MEASURING SCHOLARLY COMMUNICATIONS OF ACADEMIA OF LIBRARY AND INFORMATION SCIENCE IN CENTRAL UNIVERSITIES OF INDIA

SANJAY KUMAR MAURYA

DEPARTMENT OF LIBRARY AND INFORMATION SCIENCE

MIZORAM UNIVERSITY, AIZAWL

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BY

SANJAY KUMAR MAURYA

DEPARTMENT OF LIBRARY AND INFORMATION SCIENCE

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MIZORAM UNIVERSITY
(A Central University)
Department of Library and Information Science
Tanhril, Aizawl – 796 004

Gram: MZU, PO BOX: 190, Phone: 0389-2331607 / 2331608
Email: rkn05@rediffmail.com

C E R T I F I C A T E

This is to certify that the thesis entitled **"MEASURING SCHOLARLY COMMUNICATIONS OF ACADEMIA OF LIBRARY AND INFORMATION SCIENCE IN CENTRAL UNIVERSITIES OF INDIA"** submitted by **SANJAY KUMAR MAURYA** for the award of the Degree of Doctor of Philosophy in Library & Information Science is carried out under my supervision and incorporates the students bona-fide research and this has not been submitted for award of any degree in this or any other university or institute of learning.

Place: Aizawl, Mizoram
Date: 13.11.2019

(Prof. R. K. Ngurtinkhuma)
Supervisor

MIZORAM UNIVERSITY
AIZAWL, MIZORAM – 796 004

Month: November **Year: 2019**

DECLARATION

I, **Sanjay Kumar Maurya**, hereby declare that the subject matter of this thesis is the record of work done by me, and the contents of this thesis did not form basis of the award of any previous degree to me or to the best of my knowledge to anybody else, and that the thesis has not been submitted by me for any research degree in any other University/ Institute.

This is being submitted to the Mizoram University for the Degree of Doctor of Philosophy in Library and Information Science.

(Sanjay Kumar Maurya)
Research Scholar

(Prof. R. K. Ngurtinkhuma)
Supervisor

Head of Department

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ABBREVIATIONS AND ACRONYMS

Abbreviation	Description
ACRL	The Association of College and Research Libraries
AI	Article Influence
AMU	Aligarh Muslim University
APA	American Psychological Association
API	Academic Performance Indicators
AU	Assam University
BBAU	Babasaheb Bhimrao Ambedkar University
BC	Book Chapter
BHU	Banaras Hindu University
BIOSIS	Bio-Sciences Information Service of Biological Abstracts
CAGR	Compound Annual Growth Rate
CP	Conference Proceedings
CPP	Citations per Publication
CPY	Citations per Year
CSIRO	Commonwealth Scientific and Industrial Research Organisation
CSV	Comma-Separated Values
CUG	Central University of Gujarat
CUH	Central University of Haryana
CUHP	Central University of Himachal Pradesh
CUTN	Central University of Tamil Nadu
CV	Curriculum Vitae
DESIDOC	Defence Scientific Information & Documentation Centre
DRDO	Defence Research and Development Organisation
DST	Department of Science & Technology
DU	University of Delhi
EF	Eigenfactor
ESCI	Emerging Sources Citation Index
ETD	Electronic Theses and Dissertations

GGU	Guru Ghasidas University
GML	Geography Markup Language
GS	Google Scholar
HNBGU	Hemvati Nandan Bahuguna Garhwal University
HSGU	Dr. Hari Singh Gour University
HTML	Hyper Text Markup Language
IASLIC	Indian Association of Special Libraries and Information Centre
ICCR	Indian Council for Cultural Relations
ICSSR	Indian Council of Social Science Research
ICT	Information and Communication Technology
IF	Impact Factor
IGNOU	Indira Gandhi National Open University
ILA	Indian Library Association
INFLIBNET	Information and Library Network Centre
IPR	Intellectual Property Right
ISI	Institute for Scientific Information
J	Journal Article
JCR	Journal Citation Reports
JIF	Journal Impact Factor
JII	Journal Immediacy Index
LIS	Library and Information Science
M. Phil.	Master of Philosophy
MDS	Multidimensional Scaling
MEDLINE	Medical Literature Analysis and Retrieval System Online
MeSH	Medical Subject Headings
MHRD	Ministry of Human Resource Development
MLA	Modern Language Association
MLISc	Master of Library and Information Science
MU	Manipur University
MZU	Mizoram University
NCBI	National Centre for Biotechnology Information

NCR	National Capital Region
NEHU	North-Eastern Hill University
NIH	National Institute of Health
NLM	National Library of Medicine
NSF	National Science Foundation
PDF	Portable Document Format
PG	Post Graduate
Ph.D.	Doctor of Philosophy
PMC	PubMed Central
PNAS	Proceedings of the National Academy of Sciences
PoP	Publish or Perish
PPI	Publications per Institute
PS	PostScript
PU	Pondicherry University
RRRLF	Raja Rammohun Roy Library Foundation
RSCI	Russian Science Citation Index
RTF	Rich Text Format
SciELO	Scientific Electronic Library Online
SJR	SCImago Journal & Country Rank
SNIP	Source Normalized Impact per Paper
SPSS	Statistical Package for Social Sciences
SRELS	Sarada Ranganathan Endowment for Library Science
TU	Tripura University
UGC	University Grants Commission
USSR	Union of Soviet Socialist Republics
VoS	Visualization of Similarities
WoS	Web of Science
WWW	World Wide Web

PREFACE

The study of scholarly communication includes the growth of scholarly information, the relationships among research areas and disciplines, the information needs and uses of individual user groups, and the relationships among formal and informal methods of communication. The concept of the traditional way of scholarly communication varies nowadays and the academic landscape is changing fast. One of the challenges is to measure the impact of ever-increasing literature and thrust as well as core areas of research. As much as the scholarly communications will be produced by the researchers, the concept of measuring those communications will become an interesting area of research. Faculties of higher education institutions are playing an important role in quality research. The higher academic qualification and research skills of faculties enrich the research productivity at their personal as well as institutional level.

Measuring scholarly communications of faculties with the help of scientometric studies is one of the most popular approaches by the researchers to evaluate the effectiveness and impact of faculty's research outcome. Scientometrics and its related concepts provide an opportunity to analyze quantitatively and qualitatively scientific literature to determine its impact with the help of authorship analysis, citation analysis, keyword analysis, etc. The productivity of faculties/ researchers is no longer predominant by designation, affiliation or experience as immense metrics tools are used to determine their research impact based on originality and innovative quality of research, the same being carried out for publication media as well as institutions.

The present study is confined to measure scholarly communications of academia of Library and Information Science in 18 Central Universities of India. In the Indian LIS perspective, no study has been found based on scientometric analysis to measure scholarly communications of LIS academia in Central Universities of India till today. So, the present study is an attempt to fill up the gap in the proposed area.

The study will help to map the current status, growth, pattern, forms, impact, online visibility, and networks of scholarly communications by LIS academia of Central Universities of India. The evaluation criteria used for measuring scholarly communications will help to undertake further study related to it.

The study is presented in five chapters:

Chapter 1: Introduction

Chapter 2: Metrics: Conceptual Approach

Chapter 3: Scholarly Communications and Web Visibility in LIS

Chapter 4: Scholarly Communications of LIS Academia – An Analysis

Chapter 5: Conclusion & Suggestions

Chapter 1 introduces the overview of the entire research work and discusses the significance, scope of the study, literature review, and research design of the study. Chapter 2 highlights about the concept of bibliometrics, bibliometric laws, the concept of scientometrics, and various indicators of scientometric study. Chapter 3 briefly elaborates on the channels of scholarly communication, citation databases for scholarly communication, and various tools for mapping scholarly communications. Chapter 4 highlights the collected data and its descriptions in the form of tables, figures, and graphs as well as findings of the study. Chapter 5 presents a summary of the entire study and suggestions for improvement of scholarly communications in the field of Library and Information Science.

The appendices and bibliography are given at the end. Publication Manual of the American Psychological Association (6th ed.) is used for recording the references.

Chapter 1: Introduction

Chapter Plan

1.1 Introduction

The discipline of Library and Information Science (LIS) has existed in India for more than a century. After its inception, tremendous growth and development have been taken place in the area of library services as well as the organization of documents. The rapid growth in information technology, computer networks, electronic publishing, and digital libraries has contributed to the restructuring of scholarly publishing, its methods of access, copyright policies, and the relationships among the author, publisher & libraries (Borgman, 2000). The study of scholarly communication involves the trend and growth of communications, core areas of research for the discipline, information needs and users of information as well as the relationship in both formal and informal methods of communication. Bibliometrics studies have a set of pre-defined methods to study scholarly research output. Citation analysis, considered as one of the best-known bibliometric studies, is the measurement of scholarly communication of documents; Web citation analysis is the measurement of citations of scholarly communications of documents over the Web and citation databases are used in the extraction of Web citation from scholarly resources. The interconnection between documents and citations through hyperlink mechanism in databases allows an information seeker to move between related documents. These citations on the Web are produced from the research publications which are generated from different sources such as articles, proceedings, journals and so on. Nowadays, dissemination of scientific publications via Web becomes very common, and various discussions have already done for the possibility of Web mention being a citation for evaluating the impact of any academic activity. Scientometrics is a quantitative method of measuring scientific information based on the number of scientific articles published during a given period and their citation impact will be used for the present study. Bibliometrics and scientometrics related research includes various studies in relation to scientific publications through scattering & growth of literature, obsolescence of literature, distribution of productivity by author, journal, institution & country which helps to analyze the growth & pattern of publications.

1.1.1 Concept of Bibliometrics

The term "bibliometrics" was coined by Pritchard in 1969. Bibliometrics has been defined as "research of the quantitative aspects of production, distribution, and use of all saved information. It can also be defined as the application of mathematics and statistical methods to books and other media of communication" (Pritchard, 1969). It is an area of the research field that helps to monitor the growth & development of literature; the number of literature contributions at the author, journal, groups, organizations or country level; the rate of obsolescence; and languages used, etc. Apart from it, the bibliometric study offers citation studies. Bibliometrics study uses mainly three main types of indicators:

a) Publication Count

It is one of the means of measuring, comparing or ranking the publication productivity of individual author, institution, country; also it can be used to evaluate individual discipline, group of disciplines; and analyze the trends in research, collaborative pattern and many other aspects of research output.

b) Citations Analysis

In the citation analysis study, the use of citations in a document is analyzed by examining the frequency of citations, the pattern of citations, and the growth of citations. This type of study establishes links among documents that help to identify the properties of a document. For Web of Science indexed scholarly journals, citations is compiled by Clarivate Analytics (earlier Thomson ISI) and sold under the trademark of Journal Citation Report (JCR) and similarly SCImago Journal & Country Rank (SJR) by Scopus database, and these databases provides several indicators related to citations received by journal, author, institution, country, etc.

c) ***Co-citation, Co-word Analysis, and Bibliographic Coupling***

Co-citation and Co-word indicators relate both publication and citation count to build a multi-faceted mapping of research fields, linkages among subjects & authors; bibliographic coupling links two papers that cite the same articles. The more papers they both cite, the stronger their relationship will be.

