literature in a developing state like Orissa for the decade 1993 to 2002, although the bibliography in the original study was compiled for two decades 1983 to 2002.

Guan and Ma (2004)\(^92\) analysed and compared the research performance in computer science of four major Western countries, India and China, based on the data extracted from INSPEC database during the period 1993-2002.

Rajendiran, Ramesh Babu and Gopalakrishnan (2005)\(^93\) analysed the global output of “fiber optics” research. Articles covered in the Ei-Tech Index database
for the period of 1999-2003 has been studied. Growth of literature by year wise, country wise, authorship pattern, bibliographic forms, ranking of core journals and nature of research have been analysed.

Kademani et al (2005)\(^94\) attempted and analysed quantitatively 475 papers published by the Bio-organic Division of BARC during (1972-2002) in various domains like Synthesis, Biotechnology etc., They found that highest number of publications were 38 in 2001. The average number of publications per year was 15.3 and highest collaboration coefficient 1.0 was found in many years. The most prolific authors were found to be A. Benerji and V.R Mandapur.

Wooding et al (2006)\(^95\) explained the large scale bibliometric analysis is often hindered by the presence of homonyms, or namesake, of the researchers of interest in literature databases. This makes it difficult to build up a true picture of a researcher's publication record, as publications by another researcher with the same name will be included in search results. Co-author inclusion is a novel algorithmic method based on co-authorship for dealing with problems of homonyms in large bibliometric surveys.

Patra et al (2006)\(^96\) analysed the growth pattern, core journals and author distribution in the field of Bibliometrics using data from LISA. Growth of literature does not show any definite pattern. Bradford’s law of scattering is used to identify core journals and found “Scientometrics” as the core journal in this field. It is observed that author’s distributions do not follow original Lotka’s law. Study also identified 12 most productive authors with more than 20 publications in this field.
2.9 STUDIES BASED ON MAPPING THE LITERATURE

The term scientigraphy according to Small and Griffith (1974)\(^9\) has not been widely adopted and it is a very apt label for the mapping of science. Science maps serve as a tool for navigating through the research literature by depicting the spatial relations between research fronts which are areas of significant activity.

Ferguson, Kerrin and Patterson (1997)\(^9\) described the technique of multi-dimensional scaling (MDS) analysis and show how it might be applied to the individual structure their knowledge, does the structure vary as a function of training, individual implicit theories of personality, individual perceive their organizational psychologists

Noyons and Van Rnan (1998)\(^9\) examined the mapping tools developed by CWTS are tested on our own research field (Scientometrics, Informetrics, and Bibliometrics: SIB). The main purpose of this study is to investigate the use and applicability of bibliometric mapping in general and the CWTS approach in particular.

The global output of engineering literature in different form of publications including journals used by Indian engineers and researchers were analysed by Ravichandra Rao and Suma (2000)\(^1\). Further journals publishing Indian contributions, Indian institutions contributing to the engineering literature and subject-wise, location-wise and document wise were analysed.

Noyons (2001)\(^1\) discussed the bibliometric maps of science in a science policy context in the nineteen seventies, they have not been very successful yet. It seems, however, that only now they are becoming acknowledged as a useful tool. This is mainly due to the developments and integration of hypertext and graphical
interfaces. Because of this, the strength of such navigation tools becomes obvious. The interface can provide suggestions to answer policy-related question, which is the initial purpose of such maps.

Martinsons, Everett and Chan (2001)\textsuperscript{102} analysed the authorship of scholarly knowledge is mapped over time by combining multivariate statistics and other techniques. Observed citation frequencies are fitted to a chi-square model of importance, receptivity and similarity, while cluster analysis is employed to map changes in journal relationships over time period.

Boyack et al (2001)\textsuperscript{103} analysed the various efforts to map the structure of science from literature. The majority of these studies have been performed at the discipline or specialty level. Maps are often based on similarity between journal articles using citation analysis, co-occurrence or co-classification using keywords, topics or classification schemes, or journal citation patterns.

