### Chapter 3: Bibliometrics, Citation and Citation Analysis

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Chapter 3: Bibliometrics, Citation and Citation Analysis

3.1 Introduction:-

Dr. Ranganathan S. R. (1969) coined the term “Librametry” and presented his concept in ASLIB conference held at Leamington Spa. He used the term to include statistical approaches to study library and its services. However, the practice of using quantitative method to measure information sources were made even before Dr. Ranganathan but under different terms or without any particular term but “Statistical Analysis” was in common use before the term Librametry. Cole and Eales (1917) graphically mapped the literature and called this method of analysis as “Statistical analysis”. Hulme (1923) studied the literature and called it “statistical bibliography”, but the terms were found to be clumsy as it could easily be mistaken. Later the term was coined as bibliometrics by Pritchard (1969). (www.netugc.com)

3.2 Different Terminologies in Use:-

Many attempts have been made to define the term bibliometrics and its analogous terms since the use of the term ‘statistical bibliography’ by Hulme (1923), and according to him “the purpose of statistical bibliography is to throw light on the process of written communication and the nature and course of development of a discipline (in so far as this is displayed through written communication) by means of counting and analyzing its various facets of written communication”. Raising (1962) (http://www.saujanyabooks.com) and Sengupta I, in his article clearly defined the term statistical bibliography as “the assembling and interpretation of statistics relating to books and periodicals to demonstrate historical movements and to determine national and universal research, use of books and journal, and to ascertain in many local situations the general use of books and journals”. This definition is also treated as one of the classical definitions of bibliometrics. According to Sengupta I N The term ‘Bibliometrics’ was first coined by Pritchard (1969) in preference to existing terminology ‘statistical bibliography’ as he felt there is fair likelihood to misinterpret it as Ming-Huang Wang (2009), bibliometrical methods to books and other media of communication”. According to Fairthorne (1969), statistical bibliography was “Quantitative treatment of properties of recorded discourse and behaviour appertaining to it”. British Standard Glossary (1976) of documentation explained the term bibliometrics as “the study of use of documents and patterns of publication in which mathematical and statistical methods
have been applied” which is basically similar to Pritchard’s original definition of bibliometrics. Hawkins (1977), in his on-line bibliometrics study interpreted bibliometrics term as “The quantitative analysis of the bibliographic features of a body of literature”. Nicholas and Ritchie (1978), in their books entitled ‘Literature on Bibliometrics’ opined that bibliometrics provided information about the structure of knowledge and how it is communicated? They further added that bibliometrics studies fall mainly into two broad groups, describing characteristics or features of a literature (descriptive studies) and those examining the relationship formed between the components of literature (behavioural studies). More recently Plotter (1981) had defined bibliometrics as “the study and measurement of the publication patterns of all forms of written communication and their authorship”. Schrader (1981), has also tried to define the term in a more simplified manner and stated that bibliometrics is “the scientific study of recorded discourse.” Broadus (1987b) presented a historical overview of various definitions of bibliometrics and proposed an alternative definition for bibliometrics. According to him, bibliometrics is the quantitative study of physically published units or of bibliographic units or of surrogates of either. More explicitly Sengupta (1990) and Midrar Ullah (2008) defines the term as “organization, classification and quantitative evaluations along with their authorship by mathematical and statistical calculus”. A more elaborate concept of bibliometrics has been recently explained by Egghe (2000), as Suresh L (2005) describe “development and application of mathematical models and techniques to all aspects of communications.” From these definitions it is concluded that statistical bibliography is replaced by bibliometrics and it means study of measurement of the publication patterns of all forms of written communication and their authorship by means of using citation studies

3.3 What is Bibliometrics?

The term “bibliometrics” was first used by Pritchard (1969) in his article “Statistical Bibliography or Bibliometrics” published in the “Journal of Documentation”. “Biblio” means book and “Metric” means a scale or measure. Bibliometric means application of statistical studies in library and information science. According to Pritchard (1969), bibliometrics is defined as “the application of mathematics and statistical methods to books and other media of communication.” Potter (1981) defines bibliometrics as “the study and measurement of the publication pattern of all forms of written communication and their author”.
In Bibliometrics and Librametry as an area in which studies “information process and information handling in libraries and information canters by quantitatively analyzing the characteristics and behaviour of documents, library staff, and library users.” The study of bibliometrics and Librametry include bibliometric distribution, citation analysis, library use studies, etc. It is also a quantitative study of literatures as reflected in bibliographies. Bibliometrics is the use of quantitative analysis and statistics to describe patterns of publication within a given field or body of literature (Zhenzhong Ma, 2005)