The bibliometric studies or research is conducted by applying three laws which are:

a) ***Lotka's Law***

It defines the frequency of publication (scientific productivity) by authors in a given subject field. It states that "the number (of authors) making *n* contributions is about $1/n^2$ of those making one; and the proportion of all contributors, that make a single contribution, is about 60 percent" (Lotka, 1926).

b) ***Bradford's Law***

Bradford's law serves as a general guideline for researchers in the identification of core journals in any given field. According to Bradford's Law, "journals in a single field can be divided into three parts (zones) and each part contains the same number of articles. Out of three zones, the first zone contains core journals on the subject and relatively few in numbers that produce approximately one-third of all the articles. The second zone, containing the same number of articles as the first, but a greater number of journals, and third zone, containing the same number of articles as the second, but a still greater number of journals". Bradford expressed the mathematical relationship as $1{:}n{:}n^2$ i.e. the number of journals in the core to the first zone is a constant n and to the second zone, the relationship is n^2. Bradford expressed this relationship as $1{:}n{:}n^2$ (Tripathi & Sen, 2016).

c) ***Zipf's Law***

Zipf's law often used to forecast the frequency of words occurs within 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 equal a constant" (Chen & Leimkuhler, 1986). As per Zipf's Law, the equation for this relationship is: $r \times f = k$ where r is the rank of the word, f is the frequency, and k is the constant.

1.1.2 Concept of Scientometrics

The term "scientometrics" was introduced by T. Braun in 1977. Scientometrics refers to "those quantitative management methods which are used in the analysis of science regarded as a process of information" (Repanovici, 2011). According to Tague-

Sutcliffe (1992) “scientometrics is the study of the quantitative aspects of science as a discipline or economic activity”. Thus, scientometrics is considered to be a part of the sociology of science which has an application in making science policy, decision making & funding. Techniques used in the scientometric study can be classified into two categories: one-dimensional (scalar) and two-dimensional (relational) techniques. One dimensional technique is based on direct counts or occurrences of bibliometric entities like publications, citations, keywords & addresses and graphical representation of the same. The two-dimensional techniques are based on co-occurrences of above mentioned bibliometric entities in the relationship between each other such as the number of times publications, citations and addresses are forming a network with each other.

Scientometric measurements include:

a) h-index

The concept of h-index was introduced by Hirsch (2005) for measuring the quality and the sustainability of the impact of a researcher’s over publication. According to Hirsch “*h* index is based on a scientist's lifetime citedness, which incorporates productivity as well as citation impact (an all-in-one metric). All papers in a publication set that have at least *h* citations are called the ‘Hirsch core’; publications in the core have the greatest impact and the *h* index is approximately proportional to the square root of the total citation counts and linearly proportional to the total number of publications”.

b) g-index

> Egghe (2006) proposed the g-index to measure the productivity of the researchers based on their publications. The index is calculated based on the number of citations received by a particular researcher's publications. It is represented as "given a set of articles ranked in decreasing order of the number of citations that they received, the g-index is the (unique) largest number such that the top g articles received (together) at least g^2 citations".

Scientometric analyses the quantitative aspects of scientific productivity, its generation, dissemination, and utilization which contributes to the understanding of the various mechanism of scientific research. In a scientometric study, the primary data related to publications details are represented by authors, groups of authors, other bibliographical details as well as the citation they receive. Thus, the set of data represents by an author affiliated to organization, institution, countries, subject field or subfield can vary and result in the emergence of various evaluation indicators as well. At the institutional level, the data and evaluation indicators suggest various ways to measure scientific impact, output, and productivity with other institutions. Similarly, at the national level or journal-level, the resulting indicator suggests ways to compare, rank, and justify federal spending on scientific research. One important tool for measuring scientific research performance is through online citation databases such as Google Scholar (GS), Web of Science & Scopus, etc. These databases may be available free or on a paid basis. One of the features of these databases is that, they relate a bibliographical record of full-text articles with other publications such that how many and which publication cited the search publications indexed in the database. Online databases were used in the present study for measuring the Web presence of the research publications by LIS academia.

1.2 Significance of the Study

There are several scientometric studies conducted in the Library and Information Science (LIS) perspective in India as well as in the world also but studies related to LIS faculties of Central Universities from the Indian perspective, there is a lack of adequate scientometric studies so far. Thus, the present study is an attempt to fill up the gap created in the field. The study assessed scholarly communications of academia of Library and Information Science by using scientometric techniques, a valuable method for the identification of new scientific and technological knowledge. The increase of literature has to turn out to be a key concern for the intellectuals and library and information science professionals as they have to keep themselves updated, aware of the recent development & changes, in their subject. The publication profile acts as an indicator of the scholarly (scientific) activity of an author, institution, and country. Many important observations have been derived by analyzing scholarly communications in sense of scientific publication through their bibliographical features such as type, language, forms & medium of communication channels, journal name, year of publication, the name and affiliation of authors, authorship pattern and research collaboration, co-authorship pattern, keyword analysis, etc. In this way, the present study helped to show the current status of the scholarly performances of the academia of Library and Information Science (LIS) in India by analyzing their works where growth, stagnation, and decline have been presented according to scientometric methods.

1.3 Scope of the Study

The study belongs to the scientometric analysis of academia of Library and Information Science and confined to the scholarly communications of academia of Library and Information Science in Central Universities of India. The Central Universities in India are established by the Act of Parliament and recognized by the University Grants Commission (UGC). There are 46 Central Universities in India (as on May 2017), out of that 18 Central Universities have Library and Information Science (LIS) department with 81 faculty members that are given in Table 1.1.

Table 1.1: Central Universities with LIS Department & Faculty Members

SN	Central University (Code Name)	No of Faculty Members			Total
		Professor	Associate Professor	Assistant Professor	
1	Aligarh Muslim University (AMU)	2	3	2	7
2	Assam University (AU)	1	1	2	4
3	Babasaheb Bhimrao Ambedkar University (BBAU)	3	0	3	6
4	Banaras Hindu University (BHU)	4	1	3	8
5	Central University of Gujarat (CUG)	0	0	3	3
6	Central University of Haryana (CUH)	0	0	2	2
7	Central University of Himachal Pradesh (CUHP)	1	0	2	3
8	Dr. Hari Singh Gour University (HSGU)	1	0	2	3
9	Guru Ghasidas University (GGU)	0	1	0	1
10	Hemvati Nandan Bahuguna Garhwal University (HNBGU)	0	0	0	0
11	Indira Gandhi National Open University (IGNOU)	3	0	2	5
12	Manipur University (MU)	2	0	3	5
13	Mizoram University (MZU)	4	0	4	8
14	North-Eastern Hill University (NEHU)	2	0	4	6
15	Pondicherry University (PU)	1	1	3	5
16	Tripura University (TU)	0	1	2	3
17	University of Delhi (DU)	1	5	1	7
18	Central University of Tamil Nadu (CUTN)	1	0	4	5
	Total	26	13	42	81

(Source: Central University's websites)

1.4 Review of Literature

Okeji (2019) revealed that author productivity in the field of Library and Information Science in Nigeria was fit with Lotka's Inverse Square Law, analyzed core journal of productivity, a few universities out of total 153 recognized universities were productive, highest number of contributions found in the year 2011 & 2012, and multiple authorship pattern was prevalent. Jena & Mishra (2017) mapped research activities of 10 oldest universities of India based on the Scopus database during the year 2001 – 2015. They found a total of 50982 documents, of which the highest publications from BHU (9772, 19.17%), journal publications (83.66%) were the highest source of publication medium, H. S. Yathirajan was found to be the most productive author from all selected universities, the highest publications were found for Chemistry (12558), the highest collaborated research were found from Aligarh Muslim University (772) with Saudi Arabia, while the USA was the most collaborating country. Among the Indian universities, the highest collaboration found between the University of Calcutta (534 publication) and Jadavpur University.

Manikandan and Amsaveni (2016) analyzed the research trends in Management Information System (MIS) with the help of Web of Science (WoS) during 1989-2013 and found the highest contributing authors in three author's team and the exponential growth rate was 4.32% during the year 1991. Rafiq et al. (2015) analyzed the productivity of LIS scholars by using JCR Reports 2010 and selected 40 LIS core journals in which a total of 18371 articles were published. The significant publication growth rate (11.37%) was found in 2009, and self-citation tendency increased with an average rate of 38.56%. Among the 105 countries, USA had produced the highest publications (7818, 43%) and ranked at the top, Victoria University of New Zealand was the topmost productive institution, *Journal of Academic Librarianship* received the highest number of citations (1,401). Walters & Wilder (2015) identified the top authors in the literature of Library and Information Science (LIS) during the year 2007 to 2012 among the LIS faculty and librarians worldwide. They found that 9,800 (86.4%) authors have not contributed more than a single article, while 50 authors (0.4%) have contributed eight or more articles and contributed nearly 8% of total LIS literature. They found that top authors are likely to publish in the *Journal of Informetrics* and *Scientometrics.*

Maharana & Das (2014) analyzed the growth and development of Indian LIS researchers using Social Science Citation Index (SSCI) database for the period of 1999 – 2013, and retrieved 140 documents with 7 h-index, 1.99 citations per publication, 3.71% average annual growth rate, 89.29% journal articles, prevailed multiple authorship pattern, 0.64 Degree of Collaboration, collaboration with 19 foreign countries, M. P. Satija as the most productive author and found unfit the Lotka's Law in their study. Patra (2014) traced the citation and authorship pattern of selected LIS journals from 2000-2013 based on Google Scholar (GS). The Publish or Perish (PoP) software was used for analyzing results and found that Indian LIS journals were not covered in WoS and coverage in Scopus and ISI database was very limited. The study concluded that though GS has a wide coverage of databases while articles from Indian LIS journals were represented very less and suggested Indian

LIS researchers focus more on collaborative research for better visibility and relevance.

Santhanakarthikeyan et al. (2013) discussed the origin and development of scientometric study by comparing and contrasting currently available e-resources with the pre-Internet era also discussed important scientometric tools and techniques to measure e-resources available online. Wilson et al. (2012) surveyed 693 Australian LIS educators serving for at least two years in Australian LIS programs from 1959 to 2008 by using 8 databases. They observed mean of over 80% across databases, increase of number of authors; sharing of journals articles in more national than international, a heavily skewed productivity distribution with nearly one third of longer serving academics producing number of journals articles and small number of longer serving academics authoring or co-authoring over one-fourth of all the journals articles. Jeyshankar et al. (2012) described the results of a scientometric study of literature on Neutrino research published in India during 1966 -2011 by using the Scopus database. The study examines the growth of literature, authorship pattern, degree of collaboration, and identified the core journals. They found an increasing trend towards collaborative research and publications in specialized & high impact factor journals by Indian scientists.

Repanovici (2011) explored Transilvania University of Brasov, Romania in terms of research output of the faculty during 2008 using Publish or Perish software, h-index, g-index, hc-index and H1 norm of 60 most productive professors have been calculated and found that GS had better indexing of proceedings than ISI Web of

Science and Publish or Perish software found a useful instrument for analyzing the impact of research. Bornmann & Marx (2011) studied h-index application where the h-index can act as an alternative to the journal impact factor and how it can be used by science editors to compare research performance of individuals and institutions; and concluded that simplicity and promptness of the index make it particularly attractive.

Larivière et al. (2011) analyzed the relation of sex differences among the Professor of Quebec University in publication rate, scientific impact and research funding. They predicted that after having the age of 38 years, female faculty have less publication, less citation and less research funding as compared to male faculty; discussed various limitations like division of labor, motherhood, a restricted collaboration of network, etc. were identified as a barrier for research activities. Mittal (2011) analyzed the LIS research trends in India for the period 1990 to 2010 as per the Library and Information Science (LISA) database. Co-word analysis was done to identify the core areas of research and observed a total of 4735 descriptors assigned to 1408 journal articles of which they selected 97 keywords having a frequency equal or more than ten. Kamada – Kawai algorithm was used to construct network diagram, research trends were found to be focused on library practice, user service, cataloguing, user studies, university libraries, information retrieval, library education, citation analysis, etc. while open access, Web 2.0, World Wide Web, Internet, access to information are found to be new areas of research. Mooghali et al. (2011) performed a scientometric study of the global publication in the field of Scientometrics from 1980 to 2009. The study reveals that a total number of 691 contributions related to the Scientometrics were published during the period and out of 691 articles, 183 articles (26.48%) were written by the top ten authors of the field. It has been also declared that 67.87% of the literature was published in the area of Library and Information Science and states that library professionals have more tendencies to conduct scientometric studies. The chronological analysis disclosed that the scientific production in the field of Scientometrics showed a slow increase from 1980 to 2009 and concluded that the share of scientometric literature was on the rise as drawn from the results.