Ingwerson, Larsen and Noyons (2001)\textsuperscript{104} investigated the advantages of graphical mapping of national research publications and citation profiles from scientific fields in order to provide additional information with respect to research performance. By adopting Multi-dimensional scaling techniques, national social science profiles from seventeen OECD Countries and two block periods 1989-1993 and 1994-1998 are mapped.

Moya-Angegon et al (2004)\textsuperscript{105} examined the generation of schematic, visualizations as interfaces for scientific domain analysis. Proposes the technique that uses thematic classification (classes and categories) as entitles of co-citation and units of measure, and demonstrate the viability of this methodology through the representation and analysis of a domain of grate dimensions. The main features
of the maps obtained are discussed, and proposals are made for future improvements and application.

Ramakrishnan and Rajendiran (2004) analyzed the literature on Hepatitis B. For this purpose, three journals for a period of five years (1997-2001) have been considered, with citations counting and compared the coverage in three databases viz. MEDLINE, CINAHL and IPA. MEDLINE provided adequate indexing coverage of the cited journals and minimal coverage was provided by CINAHL and IPA.

The aggregated journal citation matrix derived from Journal Citation Reports 2001 reported by Leydesdorff (2004). This technique was recently incorporated in software tools for social network analysis. The matrix can be assessed in terms of its decomposability using articulation points which indicate overlap between the components.

Mittal, Ahmad and Singh (2005) discussed Vidang, a well known drug in ayurvedic system of medicine, is obtained from the medicine plant, Embelia ribes. Through citation mapping, a comprehensive bibliography has been compiled to study the research work done on this plant in India. Citation maps allow browsing through titles and provide the users with some directions into the information available. It may be useful for researchers to identify areas where there could be more scientific study.

2.10 BIBLIOMETRIC LAWS

2.10.1 Bradford’s Law

Wagner (1997) investigates time dependencies of Bradford distributions for 19th century mathematics and for 20th century logic. To facilitate comparisons,
he uses ‘Pareto’s Law’ and Lorenz diagrams for the representation of empirical Bradford distributions. It shows that the character of a Bradford distributions (including the core zone and the Gross droop) depends on the stage in the development of statistic field and that it varies with the time span considered.

Heine (1998)\textsuperscript{110} noticed the different ranking conventions which exists in the relationship between ‘journal productivities’ and ‘journal ranking by productivity’ of Bradford’s distributions. The writer suggested that a need accordingly rose for a standard ranking convention to assist comparisons between empirical data, and also comparisons between empirical data and theoretical models. Describes 5 ranking conventions including the one originally used by Bradford, along with suggested distinctions between ‘Bradford data set’, ‘Bradford distribution’, ‘Bradford graph’, ‘Bradford log graph’, ‘Bradford model’ and ‘Bradford’s law’.

Ravichandra Rao (1998)\textsuperscript{111} examined the applicability of what Bradford in his book on ‘Documentation’ derived the law of scattering, based on algebraic explanation with the supposition that $n_1 = n_2 = n$. An analysis of a small sample of 12 data sets, using t-test and suggested that it is unlikely that $n_1 = n_2$ were made. Identified a suitable model to explain the law of scattering. Among the various models he tried, log normal fitted much better than many models including the log linear model.

Feicheng and Rui (1999)\textsuperscript{112} used the frequency rank analysis of Bradford’s law in a research on mechanism and model of scattering distribution of scientific information. Analysed the data from BIOSIS, INSPEC and COMPENDEX and verified the suitability and precision of Bradford’s law in modern scientific and
technological settings. It was found that the frequency rank analysis of Bradford’s law was not suitable to their set of data.

Ramesh Kundra (1999)\textsuperscript{113} studied the behaviour of Bradford’s Law towards citation data on Indian Medical Journal. Three important properties have been identified relating to size and frequency in five time periods. Though not very significant properties have been identified but some significant changes are seen.