Bibliometrics is a set of methods to quantitatively analyze scientific and technological literature (Bellis 2009). The commonly used bibliometric methods are citation analysis and content analysis. Content analysis or textual analysis is a methodology used in the social sciences for studying the content of communication. Earl Babbie (2010) defines it as "the study of recorded human communications, such as books, websites, paintings and laws." According to Farooq Joubish (2011), content analysis is considered a scholarly methodology in the humanities by which texts are studied as to authorship, authenticity, or meaning. Later subject includes were philology, hermeneutics, and semiotics. Lasswell (1951, p.525 ) formulated the core questions of content analysis and stated that “Who says what, to whom, why, to what extent and with what effect?” Ole Holsti (1969) offers a broad definition of content analysis as "any technique for making inferences by objectively and systematically identifying specified characteristics of messages." Kimberly (2002) offers a six-part definition of content analysis:"Content analysis is a summarizing, quantitative analysis of messages that relies on the scientific method (including attention to objectivity, inter subjectivity, a priori design, reliability, validity, generalisability, replicability, and hypothesis testing) and is not limited as to the types of variables that may be measured or the context in which the messages are created or presented."

Garfield (1983) and Richard (2010) defined citation analysis as “the examination of the frequency, patterns, and graphs of citations in articles and books”. Content analysis uses citations in scholarly works to establish links to other works or other researchers. Citation analysis is one of the most widely used methods of bibliometrics. Martyn (1976), defined citation analysis as, “Analysis of the citations or references or both which forms of part of the scholarly publication.” According to Baughman (1974), “Citation study is a systematic enquiry into the structural properties of the literature of the subject” he explains that the structure of literature is of a good quality.
Kumar Suchetan and et. al. (2012) Bibliometric method is most often used in the field of library and information science; as well it has an equal applicability in other areas also. In fact, in many research fields use of bibliometric methods is carried out to explore the impact of their field, the impact of a set of researchers, or the impact of a particular paper etc. Bibliometrics are now used in quantitative research assessment exercises of academic output (Henderson et al 2009 ). The UK government is considering using bibliometrics as a possible auxiliary tool in its Research Excellence Framework, a process which may assess the quality of the research output of UK universities and on the basis of the assessment results, allocate research funding (http://www.ref.ac.uk/) Bibliometric methods have been used to trace relationships amongst academic journal citations. Citation analysis, which involves examining an item's referring documents, is used in searching for materials and analyzing their merit. Citation indices, such as Institute for Scientific Information's Web of Science, allow users to search forward in time from a known article to more recent publications which cite the known item. Today citation analysis tools are easily available to compute various impact measures for scholars based on data from citation indices. These have various applications, from the identification of expert referees to review papers and grant proposals, to providing transparent data in support of academic merit review, tenure, and promotion decisions.

Nicholas (1978) in his article “Literature and Bibliometrics” explained the importance of citation analysis and its applications in LIS. He pointed out that information scientists and librarians use citation analysis to quantitatively assess the core journal titles and watershed publications(less used or border lined publications) in particular disciplines; interrelationships between authors from different institutions and schools of thought; and related data about the academia. Some more pragmatic applications of this information includes the planning of retrospective bibliographies, finding the age of material used in a discipline (Half life) , and comparison between use of recent publications versus older ones, comparing the coverage of secondary services which can help publishers gauge their achievements and competition, and can aid librarians in evaluating "the effectiveness of their stock". There are also some limitations to the value of citation data. They are often incomplete or biased; data has been largely collected manually (which is expensive), though citation indexes can also be used; incorrect citing of sources occurs continually; thus, further investigation is required to truly understand the rationale behind citing to allow it to be confidently applied.
Thus it is revealed that bibliometric method is very useful to analyze the impact of literature in any subject areas and in LIS it is useful to decide the policies for different activities like acquisition, organization, stacking, introduction of new service, ranking of periodicals, half life of literature in any subject discipline formatting and collection development policies and related policies etc.