Rajendran et al. (2011) analyzed literature growth, authorship and collaboration pattern, the average length of articles and average keywords of the *Journal of Scientific and Industrial Research*. It was found that there was a poor international collaboration by Indian authors. The average number of the page of the paper was 6.27 and the Degree of Collaboration indicates a high degree. The study revealed that the journal seems to be popular among the international research community with around 25% of papers. Meho & Yang (2007) analyzed 25 LIS faculty based on citation counts in WoS, Scopus, and GS and found that GS indexed a wide variety of document types and its coverage was more for conference proceedings and non-English language journals. Costas & Bordons (2007) analyzed the relationship of the h-index with other bibliometric indicators at the micro-level for 337 Spanish Research Council scientists in the area of Natural Resources published during 1994-2004 which were obtained from the WoS. The findings indicate that the production of Natural Resources scientists amounted to 6093 documents and productivity ranged from 1 to 162 documents, while the number of citations ranged from 0 to

2201 and the number of Citations per Document from 0 to 40.96. The h-index ranged between 1 and 29.

Dakik et al. (2006) analyzed the research productivity of medical faculty at the American University of Beirut from 1996 to 2001 and found a total of 881 publications from 203 faculty members having an average productivity rate at 1.24. They found no publication from 18% of total faculty and only 20% have 2 or more publications. A significantly high rate of publication was observed for newly recruited faculty than senior faculty, who observed more citations for publications having collaboration with international investigators rather than from the same institute. Balasubramani & Parameswaran (2005) mapped the research output of BHU researchers from 2000 to 2011 through the WoS database by using HistCite software. They retrieved a total of 6943 publications of which maximum (1052 publications, 15.15%) were published in the year 2011, two authored paper ranked first in sharing of total publication, 86.09% of total publications were journal publication, *Current Science* is the topmost productive journal, the highest (15.93%) contribution were found in Physics, and USA was the topmost collaborating country with BHU. Noruzi (2005) analyzed the advantages of GS and depicts that GS serves as a good complement to the commercial database in sense of citation indexing and multidisciplinary coverage which may help to study the epidemiology of knowledge and basis for bibliometric studies.

Rowlands & Nicholas (2005) studied the attitudes and opinions of more than 5000 senior researchers who published in ISI indexed journal on open access publishing and institutional repositories through an online questionnaire. They found that senior researchers were rapidly becoming more informed about open access publishing and institutional repositories; usage of published articles depends highly on visibility on the Web and concludes that regional location is the key determinant of author attitudes. Kretschmer & Aguillo (2004) studied COLLNET members to compare co-authorship patterns in traditional bibliometric databases and the network visible on the Web. A high percentage (78%) of all bibliographic multi-authored publications becomes visible through search engines on the Web. The study has shown that Web visibility of collaboration is dependent on the type of bibliographic multi-authored papers. The Social Network Analysis (SNA) is applied to compare between bibliographic and Web collaboration networks. Harter (1998) covered 39 scholarly peer-reviewed e-journals and found that the top-five most highly cited e-journals were *Bulletin of the American Mathematical Society* (BAMS), *Online Journal of Current Clinical Trials* (OJCCT), *PACS Review*, *Digital Technical Journal*, and *Psycoloquy*. BAMS had the most significant impact and a successful journal in the field of Mathematics. The raw citation data in the study shows that almost none of the scholarly, peer-reviewed electronic journals in the sample have had a significant impact on formal scholarly communication in their respective fields.

1.5 Research Gap

On the analysis of the above literature review, it has been observed that there are sufficient numbers of researches conducted on the scientometric aspects of researchers, educators, scientists of other fields and only one specific study found on LIS educators of Australia. In the Indian LIS perspective, none of the studies has been observed on the scientometric analysis of Central Universities LIS academia of India till today. So, the present study is an attempt to fill up the gap in the proposed area. Therefore, the present study is an attempt to assess the scholarly communication of academia of Library and Information Science by using scientometric techniques.

1.6 Research Design

1.6.1 Statement of the Problem

Scholarly communications of academia in contributing in any discipline are an essential source for their professional development in the concerned area as well as for the research output of an institution or country. From the LIS perspective especially in India, there are inadequate scientometric researches conducted to measure the scholarly communication of academia of Library & Information Science in comparison to the USA and Europe. Scientific visibility of scholarly communication (research output) of LIS academia in India is properly not measured in any research conducted which displays poor visibility of scholarly communications to indicate their contribution to knowledge generation, be accountable for funding, and reap rewards in terms of personal and international recognition. Therefore, need arises to study the knowledge and information generated by LIS academia through their scholarly communication as well as to assess the current status of Web visibility and research performance by analyzing the scholarly communications of the academia in terms of growth rate, areas of research concentration, author productivity, and authorship pattern. From the LIS perspective, there have been few pieces of research so far, based on the scientometric analysis of the Library and Information Science academia and it would thus be interesting to conduct the study.

1.6.2 Objectives of the Study

The purpose of the study is to measure the scholarly communication of academia of Library and Information Science in Central Universities of India. The objectives of the study are to:

a) Examine the trends and growth of research output of academia of Library & Information Science in Central Universities of India.

b) Examine the forms and extent of research output of academia of Library & Information Science in Central Universities of India.

c) Find out the authorship pattern and degree of collaboration of academia of Library & Information Science in Central Universities of India.

d) Study the implications of Lotka's Law and Bradford's Law over the scholarly communication of academia of Library & Information Science.

e) Measure the Web visibility of online scholarly communications of academia of Library & Information Science in Central Universities of India.

1.6.3 Hypotheses

Five hypotheses are framed in this study and all the hypotheses were tested in Chapter 4. The hypotheses of the study are:

Hypothesis 1:

H_0: There is no significant relationship between research productivity and academic position of the faculties.

H_1: There is a significant relationship between research productivity and academic position of the faculties.

Hypothesis 2:

H_0: There is no significant relationship in the preference order of scholarly communications and the academic position of faculty.

H_1: There is a significant relationship in the preference order of scholarly communications and the academic position of faculty.

Hypothesis 3:

H_0: There is no significant relationship in the preference order of scholarly communications among central universities.

H_1: There is a significant relationship in the preference order of scholarly communications among central universities.

Hypothesis 4:

H_0: There is no significant increase observed in online scholarly communication over the period.

H_1: There is a significant increase observed in online scholarly communication over the period.

Hypothesis 5:

H_0: There is no significant relationship between academic position and their visibility in online scholarly communication.

H_1: There is a significant relationship between academic position and their visibility in online scholarly communication.

1.6.4 Research Methodology

This is the descriptive study designed to measure the scholarly communications of academia of Library and Information Science in Central Universities of India. The survey (through a questionnaire) and observation methods of research have been found appropriate for conducting the study. The faculty member's publications and other demographic details have been collected by routing printed questionnaire as well as an online survey conducted for each faculty member also. The collected data were cross-verified from the bio-data of faculty members available on their respective universities' websites. The population of the study was 81 faculty members of Library and Information Science from 18 Central Universities of India, and no LIS faculty has been found in Hemvati Nandan Bahuguna Garhwal University. Further, Google Scholar (GS), Web of Science (WoS) and Scopus databases have been used for measuring the Web visibility of online scholarly communications of faculty members. The methodology related to Google Scholar, Web of Science and Scopus databases has been given separately at the place of analysis & discussion of data (cf. section 4.2.2.1, section 4.2.2.2, & section 4.2.2.3). The collected data were scrutinized, tabulated and analyzed for inference. Statistical inferences were drawn by using appropriate data analysis tools i.e. Bibliometrix R; statistical tool i.e. SPSS were used for testing of hypotheses.

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Chapter 2: Metrics: A Conceptual Approach

Chapter Plan

2.1 Introduction

In general, metrics means "measurement" which is commonly used for assessing, comparing and tracking of performances & production. In academic publishing (research), metrics are used for measuring the impact of publication at various levels. It is nearly impossible to analyze and comprehend a large volume of information, which is always increasing with continuous exponential growth in different forms of literature around the globe. To identify patterns of production and consumption of information for decision making, scientific strategy, and policy design, metric studies are reliable methods to analyze the information and transform it into useful knowledge. In a real sense, the concept of metrics in the field of Library and Information Science is shifted from the publication based impact to citation-based impact in the 21st century. The productivity of researchers is no longer predominant by designation, affiliation or tenure as immense metrics tools are used to determine their research impact based on originality and innovative quality of research, the same being carried out for publication media as well as institutions. The competitive mindset of reputation, ranking, funding, awards, fellowships, etc. leads an immense pressure to provide evidence of influences, abilities, and attainments in the concerned research field results in the evolution of various kinds of metrics. Metrics are useful to determine the impact of publication in three levels (a) Macro Level Metric (b) Meso Level Metric and (c) Micro Level Metric. These metrics are studied in the field of Library and Information Science with the help of metric techniques for the quantitative measurement of scientific productivity, growth, and impact. The impact is mainly judged based on the adoption of outcomes that satisfied various metric indicators of informing activities.

2.2 Concept of Bibliometrics

The term "Bibliometrics" is coined by Prichard in 1969 under the terminology of "statistical bibliography". According to Prichard, bibliometrics is the "application of mathematics and statistical methods to books and other media of communication" (Pritchard, 1969). The terms "bibliometrics" and "scientometrics" were almost simultaneously introduced by Pritchard and Nalimov & Mulchenko in 1969 respectively. While Pritchard (1969) explained the term bibliometrics as "the application of mathematical and statistical methods to books and other media of communication", Nalimov and Mulchenko defined scientometrics as "the application of those quantitative methods which are dealing with the analysis of science viewed as an information process". Based on these clarifications, scientometrics related study is considered to be restricted to the measurement of science communication while bibliometrics study is designed to deal with more general information processes. These ambiguous borderlines between the two metrics study are almost disappeared during the last three decades, and at present both terms are considered to be synonyms with each other (Glanzel, 2003). Bibliometrics measures the quantitative aspects and impact of research output by indicators like funding, patents, awards, grants, etc. Bibliometric studies include quantitative growth of literature in subjects, the number of literature contributed by the individuals, organizations or institutions. Bibliometrics is considered as a standard tool for making science policy and research management which compiled the nature & impact of the publication, pattern of publication, sources of publication, authors of a publication, etc. of an institution or country.

"*Bibliometric study offers bibliographic and bibliometric information and high-quality, normalized data in terms of researchers, research groups, research centers, faculties or the university as a whole, graphic representation of the data, comparative bibliometric analysis of the researchers, research groups, research centres and faculties, data extraction in different formats for exporting, and faceted search*".

(Rosa et al., 2016)

2.3 Bibliometric Laws

2.3.1 Lotka's Law

In 1926, Alfred J. Lotka published his pioneering work on the frequency distribution of scientific productivity which he determined from a decennial index (1907-1916) of Chemical Abstracts. Lotka states that "the number (of authors) making n contributions is about $1/n^2$ of those making one; and the proportion of all contributors, that makes a single contribution, is about 60 percent" (Glanzel, 2003).