Bogaert et al (2000)\textsuperscript{114} attempted to show how Bradford curves, i.e. cumulative rank frequency function as used in informetrics, can describe the fragment size distribution of percolation models. The study also advances the claim that the percolation model can be used as a model to study (generalized) bibliographies. It also attempts to show how idea and techniques developed in scientometrics can be successfully applied in other fields of science and vice versa.

The number of studies in Bradford’s law is so large that it is very difficult to cover all of them in this study. However, the subject covered here may be enough to get some idea about Bradford’s law and its implications.

2.10.2 Lotka’s Law

Radhakrishna and Kernizan (1997)\textsuperscript{115} applied the Lotka’s law to computer science literature, published during 1968-72 in Communications of the Association for Computing Machinery and Journal of the ACM. In the first experiment it was assumed that an author publishes exclusively through one journal and Lotka’s law was found to be applicable. In the second experiment all papers published by the authors were considered and the deviation from Lotka’s law was considerable. They believe that to test Lotka’s law properly large scale experiments are needed.
Kumar et al (1998)\textsuperscript{116} reported a study aiming at determining the applicability of Lotka’s law, negative binomical distribution and lognormal distribution for institutional productivity, and authors productivity in the field of engineering sciences and the patents field by industrial firms in laser science and technology. The study revealed that none of the 3 distributions are applicable for institutional productivity in engineering sciences. But Lotka’s law held good for full as well as truncated set data for the patents field by industrial firms.

Gupta and Karisiddappa (1999)\textsuperscript{117} explored the possibility of using the new variable represented by the number of collaborators per author as a substitute for the number of papers in Lotka’s distribution to predict the productivity strata. On the basis of a case study in theoretical population genetics, they concluded that the number of collaborators per author did not prove to be a good substitute in Lotka’s distribution, in contrast to the result of author study.

Kretschmer and Rousseau (2001)\textsuperscript{118} are of the opinion that using the normal or total counting procedure, Lotka’s law breaks down when articles with a large, i.e. more than a hundred, number of authors are included in the bibliography. The explanation of this phenomenon is that the conditions for an application of the basic success-breeds-success models are not fulfilled any more. Studying articles with many authors means dealing with items (the articles) having multiple sources (the authors), hence Egghe’s generalized success-breeds-success mode, leading to not necessarily decreasing distributions, explains the observed irregularities.

Alvarado (2002)\textsuperscript{119} reports the results of the application of Lotka’s Law to 10 subjects areas in Brazilian national literature using minimum square and maximum probability estimators. The subjects included medicine, iron and steel, library science and veterinary science and appeared to conform to different models.
Karisiddappa et al (2002)\textsuperscript{120} examined the Lotka’s law on the scientific productivity of authors in theoretical population genetics from 1881 to 1980. The productivity distribution of authors in 10 time-year blocks and in three phases of the development (1921-50, 1951-65 and 1966-80) of theoretical population genetics was studied using cohort type of approach. They also studied the extent of cumulative advantage acquired by the prolific group of authors over a time and finally analyzed the regularity in the distribution of productivity of various cohorts, having same length of activity, but different periods of participation.

Newby et al (2003)\textsuperscript{121} in their research applied Lotka’s Law to metadata on open source software development. Authoring patterns found were comparable to prior studies of Lotka’s Law for scientific and scholarly publishing. Lotka’s Law was found to be effective in understanding software development productivity patterns and offer promise in predicting aggregate behavior of open source developers.

2.10.3 Zipf’s Law

Sen et al (1998)\textsuperscript{122} reported the results of a study on the validity of Zipf’s law related to the word length and the frequency of its use in the case of library and Information Science literature. Results obtained from the analysis of six different samples accept Zipf’s law in all the cases.

Egghe (1999)\textsuperscript{123} studied the probabilities of the occurrence of multi-word phrases in relation to the probabilities of occurrence of the single words. He gives two independent proofs that Zipf’s law is not valid in multiword phrases. Then he examined the fractal argument of Mandelbrot in the case of second phrases.
Jiang et al (2002) found that developing the probability function to describe rank-size Zipfian phenomena has been an important problem in scientometrics and informetrics. They present a new rank-size distribution of Zipf’s Law and apply it to an actual distribution of scientific productivities in Chinese Universities.