3.4 Laws of Bibliometrics:

The three most commonly used laws in bibliometrics are

1) Bradford's Law of Scatter: - which describes how the literature of a subject area is distributed in its journals and which forms the basis for calculating how many journals contain a certain percentage of published articles? (Tonta Y and Umut Al, 2004)


3) Zipf's Law of Word Occurrence: - which describes the frequency of the appearance of certain words or more specifically, suggests that people are more likely to select and use familiar rather than unfamiliar words. (Zhang W and Yoshiteru N, 2012)

Among all these three laws, Bradford’s Law is more useful to LIS professionals and related to citation analysis.

3.4.1 Bradford's Law of Scatter:-

Bradford (1934), pointed out that if scientific journals are arranged in order of decreasing productivity of articles on a given subject, they may be divided into a nucleus of periodicals more particularly devoted to the subject and several groups and zones containing the same number of articles as the nucleus when the number of periodicals in the nucleus and succeeding zones will be 1: n: n^2. Bradford's Law states that journals in a single field can be divided into three parts, each containing the same number of articles:

* A core of journals on the subject, relatively few in number, that produces approximately one-third of all the articles;
* A second zone, containing the same number of articles as the first, but a greater number of journals, and

* A third zone, containing the same number of articles as the second, but a still greater number of journals.

The mathematical relationship of the number of journals core to the first zone is a constant n and to the second zone the relationship is n². Bradford expressed this relationship as 1 : n : n². Bradford formulated his law after studying a bibliography of geophysics, covering 326 journals in the field. He discovered that 9 journals contained 429 articles, 59 contained 499 articles, and 258 contained 404 articles. So it took 9 journals to contribute one-third of the articles, 5 times of 9, or 45, to produce the next third, and 5 times 5 times 9, or 225, to produce the last third. Bradford's Law serves as a general guideline to librarians in determining the number of core journals in any given field. Bradford's Law is not statistically accurate, but it is still commonly used as a general rule of thumb.

### 3.4.2 What is Citation:

Citation is a reference to a published or unpublished source (not always the original source). More precisely, a citation is an abbreviated alphanumeric expression (e.g. Newell84) embedded in the body of an intellectual work that denotes an entry in the bibliographic references section of the work for the purpose of acknowledging the relevance of the works of others to the topic of discussion at the spot where the citation appears. Generally the combination of both the in-body citation and the bibliographic entry constitutes what is commonly thought of as a citation (whereas bibliographic entries by themselves are not). A prime purpose of a citation is intellectual honesty to attribute prior or unoriginal work and ideas to the correct sources and to allow the reader to determine independently whether the referenced material supports the author's argument in the claimed way.

### 3.4.3 What is Reference:

Reference is derived from Middle English referren, from Middle French référer, from Latin referre, "to carry back", formed from the prefix re- and ferre, "to bear". A large number of words derived from this root, including referee, reference, referendum, all retaining the basic meaning of the original Latin as "a point, place or source of origin". According to Med Library (2011), A referee is the provider of this source of origin, and a referent is the
possessor of the source of origin, whether it is knowledge, matter or energy. Because of its meaning, the word reference is used in every sphere of human knowledge, adopting shades of meaning particular to the contexts in which it is used. References can take on many forms, including: a thought, a sensory perception that is audible (onomatopoeia), visual (text), olfactory, or tactile, emotional state, relationship with other, space-time coordinate, symbolic or alpha-numeric, a physical object or an energy projection; but, other concrete and abstract contexts exist as methods of defining references within the scope of the various fields that require an origin, point of departure, or an original form. This includes methods that intentionally hide the reference from some observers, as in cryptography. Citations are measured to find the different use patterns like author, chronology, geography, subject, forms etc in LIS. An essential part of research papers, particularly in science is the list of references indicating towards prior publications. Ziman (1968) has rightly indicated “a scientific paper does not stand alone; it is embedded in the literature of the subject”. Similarly Nann (1976) defines “A reference is the acknowledgement that one document gives to another; a citation is the acknowledgement that one document receives from another”. Malin (1968) says “A citation implies a relationship between a part or the whole of the cited document and a part or the whole of the citing document.” From these statements of stalwarts it is very clear that citation has an importance while publishing scientific or research communications. It is must to cite the author from which data is used. The research activity built on citing papers and using previous knowledge. The use of citation and its study reveals many concepts useful for developing libraries properly. Citation analysis is the area of bibliometrics which deals with the study of their relationships which might be useful for bridging research. Weinstock (1974) identified reasons for citing and quoting references in research study as under