2.3.2 Bradford's Law

In 1934, according to Bradford, "if a comprehensive literature search is conducted on some subject covering a specified period, often it will be found that the literature is scattered in a regular pattern over a very large number of sources". Bradford law state that "if publication sources are arranged in descending order of productivity, with the journal yielding most articles at the top of the list and the journals yielding the fewest at the bottom, the sources can be divided into a nucleus of periodicals more particularly devoted to the subject, and several groups or zones containing the same number of articles as the nucleus, where the number of periodicals in the nucleus and succeeding zones will be as i: j: j^2 ” (Chen & Leimkuhler, 1986).

2.3.3 Zipf’s Law

Zipf’s Law (1935) is one of the important laws of bibliometric studies which is used to forecast the frequency of words within 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 multiple by its frequency will equal a constant. The equation for this relationship is r x f = k where *r* is the rank of the word, *f* is the frequency, and *k* is the constant”. Zipf’s demonstrated his law in the analysis of James Joyce’s Ulysses. “He showed that the tenth most frequent word occurred 265 times, the two hundred words occurred 133 times and so on. Zipf’s found, then that the rank of the word multiplied by the frequency of the word equals a constant that is approximately 26,500” (Mishra, Gawde, & Solanki, 2014). According to Potter (1988), Zipf's Law is not statistically perfect, though it is very valuable for indexes.

2.4 Concept of Scientometrics

Scientometrics is a very modern term that is used as synonymous with the term bibliometrics. The term is commonly used in USSR as “Naukometriya”, the term scientometrics becomes popular in Western countries as they started to use this term after the introduction of the well-renowned journal “Scientometrics” in the year 1978 by T. Braun. According to T. Braun “scientometrics study includes a complex of the quantitative mathematical and statistical method used to investigate various aspects of research publications in evolutionary and prospectus of science." Scientometrics concept was first defined by Nalimov (1971) as developing "the quantitative methods of the research on the development of science as an informational process". Scientometric study can be considered as "the study of the quantitative aspects of science and technology seen as a process of communication and some of the main themes include ways of measuring research quality and impact, understanding the processes of citations, mapping scientific fields and the use of indicators in research policy and management. Scientometrics focuses on communication in sciences, social sciences, and humanities among several related fields." (Mingers & Leydesdorff, 2015). The scientometric study is considered to be a powerful visualizing tool for cognitive landscapes of any scientific research and development area that related to mathematical regularities and statistical aspects of data on Science and Technology. It highlights the history of science by linking the technology, identify social change, sociology of science groups and provides support in displaying and statistical analysis. In scientific discipline, the scientometric study applied for making studies on the sociology of science, philosophy of science, history of science, growth & development of science and scientific organizations. Thus, helps in identifying the behavior of science and scientist, with the help of various scientometric indicators for decision making, science policy & funding.

2.5 Indicators of Scientometric Study

Indicators are often discussed in scientific literature as measuring tools or indexes for measurement of research performance, research impact and research quality at the level of authors, journals, organizations and country to assess the state and prospects of research activities for evaluation, comparison, and rankings. In general, some common indicators of scientometrics are used for calculating and counting the main variables of authors, publications, references, and citations.

2.5.1 Publication Counts

Publication count measures productivity in all aspects of bibliometric measurement i.e. by author, by the institution, by country, etc. and provide raw data for citation analysis. Ranking in terms of volume of publication and compare the results for authors, institutions, a country within and among specific subject field can be determined. Apart from it, the total number of documents by document type, year-wise count of publication & citations, forms of the document is usually determined by this indicator.

2.5.2 Citation Counts

Citation count measures the number of citations received by an article during a period of study. These citation counts are applicable to determine how many citations received by an author, journal, institution or country over some time. Further, the citation count helps to determine the various indexes used in measuring the impact of authors and journals. Some of the following studies are related to citation counts:

a) Authorship Study

The study will mainly focus on the impact (ratings) of publications by counting the number of citations for single-authored publications in comparison with multi-authored publications. Similarly, the impact of authorship study is considered for comparison of different forms of publications based on citation counts.

b) *Ranking of Journals*

Ranking of journals is done mainly in three different ways like ranking by counting the number of citations, ranking by journal impact factor and ranking by journal immediacy index. Journal Impact Factor (JIF) was devised by Eugene Garfield (1975) is a "scientometric index that calculated the yearly average number of citations that recent articles received during a given period to the last two preceding years' citable publications." JIF used for ranking of journals is an important tool to identify the most influential journal in a given field of subject. JIF can be calculated as $IF_x = A/B$, where A denotes the number of citations received by a journal (x) in a given year, B denotes the total number of citable articles published in that journal during the last two preceding years. The JIF is a publication level metric that is used only for articles, reviews and conference proceedings not for individual papers, authors, institutions or universities.

Journal Immediacy Index: Journal Immediacy Index (JII) measures how quickly average articles of a journal are cited in the same year it is published. It is calculated by dividing the total number of citations to the articles in a given year to the total number of articles published in the same journal in that particular year.

c) ***Cited Half-Life***

It measures the number of years, including the preceded year from the current year, the account for half the total citations received by the cited journal in the current year. For example, if a journal's half-life in 2018 is 5, it means the citation from 2014-2018 is half of the citations from that journal in 2018, and the other half citations received before 2014.

d) ***Self-Citations***

Self-citations indicate for those authors who cite their works which account for a significant portion of all citations. Self-citation practices may be due to the cumulative nature of individual research, promotion of own work, for personal gratification, citing colleagues article rather than competitor article, or the value of self-citation as a rhetorical and tactical tool in the struggle for visibility and scientific authority (Fowler & Aksnes, 2007). These types of studies are important where the evaluation of research performance is done for authors, institutions or countries in measuring their role and impact based on the citation. The practice of self-citation is nearly impossible for some authors who conduct unique research though, for a common type of research, it should be avoided to a certain extent of reasonable conditions.

2.5.3 Citations per Publication

Citations per Publication (CPP) are analyzed to assess the impact of article output per year, different countries, institutes, and authors worldwide. To know the most prolific authors or institutes, most frequently cited articles per year, year-wise citation performance, the ranking of core publications in the specific field of subjects, etc. Similarly, Publications per Institute (PPI) in a country was used to be an indicator to compare the institute's research performance by country (Li & Ho, 2008).

2.5.4 Literature Usage Count

Counting of literature usage helps to know how much procured or subscribed document is used or not. Generally, the scientometric indicator i.e. number of times cited do not reflect the current interest of the research community due to the continuous development of new methods, tools & techniques, indicators and in making of policymaking. So, literature usage count "would be a new indicator in recentness detection of research fronts and in comparison to times cited, usage count is a dynamic and instant indicator" (Liang et al., 2017).

2.5.5 Citation Analysis

Citation analysis is a non-intrusive method that measures the relative impact or importance and quality of an author or journal publication based on counting the number of times publication has been cited by others. Citation analysis is used mainly for the following purposes:

a) To establish the link between particular publications work of an author cited in other authors' publications work based on it or cited by the same authors.
b) To find out more related subject fields or topics by identifying influential works in that area.

c) To know how much impact one's publication by looking at his/her total number of citations.
d) For academic career promotion and tenure purpose by knowing the quality of sources of publication and number of times publication has been cited.

For study citation analysis, there are various tools available of which some may be subscription-based or freely available. These tools include citation databases like WoS, Scopus, and Google Scholar, etc. and each database has its strengths and weaknesses when analyzing in coverage of the universe of publications. So, it is better to use more than one metrics tool to get a clear picture of the scholarly impact of an author or journal.

2.5.6 Bibliographic Coupling

Bibliographic Coupling is the relation between two articles when two articles were cited in one or more papers in common. The stronger bibliographic coupling relation between two articles represents more similar subject coverage by them. Bibliographic coupling links the source documents and provides a clue to an information scientist about the relatedness of two documents (Sharada & Sharma, 1993). Bibliographic Coupling is used for:

a) Finding a relationship between two subjects and two different articles.
b) Finding topics for research by the researchers.
c) To understand the development of new subjects and the merging of subjects.
d) To know the pattern of research.
e) To get help in the collection development of libraries.

2.5.7 Co-citation Analysis

Co-citation Analysis helps in tracking pairs of papers that are cited together in the source articles. A cluster is formed when the same pair of papers is co-cited by many authors, and within-cluster the co-cited papers tend to share some common theme. Thus, co-citation analysis is an important method for the study of the cognitive structure of science and effective method for monitoring the development of science. With the merging of single-link clustering and multidimensional scaling clustering techniques helps in mapping the structure of a particular research area as well as science as a whole. Co-citation analysis helps in revealing the interdisciplinary research trends within institutions or journals (Kademani, 2011). Co-citation analysis is applicable for a document, author and journal. Document co-citation analysis is "intended to find out highly cited articles, author co-citation network is intended to find out the most influential authors, journal co-citation network is intended to find out the dominant source of articles published in the journal" (Liang & He, 2017).

2.5.8 Co-word Analysis

Co-word Analysis involves the identification of core keywords and their co-occurrences in an attempt to generate a co-word structure map of papers linked by the degree of co-occurrence of the keywords. Co-word is the relation between two or more keywords representing a common area of research topic, the more the stronger links between keywords denote closeness of keywords. To reveal the structure and developments of the research field, different co-word methods are applied based on the co-word matrix. The co-word matrix consists of factor analysis, cluster analysis, multivariate analysis and social network analysis that helps a researcher to identify the overview of a subject field (Chen, Chen, Wu, Xie, & Li, 2016). Mapping and visualization of significant words, terms or phrases are done to understand bibliographic networks for major topics in a domain, relationship of topics and scattering of ideas over the period. Further, in co-word analysis, the keyword is taken either from title or subtitle, author keywords, abstract of articles and full-text articles. To retrieve keywords through two popular techniques i.e. Multidimensional Scaling (MDS) and Visualization of Similarities (VoS) are used that works based on the distance between keywords and by the similarity of nodes in the clusters of keywords (Nadzar, Bakri, & Ibrahim, 2017).

2.5.9 Journal Impact Factor

The Journal Impact Factor (JIF) is analyzed by calculating total citations of a journal in the current year for all scholarly publications published in the previous two years, divided by the total number of scholarly publications published in the journal during the previous two years. "Journal impact factor is based on two elements, the numerator represents the number of citations in the current year to any items published in a journal in the previous two years, and the denominator represents substantive article (source item) published in the same two years" (Garfield, 1999). JIF can be measured for more than two years, and when it is calculated for the previous five years, it is known as a five-year journal impact factor, which will result in a greater weight too rapidly changing fields. The JIF does not help in measuring the quality of the peer-review process and the quality of the content of the journal, but it reflects an average number of citations to the articles published in journals, books, theses, project reports, newspaper, conference proceedings, Internet documents, notes, etc. JIF without self-cites can be calculated by subtracting the citations from journal articles to the journals in which it published.

The IF of any journal may be calculated by the formula (Sharma, Sarin, Gupta, Sachdeva, & Desai, 2014)

"2012 Impact Factor = A/B

Where A is the number of times articles published in 2010 and 2011 were cited by indexed journals during 2012. B is the total number of citable items like articles and reviews published by that journal in 2010 and 2011".

2.5.10 Eigenfactor

The Eigenfactor (EF) is an "overall rating (scoring) tool for the scientific journal community where all articles published in the journal during a year are taken into consideration when making the calculation. The calculation of the EF for journals based on the PageRank algorithm, which enables determining the value of the journal that is citing the article, and citations are given different weights according to how high the EF of the score of the journal is" (https://libguides.oulu.fi/c.php). The EF score is calculated by "counting all citations from five years after the article was published, and not just citations from a specific category of journals. Apart from journals, EF considers citations for newspaper articles, doctoral thesis, and books, etc" (Sassali, n.d.).