Kot et al (2003) analysed the Usenet newsgroups that provides a popular means of scientific communication, and demonstrates striking order in the diversity of biology newsgroups. Submissions to newsgroups accept a form of Zipf’s Law, a simple power law for the frequency of posts as a function of the rank, by posting, of contributors. The study shows that a simple stochastic process accounts for this pattern and reproduces many of the properties of newsgroups. This model successfully predicts the relative contribution from each poster in terms of the size, the number of posters and total posts of the newsgroup.

Saxena and Jauhari (2003) studied Zip’s Law in a random text from English with a new ranking method. It studied the properties of this text and compares the product of rank and frequency for three ranking procedures. It also analyses the performance of data in the extreme regions of the Zip’s curve. It was observed that ranking procedure and type of text have definite bearings on the performance of Zip’s curve.

2.11 CONCLUSION

From the above review of literature, the following inferences could be drawn:
1. The review of literature has been based on several grouping such as journals; country’s output; Scientist’s works; citation analysis; database; mapping the literature and bibliometric law.

2. The early research on scientometric studies were mostly by single authors. In the recent years there seems to be a collaborative study.

3. The research contribution by Indian authors on scientometric is in increasing trend.

4. The research analysis on scientometrics has been increasingly adopting advanced statistical tools and techniques as revealed by the review. Probably the use of software package for the analysis of data has facilitated such kind of analysis. The research contributions by the Indian authors are in increasing trend and competing with the western authors in these branches of knowledge.

5. It is observed that most of the studies are database oriented and individual journal oriented.

6. It is also observed that there are studies of analyzing the individual scientists’ contributions by Library and Information Science professionals mostly in the field of special libraries.

7. The studies on mapping are also seen in the recent years.

8. It further reveals that the research in the field of scientometrics in marching ahead not only in India but also in other parts of the world.
9. It was found that there was not stand on the subject of textile research using Scopus database research productivity literature at database oriented or at journal oriented or at individual countries output study.

Therefore the investigator has selected this subject field and analysed the productivity on Textile research covered in Scopus databases. Attempt here is not to provide an extensive review of the current status or overall progress of the ongoing R&D efforts on Textiles. But the immediate concern is to take stock of the existing institutional framework, current trends and prospects of research on the most pertinent aspects of systematics and taxonomy that are relevant to inventorying, mapping and monitoring textile and its various spatial elements for long-term policy, management and sustainable utilization.
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245. 3rd COLLNET Meeting of Principle Investigators "Collaboration in Science and Technology" Friday 20th July, 2001 at The University of New South Wales, Sidney, Australia (at the end of the ISSI Conference, July 16 - 20, 2001).

246. The 4th COLLNET Meeting and a Special Session on Collaboration (revised version of program as PDF file, 2003-8-20) has been held at the last day (August 29, 2003) of the 9th International Conference on Scientometrics and Informetrics. Beijing, China, August 25-29, 2003.


249. Fourth International Conference on Webometrics, Informetrics and Scientometrics & Ninth COLLNET Meeting The International Workshop on Webometrics, Informetrics and Scientometrics & Seventh COLLNET Meeting in conjunction with the Extra Session on Information Visualization for Webometrics, Informetrics and Scientometrics on 10-12 May, 2006 at LORIA-INIST, France.

250. Fifth International Conference on Webometrics, Informetrics and Scientometrics (WIS) & Tenth COLLNET Meeting Humboldt-Universität zu Berlin Institute of Library and Information Science Berlin, Germany 13-16 September, 2009.

251. Sixth International Conference on Webometrics, Informetrics and Scientometrics (WIS) & Eleventh COLLNET Meeting held at University of Mysore19-22 October, 2010, Mysore, India.

252. Seventh International Conference on Webometrics, Informetrics and Scientometrics (WIS) & Twelfth COLLNET Meeting will be held 20-23 September, 2011 at Istanbul Bilgi University, Istanbul, Turkey.