1. Giving homage to pioneers.
2. Giving credit for related works (Homage to Press.)
3. Identifying methodology, equipment etc.
4. Providing background reading.
5. Correcting one’s own work.
6. Correcting the work of others.
7. Criticizing previous work and adding quality and innovation.
8. Substantiating claims. (Fernando A D N 2004),
9. Alerting to forthcoming work.
10. Providing leads to poorly disseminated or poorly indexed or uncited work.
11. Authenticating data and classes of fact-physical constants etc.
12. Identifying original publications in which an idea or concept was discussed.
13. Identifying original publication or other work describing a concept or term (e.g., Hodgkin’s Disease, Pareto’s Law, Friedel-Crafts reaction etc.)
14. Disclaiming work or ideas of others. (Negative Claims)
15. Disputing priority claims of others. (Negative Homage)

Apart from these points, references appended in the research study is a valid indicator of its significance. The facts stated in the research need to be supported by earlier citations (studies) and there is always a relation between citing theses or book or an article indicating similarity of the research.

3.4.4 Importance of Citations:

Ziman (1968), Price (1968), Narin (1976), Marin (1968) had opened that citations play an important role in research. Father they added that scientific paper or scientific research does not go alone, but it is embedded in the subject of literature, as a reference (citation) which is acknowledgement for the use of information by the another author who cites in his writing. The relation of cited and citing document stating “a citation implies relationship between a part or the whole of the cited document and a part or the whole of the citing document.” Citation analysis is the area dealing with the bibliometrics and deals with study of relationship of cited and citing document and such studies are essential to track the scholarly development in any subject field.

3.5 Citation Analysis:

(www.netugc.com) When one author cites another author, a relationship is established. Citation analysis uses citations in scholarly works to establish links. Many different links can be ascertained, such as links between authors, between scholarly works, between journals, between fields, or even between countries. Citations both from and to a certain document may be studied. One very common use of citation analysis is to determine the impact of a single author on a given field by counting the number of times the author has been cited by others. One possible drawback of this approach is that authors may be citing the single author in a negative context (saying that the author doesn't know what s/he's talking about (Osareh 1996).

3.5.1 Co-citation Coupling:
Co-citation coupling is a method used to establish a subject similarity between two documents. If papers A and B are both cited by paper C, they may be said to be related to one another, even though they don't directly cite each other. If papers A and B are both cited by many other papers, they have a stronger relationship. The more papers they are cited by, the stronger their relationship is.

3.5.2 Bibliographic Coupling:

Bibliographic coupling operates on a similar principle, but in a way it is the mirror image of co-citation coupling. Bibliographic coupling links two papers that cite the same articles, so that if papers A and B both cite paper C, they may be said to be related, even though they don't directly cite each other. The more papers they both cite, the stronger their relationship is.

3.6 Reasons to conduct Bibliometric Studies:

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

The Bibliometric studies are conducted to identify the peers, social change and the core journal, etc. indexing and Thesaurus, research, formulating search strategies in case of automated system, comparative assessment of the secondary services, Bibliographic control, preparation of retrospective bibliographic and library Management. Collection development includes planning, implementation and evaluation of collections (Baughman, 1977):

**Planning** is to map information needs, to develop aims and make decisions about priorities. Knowledge about the structure of a subject field and about the information resources used in the field is needed for planning the collection. Bibliometric methods such as citation analysis, bibliographic coupling, co-word analysis and co-citation analysis can be used to map the knowledge structure and the use of literature. **Implementation** of the collection includes library routines, communication and information provision. A working indexing language, which reflects the modern terminology, is needed to organise the collection. Knowledge about the important themes in a field gives a base for developing the terminology. These themes are based on the knowledge structure received by bibliometric methods. Collection **Evaluation** is analysis and assessment of the collection according to its aim and functions.
Different bibliometric methods such as citation analysis, analysis of the scattering of articles to journals and analysis of the obsolescence of literature are used for this purpose.