2.5.11 Article Influence

Article Influence (AI) is a standardized Eigenfactor score which is calculated annually and is defined as "Eigenfactor score divided by the fraction of all articles published by a journal" (Chang & McAleer, 2013). The AI scores measure the average influence per article of a journal and are comparable to Thomson's scientific impact factor. The mean AI score is 1.00, if it is greater than 1.00 that means each article in the journal has more influence than average and vice–versa.

2.5.12 SCImago Journal Rankings

The SCImago Journal & Country Rank (SJR) "is a publicly available portal that includes the journals and country scientific indicators developed by SCImago Lab group and Elsevier Scopus database. These indicators can be used to assess and analyze scientific domains in journals as well as country level. Journals can be grouped by subject area (27 major thematic areas), subject category (313 specific subject categories) or by country. Citation data is drawn from over 34,100 titles from more than 5,000 international publishers and country performance metrics from 239 countries worldwide. SJR is based on Google's PageRank algorithm and allows us to embed significant journal metrics in Web clickable image widget" (SJR - About Us, n.d.).

2.5.13 Source Normalized Impact per Paper

According to Moed (2011), Source Normalized Impact per Paper (SNIP) is defined as "the ratio of journal's citation count per paper and the citation potential in its subject field. The base idea of citation potential is that the probability that an n-year old paper in a particular field is cited is directly proportional to the frequency at which articles in the field cite is directly proportional to the frequency at which articles in the field cite other n-year-old documents". In other words, SNIP is "calculated as the number of citations given in the present year to publication in the past three years divided by the total number of publications in the past three years" (CWTS, n.d.).

2.5.14 h-index

The h-index is calculated to determine the most prolific authors in a given field when the impact of publications by the author is taken into account. Hirsch (2005) defined h-index as "the number of papers with citation number $\geq$ h, as a useful index to characterize the scientific output of a researcher. A researcher has index *h* if *h* of *h* his or her N_p papers have at least *h* citations each and the other (N_p – h) papers have $\leq$ h citations each". The h-index is a very useful indicator for comparison of research contribution's impact on individuals dealing in the same research field, also helps in their recognition, promotion, grants, rewards, etc. Mingers, Macri, & Petrovici (2012) describe the use of h-index in measuring of journal's research quality and contributions in the following ways:

a) It has a similar correlation with the impact factor and peer review evaluations.
b) Recognize impact as well as the total number of papers published in the journal.
c) It shows citations for a long period than the impact factor which is better particularly discipline like Social Science.
d) It is robust, simple to understand, and unaffected to very highly cited papers that skew the impact factor.

e) It can be used with the Google Scholar database and helps in providing metrics for all journals equally in comparison to the Web of Science & Scopus database.

2.5.15 g-index

The concept of g-index (Egghe, 2006) is “improvement of h-index for measuring the citation performance of a set of articles. If the articles are ranked in decreasing order of the number of citations, g-index is the (unique) largest number such that top g articles received (together) at least g^2 citations and also the value of g-index is greater or equal to the h-index value”. The g-index is advantageous over h-index while accounting for the performance of the author's top articles and at the same time in giving credit to low cited papers or non-cited papers while giving credit to highly cited papers.

2.5.16 i10-Index

The concept of i10-index was introduced by the Google Scholar database in 2011 that measures citation impact by counting the total number of papers that received at least 10 citations. It is the simple and direct indexing measurement to calculate the impact of publications by authors or journals which received a minimum of 10 citations.

2.6 Conclusion

Metrics study is not a new concept though its implications in exploring the impact and quality of publications are attracting many researchers to conduct research and came out with new ideas towards more suitable indicators of measurement. The metric study is useful for determining the trend, quality and impact of publications that lead as an indirect reward, recognition for the intellectual minds working in any subject field of study. The journey of metrics study is started with the concept of bibliometrics which mainly deals in the statistical and mathematical analysis of bibliographical details of publications to identify the productivity trends, pattern, and growth of literature. The concept of citation analysis shifts the publication analysis in the relevance to identify most cited, influential or impactful publications; and scientometric study to play a major role in the measurement of impact and evaluation of research performances. The scientometric study utilizes quantitative aspects of publications for mapping of scientific research by displaying cognitive aspects of scientific research and qualitative aspects of publication for citation mapping, bibliographic coupling, co-authorship network, and co-word mapping, etc. by using indicators that help in making of the scientific policy of research. Finally, no metrics indicators are self-sufficient to measure the quality aspects of research publication though the effort towards research impact calculation is remarkable.

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Chapter 3: Scholarly Communications and Web Visibility in LIS

Chapter Plan

3.1 Introduction

Scholarly communication is a cyclical process of academics, scholars and researchers involved in the creation, publication, dissemination, and discovery of academic research through communication channels so that it is visible to the wider community and beyond. Communication channels in the form of formal and non-formal way are the most important vehicle that enables learned societies to present their findings on the basis of certain research questions, methodologies, data collection and analysis. In the 21^{st} century, scholarly communications are no longer restricted to print resources as availability of electronic and digital media for communication through databases, archives or institutional repositories are prevalent for easy accessibility and usage. Scholarly communications in the realm of competitive research culture judged by the academic output or list of publications in the quality and prestigious channels as it is helpful for appointment, promotion, rewards & recognition within their disciplines. Visibility of LIS faculties in formal and informal channels of communication ultimately increases the citation counts as well as provides a platform for engagement in the advancement of knowledge through collaboration with research partners, funding organizations and institutional research teams. Web visibility help to aware and identify most prolific publications, opportunities for professional gain and ability to reach far beyond traditional academic borders.

3.2 Channels of Scholarly Communications

There are many avenues of scholarly communications through which visibility of academic publications can be reached through wider communities. These include formal and informal channels of communications for information exchange that reflects the creator's expertise and credibility in their academic publication. The sources of formal channels are mainly used for academic publications that get through a critical process of review & revision and the credentials of authors or creators are provided with proper references and citations. While in the informal channel of communication, the sources may not provide the author or creators credentials and proper citations that raise a question on its authenticity. Some of the formal and informal channels of communications are discussed below:

3.2.1 Formal Channels of Communication

a) Academic Journals

Academic journals are considered to be the most popular and preferred medium of communication by the scientific community as of their high level of impact, quality, credentials, ease of accessibility and outreach potentials. They are usually peer-reviewed or refereed in nature.

b) Conference Proceedings

Conference proceedings include the interactive publications for feedback by the expert communities on a particular theme of research which may be published before or after the conference. Conference proceedings include published records of conference, symposium or other expert meetings sponsored by a society or association.

c) Research Monograph

A research monograph is a straight forward and concise form of research paper that is written on a single specialized topic on a particular subject. It can be reformatted editions of dissertation or thesis published by a university press and commercial scholarly publishers.

d) Research Reports

A research report or project report is a formal mode of research communication, prepared by the researchers to record and disseminate research results to concerned funding organizations or stockholders associated with the research process.

e) Theses and Dissertations

Theses and Dissertations are the formal mode of research communication to record and disseminate research results by students or scholars enrolled in research institutes or universities for the award of a research degree. In India, Shodhganga (a project of INFLIBNET) is responsible for the collection of electronic Theses and Dissertations (ETD) from various participating universities and act as a national repository of Theses and Dissertations.

f) Working Papers

Working papers are a type of scholarly communication to disseminate findings of research publications which is under the process of publication i.e. has not been yet published or under review process. It helps researchers in getting qualitative and timely feedbacks for further improvement or changes in research design or analysis of generated data. It provides opportunities in seeking corroboration from peer-reviewed research and asks other researchers for help in assessing a study.

g) Patents / Standards

A patent protects intellectual property right (IPR) of scientific inventions which has certain applications for the betterment of human life and gives the owner the right to prevent others from making, using, importing, and selling the inventions.

3.2.2 Informal Channels of Communication

a) Personal Website

The personal website is an effective way to enhance owns academic & professional achievement and work to the academic community. A well designed personal website not only increases the Web visibility of an author but also helps to demonstrate the impact and influence for other researchers or professionals.

b) Slide share

Slide share is a site hosting service founded in the year 2006 by Microsoft Corporation with the goal of making knowledge sharing easy. In 2012, Slide share is acquired by LinkedIn and at present, the hosting service includes professional content like slide presentations, infographics, documents, and videos. It also supports documents like PDF, videos, webinars along user facility of ratings, comment and uploads the content.

c) YouTube

YouTube is a popular American video-sharing website where a user can watch, like, share, and comment and uploads their videos. YouTube is helpful for the academician as its videos can enhance support for teaching and learning programs, resource discovery and use of information provides basic instructional academic activities and scholarly support services for better research skills.

d) Internet Forums and Discussion Group

Internet-based discussion groups are very useful as they place several people, ideas and suggestions on a common platform. It serves as a communication hub for a group of people who work together to share and exchange ideas in solving a particular problem of common interest. Reddit, Stack Overflow, India – Forums, Yahoo Groups, Google Answer, Experts – Exchange are some of the examples of the online forum.

e) Social Media

Social media plays a vital role in scholarly communications for history organizations, researchers and publishers which helps in promoting and circulating research. It helps in providing current awareness service and attracts the attention of an academic community. By using social media, a researcher can be able to learn, share, discuss each other's work in a virtual way and get an opportunity to collaborate with other researchers of common interest. Facebook, Twitter, ResearchGate, Academia.edu, etc. are some of the common examples of social media for scholarly communications.

3.3 Citation Databases for Scholarly Communications

Citation databases have been developed for evaluating scholarly communications based on publication and citation of the publication. Citation database can be used for cited reference searches, enabling one to find, identify, select, and obtain citation data by author-wise, year-wise, document-wise, research area-wise, etc. and navigate literature on a topic. Citation databases enable one to find recent papers that reference a known paper or author belongs to related subject areas. Some of the characteristics of citation databases, in terms of user perspectives, as given by Soudant (n.d.) are:

a) To find more papers based on a topic.
b) To trace out how an idea has been established, useful, prolonged or revised in later publications.
c) To know the researchers who cite your work or work of lab mates.
d) To identify the number of citations and further metrics indicators for the evaluation of scholarly communication i.e. helpful for bibliometric/ scientometric related study. Citation databases tend to focus mainly on journal articles but it also includes other materials such as a book, conference papers, dissertations, reports, etc. Some popular types of citation databases are discussed below which allow interdisciplinary citation searching.

3.3.1 Scopus Database

Scopus is one of the largest abstract and citation database provided by Elsevier for peer-reviewed literature, launched in 2004. The peer-reviewed literature includes scientific journals, books, conference proceedings, etc. Worldwide coverage of

Scopus includes disciplines like Life Sciences, Social Sciences, Physical Sciences, and Health Sciences. Scopus covers nearly index content from more than 5,000 publishers, having more than 24,600 active serial titles and more than 194,000 books. Dating back to 1970, Scopus included 1.4 billion cited references from 75 million items contributed by nearly 16 million authors belongs to 70,000 institutions. Scopus database has rich underlying metadata architecture for connecting people, publishing ideas and institutions. The sophisticated tools and analytics used by this database help in generating detailed citation results, researchers profile ID and intuitions for better judgment, actions, and conclusions. The powerful resources discovery and analytical tools of the Scopus database empowers researchers, librarians, institutional research managers and funders to take a better decision (Scopus | Elsevier Solutions, n.d.).

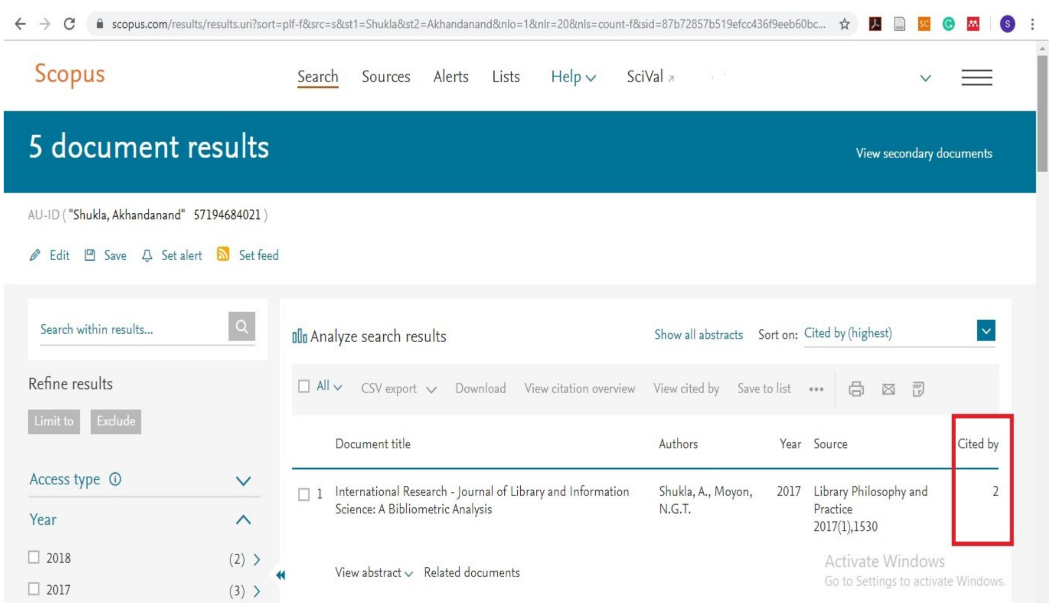

Fig. 3.1: Searching Result in Scopus
(Source: https://www.scopus.com/)

3.3.2 Web of Science Database

Web of Science (WoS) is the world's most powerful citation database launched in the year 1977 based on the pioneering concept of Citation Indexing given by Dr. Eugene Garfield. WoS is a subscription-based database that provides comprehensive citation data for multi-disciplinary scholarly communications. “It was originally produced by Institute for Scientific Information (ISI) and at present maintained by Clarivate Analytics. It provides data, analytics, and insights as well as workflow tools and personalized professional services to the researcher and the entire research community involved in the research. It contains almost 1.7 billion cited references from over 155 million records included in 34,000 journals. Web of Science core collection includes nearly 21,000 peer-reviewed quality journals, 2,05,000 conference proceedings, and more than 1,04,000 editorial books” (Web of Science Platform, n.d.). Apart from core collection, WoS platform covers subject-specific citation index like Medline, BIOSIS Citation Index, and Zoological Record; types of document-specific index like Derwent Innovations Index (for patents), Data Citation Index (for datasets and data studies); regional citation index includes Russian Science Citation Index (RSCI), KCI Korean Journal Database and SciELO Citation Index. WoS database is not specific only for science-related subjects as it also covers the Social Science Citation Index, Arts & Humanities Citation Index and the Emerging Sources Citation Index (ESCI). The journal selection process of Clarivate Analytics is “neutral and applied to all journals from over 3,300 publishing partners by considering qualitative and quantitative assessment for most relevant research from commercial, society and open-access publishers” (Wayback Machine, 2018).

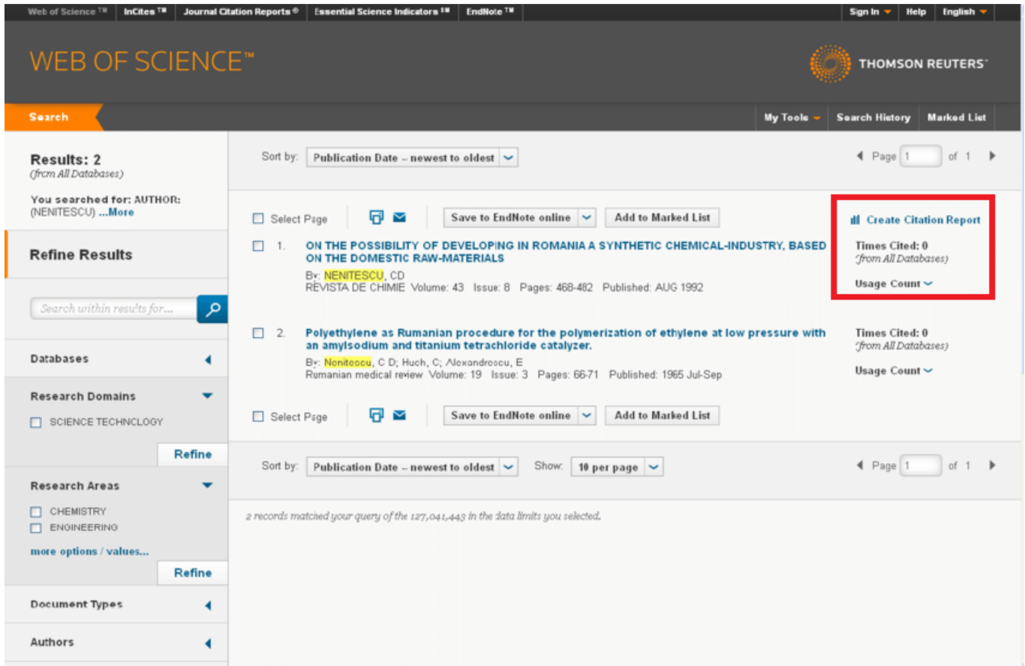

Fig. 3.2: Searching Result in Web of Science
(Source: https://www.google.com/search?q=search+result+in+web+of+science)

3.3.3 Google Scholar Database

Google Scholar (GS) database is a freely accessible Web search engine owned by Google and launched in the year 2004. GS includes indexes or metadata of scholarly literature published in any format like books, journal articles, conference proceedings, theses, dissertations, preprint, technical report, etc. In GS vast amount of literature belongs to any discipline is easily searchable by using techniques like custom range for year-wise selection, sorting by the relevance of documents, sorting by date for the latest publications. Apart from it, GS provides the option to select patents and citations for the search literature along with alert creating service. The advanced search facility of GS is somewhat like a library catalogue that allows one to find articles by all search words, by exact phrase, by at least one word, to select the occurrence of words in the title or anywhere in the article, to search by author and search by journal-wise. GS allows one to create their own Google profile ID through verification of email, which allows one to add academic publication by adding articles manually or in groups. Profile ID is useful to recognize the exact author by ID number or by the affiliating institute; in this way it helps one to increase their visibility and impact of publications. Profile Search results provide bibliographical details of publications along with total citations and year of publication. Metrics facility is available in GS at author and journal-level; at author level, it automatically calculates h index and i10 index of authors on a five-year basis whereas at journal level it categorizes sources of publication by discipline-wise and further arranged as per sub-categories of discipline to subject-wise. Citation metric indicator in the form of h5–index, and h5-median for topmost sources of subjects is also available in GS.

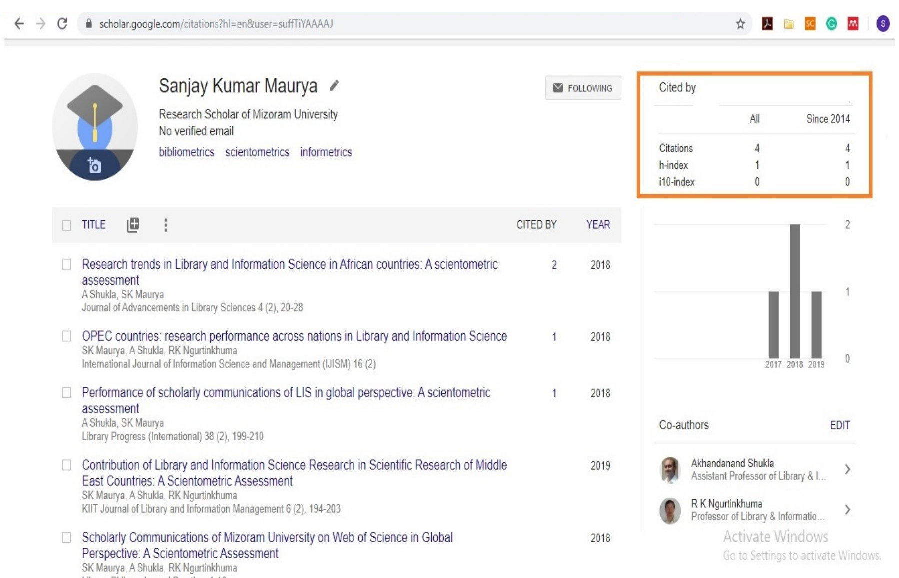

Fig. 3.3: Searching Result in Google Scholar
(Source: https://scholar.google.co.in/citations?user=suffTiYAAAAJ&hl=en)

3.3.4 PubMed Database

PubMed is a freely accessible citation database for search and retrieval of peer-reviewed biomedical and health sciences literature. PubMed was developed in the year 1996 with the aim of improving health in both a personal and global way. “It is maintained by the National Centre for Biotechnology Information (NCBI) under the U.S. National Library of Medicine (NLM) located at the National Institute of Health (NIH).

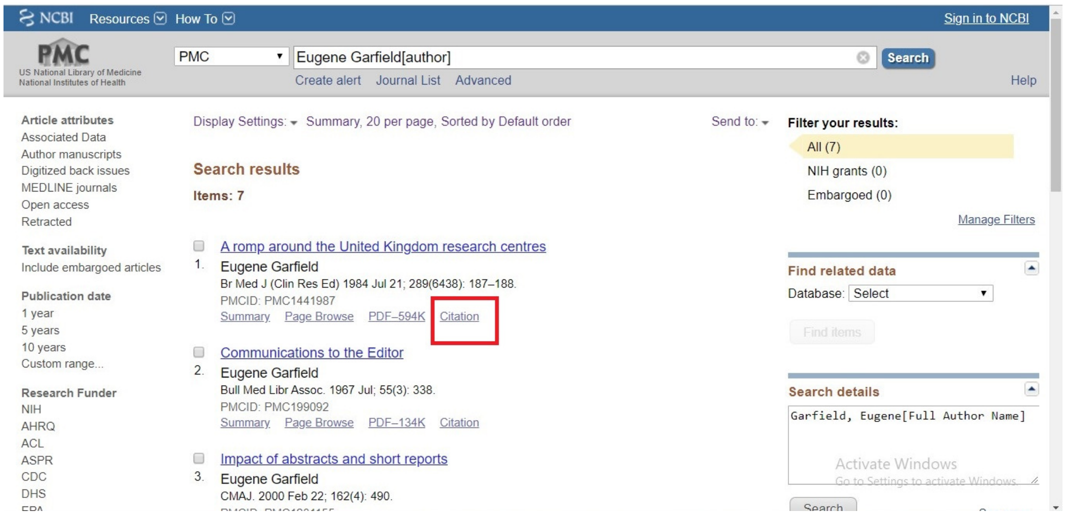

Fig. 3.4: Searching Result in PubMed
(Source: https://www.ncbi.nlm.nih.gov/pubmed/?term=Eugene+Garfield)

MEDLINE is the largest component of PubMed that contains citations from medical literature indexed in MeSH terms. PubMed Central (PMC) is a full-text archive of biomedical and related disciplines like Life Science, Behavioral Science, Chemical Science and Bio-engineering” (PubMed Help, n.d.). From 2000 onwards PubMed Central merged articles from thousands of journals into two main journals i.e. *PNAS: Proceedings of the National Academy of Sciences*, and *Molecular Biology of the Cell*. PubMed contains more than 30 million citations of which PubMed Central contains more than 5.3 million full-text records that include 1.36 million digitized contents, 0.64 million author manuscripts, and 3.3 million journals & publisher programs (PMC Overview, n.d.).