Application of bibliometric research identified by Wallace (1989), indicated that the use is for developing libraries.

- Improving the bibliographic control of literature.
- Identifying a core literature especially journals.
- Classifying a literature.
- Tracing the spread of ideas and growth of a literature.
- Improving the efficiency of information handling services.
- Predicting publishing trends and needs.
- Describing patterns of book use by patrons.
- Developing and evaluating library collections.

3.7 **Strengths of Bibliometrics as a Research Approach:**

Bibliometric studies are useful and have a quantitative base. The method helps analysis status and strength is in:

- Methods are objective and repeatable
- Results have a wide range of potential practical value
- Does not require human subject interaction
- High reliability in data that are collected unobtrusively, from the published record, and can be easily replicated by others.

3.7.1 **Limitations of bibliometrics as a research approach:**

Following few limitations of the study are observed by.

Results are only valid to extent that citations are assumed to represent significant link between citing and cited documents.

- Technical issues related to data obtained from citation indexes and bibliographies
- Variations and misspelling of author names, authors with same name, incomplete coverage of non-English publications

3.8 **Application of Bradford’s Law in Library and Information Science Research:**
Stephen J. Bensman. (2005), Bradford’s law is used to solve problems in journal collection management as well as resource development in any libraries. The basic concept is to conduct Bradford analyses of journals i.e. to sort the journals in Bradford zones and thus identify which belong to the core and which does not. Any Bradford analysis involves three steps

1. Identify many or all items (usually articles) published in this field;

2. List the sources (usually journals) that publish the articles (or items) in rank order beginning with the source that produces the most items;

3. While retaining the order of the sources, divide this list into groups (or zones) so that the number of items produced by each group of sources is about the same.

The “most obvious potentials” of Bradford analyses are:

- Selection/de-selection
- Defining the core
- Collection evaluation
- The law of diminishing returns
- Calculation of cost based on various coverage
- Setting priorities among journals

Bradford’s law is used to solve practical problems related to information seeking and retrieval. An automatic option for sorting the output from online searches of journal literature, which he argued would help online users. “Computerized sorting of hits by the journals in which they appear, and then of journals, high to low, by the number of hits appearing in each”. Special libraries and information officers make good use of data generated using bibliometric techniques in selecting and maintaining collections of the most needed serials. Bradford’s law, Lotka’s law, Zipf’s law, and citation analysis have contributed to the effective operation of special libraries”

From the various studies it is analysed major thrust areas of research in Library and Information Science are using application of bibliometrics and the reasons are:

1. Identify the quantum and structure literature on a specific subject during a particular period
2. Examine the growth literature output in a subject during a period of time
3. Identify the source and country-wise distribution of research literature in a particular subject
4. Compare and measure the growth rate of literature on a particular subject in various countries
5. Analyze the authorship pattern of literature on a particular subject published from various countries
6. Analyze the degree of single versus multiple author publication and study the trend in authorship pattern
7. Apply Lotka’s authorship productivity concepts on the frequency distribution of authorship productivity
8. Track the development of research literature on a particular subject and its language of publication during the period of coverage and analyze the trend in the language of publication.
9. Study the language of the publication in the context of quantum of pages
10. Study the frequency distribution of applications in the context of country-wise breakdown
11. Analyze quantitatively the annual literature output on a specific subject
12. Identify the variety of research publication on a particular subject
13. Analyze the trend among the various types of publication

The recent developments and methods used and developed the techniques:

3.8.1 The impact factor:-

The impact factor, often abbreviated as IF, is a measure reflecting the average number of citations to articles published in science and social science journals. It is frequently used as a proxy for the relative importance of a journal within its field. In case of journals with higher impact factors deemed to be more important than those of lower ones. The impact factor was devised by Eugene Garfield, the founder of the Institute for Scientific Information (ISI), now part of Thomson Reuters. Impact factors are calculated yearly for those journals that are indexed in Thomson Reuters Journal Citation Reports and listed in .