3.4 Tools for Mapping of Scholarly Communications

The mapping of scholarly communications was done to build bibliometric maps that represent the specific disciplines, scientific domains or areas of research in a conceptual, intellectual, and socially structured way. The general workflow of mapping analysis has been done in different steps like data retrieval, pre-processing, network extraction, mapping, analysis and visualization (Cobo, López-Herrera, Herrera-Viedma, & Herrera, 2011). For mapping of scholarly communication different software and tools are developed to analyze scientific domains. These software tools are discussed below:

3.4.1 Bibexcel

Bibexcel (Persson, Danell, & Schneider, 2009) is free-ware, non-profit, versatile bibliometric toolbox designed for analyzing bibliographic relationship which can be read by software like Excel, SPSS, UCINET, and Pajek. Bibexcel software can read and retrieve the data imported from the bibliographical databases like Web of Science, Scopus, and Procite export format. It can create a different bibliometric network on the basis of extracted data for the study of bibliographic coupling, co-authorship, co-word analysis, calculation of h-index, Salton's Cosine, Jaccard's index, etc.

3.4.2 CiteSpace II

CiteSpace II, developed at Drexel University (USA), is a freely available Java Application program that combines information visualization methods, bibliometrics and data mining algorithm to make an interactive visualization tool for the extraction of patterns in citation data (Synnestvedt, Chen, & Holmes, 2005). It can read data from bibliographic databases like PubMed, Web of Science, arXiv, and SAO/NASA Astrophysics Data System (ADS). Apart from that, it can also able to read metadata of NSF awards and patent data provided by the Derwent Innovations Index. CiteSpace supports structural and temporal analysis of the variety of networks obtained from the reference of publications such as collaboration network, co-citation network for authors & documents; also supports network of the hybrid node for a keyword, institution, and countries and hybrid link types such as co-citation, co-occurrences and directed citation links.

3.4.3 CitNetExplorer

CitNetExplorer is a freely available software tool for visualizing and analyzing citation networks for scientific publications. It supports data directly from the Web of Science database and formed interactive citation networks by forming clusters for closely related publications. The application of CitNetExplorer includes:

a) Investigating the growth & development in a research field over time.

b) Identifying the works on a particular research topic.

c) Discovering the published works of a researcher.

d) Supports in the literature review.

3.4.4 VOSviewer

VOSviewer (Van Eck & Waltman, 2010) is a “free software tool developed by the Centre for Science and Technology Studies at Leiden University (Netherland) for analyzing and visualizing bibliometric networks”. The main feature of this software is that it can create a map for network data, bibliographic data, and text data. Apart from bibliographic databases such as Web of Science, Scopus, PubMed it can also support the VOSviewer file, GML file, Pajek networks files for creating the map. The network of journals, authors can be constructed based on citation, co-citation, bibliographic coupling or co-authorship. It offers a text-mining facility for extraction and formation of a co-occurrence network of keywords also. It uses the VOS clustering technique for making the map and represented the map in 4 views: Label View, Density View, Cluster density View, and Scatter View.

3.4.5 HistCite

HistCite (Garfield & Pudovkin, n.d.) is "a flexible software tool used in the visualization of literature extracted from the Web of Science and helps the user to evaluate the output of topical and citation-based searches". HistCite is a software implementation of algorithmic historiography that creates clear and informative data tables and publication-quality graphs in HTML format. The table contains chronological as well as frequency wise ranking of author or journals, publication-quality is sorted by local and global cited frequencies. Some of the new features of this software include frequency distribution, percentile citation score, number of references, number of authors, and publication year of papers.

3.4.6 Sci^2

The Science of Science (Sci^2) tool is "freely available, modular toolset which is specially designed for the study of science developed by Cyber structure for Network Science Centre at Indiana University. It supports the temporal, geospatial, topical, network analysis and visualization of the scholarly dataset at the micro (individual), meso (local) and macro (global) levels" (Sci2 Tool, n.d.). Sci^2 can able to read the data from Web of Science, Scopus, Bibtext, Endnote Export Format, CSV and other funding agencies data (National Science Foundation). The Sci^2 allows the extracted data from databases to be prepared and processed, the formation of networks in temporal, geospatial, topical and network analysis, further visualize the result with help of plug-ins and layout algorithms. The network formed in this tool includes author-document, co-author, co-word, co-citation, bibliographic coupling, and citations by author, document, and source (Cobo et al., 2011).

3.4.7 VantagePoint

VantagePoint is "a commercial powerful text-mining tool for discovering knowledge in search results from patent and literature databases or from generally indexed terms. It was developed by Search Technology Inc. (USA) for the mapping of scientific literature and works on Windows 7, 8, and 10 platforms" (https://www.thevantagepoint.com). It can import data from almost any literature or patent database and represents the bibliographical dataset in the individual field. Some of the features of this software include:

a) It makes a different list like the list of top affiliations in author or country, and browse the records for each one. Further, the list can be formed in the group and results helps in comparison of the item in groups.
b) The co-occurrence matrix allows determining the author's publication over a period of time.

c) It allows multidimensional statistical analysis for making clusters and relationships among keywords, authors, institutions, and countries.
d) It uses fuzzy matching techniques to identify, associate and clean up data.
e) It allows users to create, edit and apply thesauri for specialized data reduction or conversion.

3.4.8 Publish or Perish (PoP)

Publish or Perish (Harzing, 2016) is a "software program that retrieves and analyzes academic citations from databases like Google Scholar, Microsoft Academic, Scopus, Web of Science and allows to import external data from CSV, EndNote, and RIS format". The PoP search results can be saved in some well-known reference styles such as APA, Harvard, Chicago, MLA, CSRIO, and Vancouver. It is designed to empower individual academics, and helpful to evaluate academic performance in a mechanistic way. Some of the following metrics are analyzed by PoP:

a) The total number of publications and citations.
b) Citations per author, citations per paper, papers per author, citations per year.
c) H-index, contemporary h-index, the average annual increase in individual h-index.
d) The g-index.
e) Age-weighted citation rate.
f) The number of authors per paper.

3.4.9 Bibliometrix R Package

Bibliometrix R Package is a unique tool, developed in the statistical computing and graphic R language according to a logical bibliometric workflow by Massimo Aria and Corrado Cuccurullo. R software is highly extensible due to its user-oriented and user programming language, which automatically analyzes and creates new functions. Because of this feature, the Bibliometrix R package can be rapidly upgraded and can be integrated with other statistical R packages. It is an open-source tool that analyses quantitative research especially science mapping for bibliometric & scientometric related study. It works with data extracted from mainly two citation databases i.e. Web of Science and Scopus. Some of the features of these packages are (Pradhan, 2017):

a) Provide a structured analysis for a large body of information.
b) Analyze trends of research over a period of time.
c) Highlights theme areas of research.
d) Identify shifts in the boundaries of disciplines.
e) To detect the most prolific author, institution and country.
f) Build metrics for co-citation, bibliographic coupling, collaboration, and co-word analysis.
g) Form network analysis, multiple correspondence analysis, and other data reduction techniques.

3.4.10 Metaknowledge

Metaknowledge (McLevey & McIlroy-Young, 2017) is "a full-featured Python 3 package that performs computational research in information science, network analysis and science of science and simplifies bibliometric and scientometric related study”. It supports raw data from bibliographic databases like Web of Science, Scopus, PubMed as well as from ProQuest Dissertations & Thesis, and selected funding agency. It can “handle large datasets efficiently, reads directory of plain-text files containing bibliographic metadata on publication and citation, writes a variety of data structure help in analyzing quantitative, network and text dataset” (McLevey & McIlroy-Young, n.d.). Some of the features of Metaknowledge package are:

a) Produced a tidy dataset for longitudinal research, reference publication year spectroscopy, and network & text analysis.
b) Supports & integrates open source and reproducible workflows.
c) Provide an interface for other software like R, VOSviewer, Gephi, etc.
d) Provide fast computation and efficient with large datasets.

3.5 Conclusion

Scholarly communication is an important activity of academia for the creation, sharing, and distribution through different forms of academic communication. The form of scholarly communication may be peer-reviewed or not, peer-reviewed works have more impact over non-peer-reviewed and they are generally produced to get recognition, research expertise and attention towards the intellectual creativity of an author. At the institutional level, the impact of scholarly communication is considered as essential parameters for the selection, promotion, increment and receiving a research grant from the parent organizations. The evaluation of scholarly communication is conducted by using bibliometric or scientometric indicators that determine the research impact and productivity analysis based on popular bibliographic/ citation databases. Web visibility analysis is done on the basis of these databases to analyze the scholarly communication in the form of publication performance, and their impact at the level of the individual author, publisher, institutional organization or country level. One has more visibility over these databases is calculated by counting the number of publications and citations. Scientometric tools and software are providing mapping and visualization techniques for tracing the history, evolution and exploring scientific knowledge through scholarly publications, the impact of scholarly publications by quantifying citations form cited references by displaying the structural relationship and dynamics of scientific research domains.

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Chapter 4: Scholarly Communications of LIS Academia – An Analysis

Chapter Plan

4.1 Introduction

Scholarly communication is a complex process that involves several steps of scholarly research, writing, publishing and other aspects of scholarly output. The process of scholarly communication includes doing research for papers, preparing how to write a journal article, identification of publisher, facilitate awareness and access to scholarly communication and many more.

ACRL defines it as:

> "S*cholarly communication is frequently defined or depicted as lifecycle documentation that involved steps for the creation, publication, dissemination and discovery of a piece of scholarly research*" (Fruin, 2003).

The core concept behind scholarly communication by the academics is to establish relationships among individual researchers and international research groups by sharing the related field of interest and research that will increase awareness of one scholar to the work and idea of another, so it has been always considered as a fundamental aspects of scholarly and scientific research (Klain-Gabbay & Shoham, 2018).

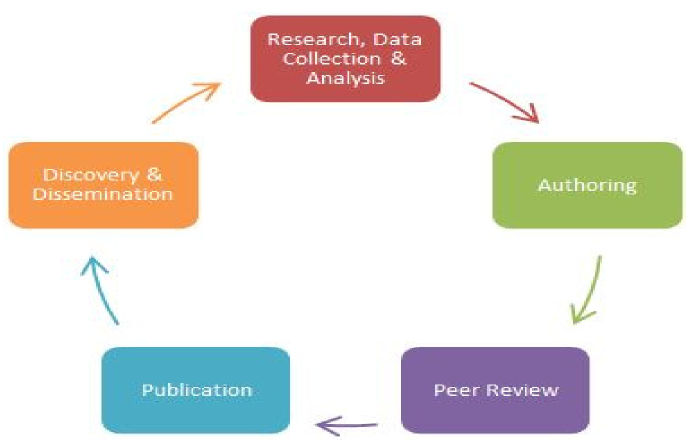


Fig. 4.1: Process of Scholarly Communication
(Source: https://acrl.libguides.com/scholcomm/toolkit)

This chapter covers the data analysis and findings based on the research objectives laid for the purpose of measuring scholarly communications of academia of LIS in Central Universities of India. A critical evaluation of processed data gives the right meaning for the research objectives and establishes a relation with different variables of this study.

4.2 Data Analysis and Findings

Analysis of data is a skilled work that every researcher has to do with the utmost care by following the data analysis process. Based on the background of the objectives, a structured questionnaire was prepared and distributed among 81 LIS faculty members affiliated to 18 Central Universities of India. Out of 18 Central Universities, Hemvati Nandan Bahuguna Garhwal University did not have any faculty in the LIS department, so excluded in the study. Again out of total faculty, 63 faculty members (77.77% of total) responded to the questionnaire. The collected data are analyzed, tabulated and interpreted to draw the inferences under various sub-headings. The analysis has been divided into two parts, the first part based on primary data obtained through questionnaires and bio-data while the second part based on online tools.