In a given year, the impact factor of a journal is the average number of citations received per paper published in that journal during the two preceding years. For example, if a journal has an impact factor of 3 in 2008, then its papers published in 2006 and 2007 received 3 citations
each on average in 2008. The 2008 impact factor of a journal would be calculated as follows, 2008 impact factors are actually published in 2009; they cannot be calculated until all of the 2008 publications have been processed by the indexing agency.

\[ A = \text{the number of times articles published in 2006 and 2007 were cited by indexed journals during 2008.} \]

\[ B = \text{the total number of "citable items" published by that journal in 2006 and 2007. ("Citable items" are usually articles, reviews, proceedings, or notes; not editorials or Letters-to-the-Editor.)} \]

2008 impact factor = \( \frac{A}{B} \).

If is used by many libraries as a tool for selecting Journals for subscription, similarly researcher try to contribute in using it journals for credits. New journals, which are indexed from their first published issue, will receive an impact factor after two years of indexing; in this case, the citations to the year prior to Volume 1, and the number of articles published in the year prior to Volume 1 are known zero values. Journals that are indexed starting with a volume other than the first volume will not get an impact factor until they have been indexed for three years. Annuals and other irregular publications sometimes publish no items in a particular year, affecting the count. The impact factor relates to a specific time period; it is possible to calculate it for any desired period, and the Journal Citation Reports (JCR) also includes a 5-year impact factor. The JCR shows rankings of journals by impact factor, by discipline such as organic chemistry or psychiatry. The terminology used later and becomes popular is Infometrics which covers:

3.8.2 The h-index:-

The h-index is an index that attempts to measure both the productivity and impact of the published work of a scientist or scholar. The index is based on the set of the scientist's most cited papers and the number of citations that they have received in other publications. The index can also be applied to the productivity and impact of a group of scientists, such as a department or university or country. The index was suggested by Jorge E. Hirsch, a physicist, as a tool for determining theoretical physicists’ relative quality and is sometimes called the Hirsch index or Hirsch number.
The h-index can be manually determined using citation databases or using automatic tools. Subscription-based databases such as Scopus and the Web of Knowledge provide automated calculators. Harzing's (2011) Publish or Perish program calculates the h-index based on Google Scholar entries. In July 2011 Google trialed a tool which allows a limited number of scholars to keep track of their own citations and also produces a h-index and an i10-index (Google Scholar Blog, 2011), the i10 index indicates the number of academic papers an author has written that have at least ten citations from others. It was introduced in July 2011 by Google as part of their work on Google scholar. A search engine dedicated to academic and related papers. Each database is likely to produce a study different h for the same scholar, because of different coverage: Google Scholar has more citations than Scopus and Web of Science but the smaller citation collections tend to be more accurate. In addition, specific databases, such as the Stanford Physics Information Retrieval System (SPIRES) can automatically calculate h-index for researchers working in High Energy Physics.

3.9 Infometrics:-

Infometrics is the study of quantitative aspects of information. This includes the production, dissemination and use of all forms of information, regardless of its form or origin. As such, infometrics encompasses the fields of

- Scientometrics, which studies quantitative aspects of science;

- Webometrics, which studies quantitative aspects of the World Wide Web;

- Cybermetrics, which is similar to webometrics, but broadens its definition to include electronic resources;

- Bibliometrics, which studies quantitative aspects of recorded information. Scientometrics and webometrics are the latest methods.

3.9.1 Scientometrics:-

Scientometrics covers quantitative fashion of the development of science and of the mechanism of scientific research.
- Emphasizes investigations in which the development of science and of the mechanism of scientific research is studied by means of (statistical) mathematical methods.

- Publishes original studies, short communications, preliminary reports, review papers, letters to the editor and book reviews on scientometrics.

- Includes the Journal of Research Communication Studies.

Scientometrics is concerned with the quantitative features and characteristics of science and scientific research. Emphasis is placed on investigations in which the development and mechanism of science are studied by statistical mathematical methods. (www.springer.com) The journal publishes original studies, short communications, and preliminary reports, and review papers, letters to the editor and book reviews on scientometrics. Due to its fully interdisciplinary character, the journal is indispensable to research workers and research administrators. It provides valuable assistance to librarians and documentalists in central scientific agencies, ministries, research institutes and laboratories. Scientometrics includes the Journal of Research Communication Studies. Consequently its aims and scope cover that of the latter, namely, to bring the results of such investigations together in one place.

Bibliometrics and scientometrics are two closely related approaches to measuring scientific publications and science in general, respectively. In practice, much of the work that falls under this header involves various types of citation analysis, which looks at how scholars cite one another in publications. This data can show quite a bit about networks of scholars and scholarly communication, links between scholars, and the development of areas of knowledge over time.

Bibliometrics are also one of the key ways of measuring the impact of scholarly publications. If an article is published in a journal with a high impact factor, which is determined in part by the number of citations to articles within a particular journal, this raises the publishing profile of the author. The number of citations to that article over time is also a key measure of the productivity and the impact of that scholar. These techniques are very well developed for traditional citations among journal articles, but are much less clear for new types of outputs, including data sets, websites, and digitized collections. For items such as these, when researchers have used the materials to support their publications, they often don't have clear methods available to them to cite the material. Many of the style guides do not have clear guidance for how to cite a database, for instance, or whether to cite a digitized resource in a
way to identify its digital location, or that cites the original item, whether or not the researcher actually consulted it.

3.9.2 Webometrics (Cyber metrics):

The concept of webometrics is based on bibliometrics, because like the bibliometrics study, one can measure the different quantitative aspect of the web in webometrics study. Secondly it is based on Infometrics. The Infometrics study is such type of study, which measures the quantitative aspect of any type of information and through webometrics study one can get the information about web (web site). That’s why the above phrase is used.

The science of webometrics (also Cyber metrics) tries to measure the World Wide Web to get knowledge about the number and types of hyperlinks, structure of the World Wide Web and usage patterns. According to Björneborn and Ingwersen (2004), the definition of webometrics is "the study of the quantitative aspects of the construction and use of information resources, structures and technologies on the Web drawing on bibliometric and Infometrics approaches." The term webometrics was first coined by Almind and Ingwersen (1997). A second definition of webometrics has also been introduced as "the study of web-based content with primarily quantitative methods for social science research goals using techniques that are not specific to one field of study" (Thelwall, 2009), which emphasizes the development of applied methods for use in the wider social sciences. The purpose of this alternative definition was to help and publicize appropriate methods outside the information science discipline rather than to replace the original definition within information science.

Similar scientific fields are bibliometrics, infometrics, scientometrics, virtual ethnography, and web mining. One relatively straightforward measure is the "Web Impact Factor" (WIF) introduced by Ingwersen (1998). The WIF measure may be defined as the number of web pages in a web site receiving links from other web sites, divided by the number of web pages published in the site that are accessible to the crawler. However the use of WIF has been disregarded due to the mathematical artifacts derived from power law distributions of these variables. Other similar indicators using size of the institution instead of number of web pages have been proved more useful. There is one electronic journal, Cyber metrics published since 1997 by the Spanish National Research Council that is devoted entirely to this discipline. Cyber metrics is a branch of knowledge which employs mathematical and statistical techniques of quantity web sites or their components and concepts, measure their
growth, stability, propagation, and use examines the authenticity of content, establish laws governing these factors, studies the efficiency of cyber information services and systems, services and products and assesses the impact of cyber age on society.

3.10 Conclusion:-

Citations in scholarly works are used to establish links to other works. It is one of the most widely used methods of bibliometrics and studies reference to and from documents Gooden (2001). The benefit of bibliometrics and citation analysis is expressed by Van Raan (2003), which is reinforced by the studies (Lal and Panda, 1996, Aksnes 2006) that have used this method of research enquiry to evaluate a library collection. Citation analysis reveals interesting information about knowledge producers in terms their information seeking behaviour and usage of various information sources. It can highlight the familiarity, awareness and usage of knowledge producers regarding the online and print information sources. Citation analysis examines the frequency, patterns and graphs of citations in articles and books (Garfield, 1983). This chapter satisfy the objective set for the study i.e. “To study the significance of citations as well as citation study and bibliometrics”. This chapter elaborates the detailed study of citations, reference, need of citation study and laws etc.

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