4.2.1: Part 1 – Analysis based on Primary Data

This section of analysis covers the first four objectives proposed for the study based on data collected from LIS faculty members through questionnaires, bio-data & department websites.

4.2.1.1 Number of Faculty Members in LIS Departments

There are 81 faculty members in LIS Departments of 17 Central Universities of India. The questionnaire responses of LIS faculty members have been arranged according to the university as shown in Table 4.1.

Table 4.1: Number of LIS Faculty in Central Universities

Name of University	No. of LIS Faculty	Response Received	Response Rate (%)
AMU	7	7	100
AU	4	3	75
BBAU	6	5	83.33
BHU	8	6	75
CUG	3	2	66.66
CUH	2	1	50
CUHP	3	3	100
CUTN	5	5	100
DU	7	7	100
GGU	1	1	100
HSGU	3	0	0
IGNOU	5	1	20
MU	5	1	20
MZU	8	8	100
NEHU	6	5	83.33
PU	5	5	100
TU	3	3	100
Total	81	63	77.77

(Source: Survey Data)

Table 4.1 shows department-wise LIS faculty working in Central Universities of India, out of which 63 LIS faculty responded to the questionnaire and the questionnaire response rate was 77.77%. Among the LIS departments of Central Universities, AMU, CUHP, CUTN, DU, GGU, MZU, PU and TU have the highest response rate (100%) followed by BBAU & NEHU (83.33%), AU & BHU (75%), CUG (66.66%), CUH (50%), IGNOU & MU (20%) while no response has been received from HSGU.

4.2.1.2 Gender * Academic Position

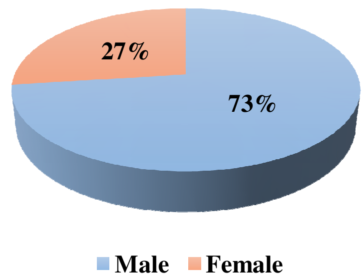


Fig. 4.2: Gender Representation among LIS Faculty

Fig. 4.2 represents gender analysis of LIS faculties affiliated to Central Universities of India. Out of 63 faculties, 46 faculties were male (73%) and 17 were female (27%). Table 4.2 represents the gender analysis of the academic positions of faculties. It has been observed that 30 faculties (47.6%) were Assistant Professor, of which 70% were male and 30% were female. Further 15 faculties (23.8%) were Associate Professor, of which 73.3% were male and 26.7 were female. Similarly, 18 faculties (28.6%) were Professor, of which 77.7% were male & 22.3% were female.

Table 4.2: Gender * Academic Position

Academic Position	No. of Faculty	Gender			
		Male	%	Female	%
Assistant Professor	30	21	70	9	30
Associate Professor	15	11	73.3	4	26.7
Professor	18	14	77.7	4	22.3
Total	63	46	73	17	27

(Source: Survey Data)

4.2.1.3 Gender * Age of Respondents

Table 4.3 highlights the gender and age relationship of faculties. Out of the total 63 faculties, the age group has been shared by 40 faculties out of which 32 faculties (80%) were male and 8 faculties (20%) were female. The age group has been divided into 5 categories viz. <30, 31-40, 41-50, 51-60 and >60. There has been no faculty belongs to less than 30 years age group while the highest number (37.5%) of faculty belongs to age group 41-50, followed by the age group 31-40 (30%), age group 51-60 (22.5%) and more than 60 years age group (10%). Interestingly, no female faculty falls under more than 60 years of age.

Table 4.3: Gender * Age of Respondents (N=40)

Gender of Respondents	Age of Respondents (in years)					Total	%
	<30	31-40	41-50	51-60	>60		
Male	0	10	11	7	4	32	80
Female	0	2	4	2	0	8	20
Total	0	12	15	9	4	40	100
%	0	30	37.5	22.5	10	100	

(Source: Survey Data)

4.2.1.4 Academic Position * Age of Respondents

Analysis of the academic position and age group of respondents has been discussed in Table 4.4. From the observation, it has been found that 52.5% faculty members belong to the Assistant Professor category, 17.5% faculties belong to Associate Professor and 30% belong to Professor category.

Table 4.4: Academic Position * Age of Respondents (N=40)

Age Group	Academic Position			Total	%
	Assistant Professor	Associate Professor	Professor		
<30	0	0	0	0	0
31-40	12	0	0	12	30
41-50	9	2	4	15	37.5
51-60	0	5	4	9	22.5
>60	0	0	4	4	10
Total	21	7	12	40	100
%	52.5	17.5	30	100	

(Source: Survey Data)

Further 30% faculties belong to the age group 31-40 which belongs to Assistant Professor; 37.5% faculties belong to age group 41-50, of which 60% were Assistant

Professor, 13.3% were Associate Professor and 26.6% were Professor. In the age group of 51-60, out of 22.5% faculties, no faculty belongs to Assistant Professor while 55.5% were Associate Professor and the remaining 44.5% were Professor; similarly, in the age group of >60 years, all the faculties belong to Professor category. Thus, we can say that reaching a higher academic position age is the decisive factor.

4.2.1.5 Academic Position * Academic Qualification

Faculty member's academic position and academic qualifications are represented in Table 4.5 that depicts 93.6% faculties have Ph.D. degree as their highest qualification, 3.1% faculties were pursuing Ph.D., 1.6% faculties were having MLIS/ M. Lib. I. Sc. degree while no response received from 1.6% faculties. It has been observed that out of responded faculty, all Associate Professor and Professor had a Ph.D. degree while 86.66% Assistant Professor have a Ph.D. degree, 6.6% were pursuing Ph.D. and 3.3% have only Master degree as the highest qualification.

Table 4.5: Academic Position * Academic Qualification

Academic Position	Academic Qualification						Total	%
	Ph.D.	Ph.D. Pursuing	M. Phil.	M. Phil. Pursuing	MLIS	No Response		
Assistant Professor	26	2	0	0	1	1	30	47.7
Associate Professor	15	0	0	0	0	0	15	23.8
Professor	18	0	0	0	0	0	18	28.5
Total	59	2	0	0	1	1	63	100
%	93.6	3.1	0	0	1.6	1.6		

(Source: Survey Data)

4.2.1.6 Academic Position * Teaching Experience

Academic position and teaching experience are shown in Table 4.6 that represents 4.8% faculty member belongs to only Assistant Professor category and have 0-5 years of experience. In the category of 6-10 years experience, 78.5% were Assistant Professor, 14.2% were Associate Professor and 7.1% were Professor. In the category of 11-15 years of experience, 72.2% were Assistant Professor, 9% were Associate Professor and 18% were Professor. In the category of 16-20 years of experience, 12.5% were Assistant Professor, 37.5% were Associate Professor and 50% were Professor. In the category of 21-25 years of experience, 57.1% were Associate Professor and 42.8% were Professor. In the category of 26-30 years of experience, 50% were Associate Professor and 50% were Professor. In the category of 31-35 years of experience or >35 years of experience, all faculties belong to Professor only. Overall, the highest percentage (22.4%) of faculties were having 6-10 years of experience followed by 17.4% with 11-15 years of experience and 12.8% with 16-20 years of experience.

Table 4.6: Academic Position * Teaching Experience

Academic Position	Teaching Experience (in years)									Total	%
	0-5	6-10	11-15	16-20	21-25	26-30	31-35	>35	No Response		
Assistant Professor	3	11	8	1	0	0	0	0	7	30	47.6
Associate Professor	0	2	1	3	4	1	0	0	4	15	23.8
Professor	0	1	2	4	3	1	2	1	4	18	28.5
Total	3	14	11	8	7	2	2	1	15	63	100
%	4.8	22.2	17.4	12.8	11.1	3.1	3.1	1.5	23.9	100	

(Source: Survey Data)

4.2.1.7 Academic Position * Research Experience

Academic position and research experience are shown in Table 4.7 that represents 7.9% faculty member belongs to the Assistant Professor category and has 0-5 years of research experience. In the category of 6-10 years of research experience, 84.6% were Assistant Professor and 15.4% were Associate Professor. In the category of 11-15 years of research experience, 30% were Assistant Professor, 10% were Associate Professor and 60% were Professor. In the category of 16-20 years of research experience, 33.3% were Assistant Professor and 66.6% were Professor. In the category of 21-25 years of research experience, 42.8% were Associate Professor and 57.1% were Professor. There were no faculties found under the category of 26-30 years of research experience. In the category of 31-35 years of research experience or >35 years of research experience, all faculties belong to Professor only. Overall, the highest percentage (20.6%) of faculties have 6-10 years of research experience followed by 15.9% faculties with 11-15 years of research experience 11.1% faculties with 21-25 years of research experience.

Table 4.7: Academic Position * Research Experience

Academic Position	Research Experience (in years)									Total	%
	0-5	6-10	11-15	16-20	21-25	26-30	31-35	>35	No Response		
Assistant Professor	5	11	3	2	0	0	0	0	9	30	47.6
Associate Professor	0	2	1	4	3	0	0	0	5	15	23.8
Professor	0	0	6	0	4	0	3	0	5	18	28.5
Total	5	13	10	6	7	0	3	0	19	63	100
%	7.9	20.6	15.9	9.5	11.1	0	4.8	0	30.1	100	

(Source: Survey Data)

4.2.1.8 Preferred Language of Research Publication

Fig. 4.3 represents the preferred language of research communication by the LIS faculty members of Central Universities of India. It has been found that out of total 63 faculties, 25 faculties have not responded to the question while rests of the faculty members (38) have responded. Out of responded faculties (38), the majority of the faculties have opted *English* as the most preferred language for research communication in every form of the document mentioned in the questionnaire. Apart from *English*, the *Hindi* language is also preferred for authored books, co-authored books, and journal articles while other languages have been found for journal articles, news items and other forms of documents also.

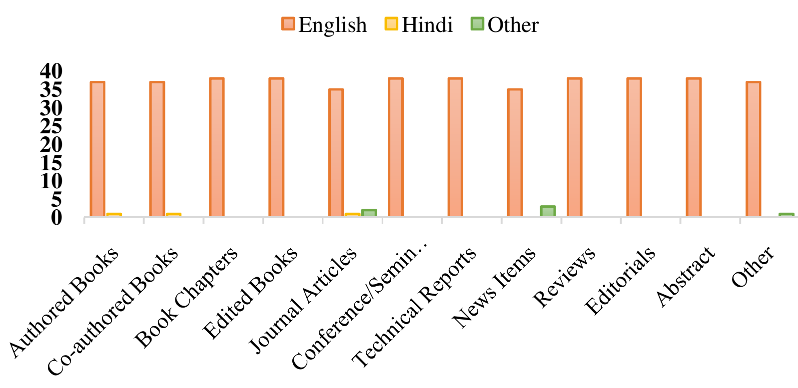


Fig. 4.3: Preferred Language of Publication by Faculties

4.2.1.9 Preferred Medium of Scholarly Communication

Table 4.8 represents the preferred medium for research publications by the LIS faculty members of Central Universities of India in accordance with the number of frequency of preference order provided by them. The frequency of preference order is calculated by assigning the definite value against preference order. The calculation of frequency value is given herewith:

Preference Order	Frequency Value
1	12
2	11
3	10
4	9
5	8
6	7
7	6
8	5
9	4
10	3
11	2
12	1

On the observation of Table 4.8 it has been found that Journal Articles (17.8% of total frequency value i.e. 2195) have been found as the most preferred medium of scholarly communication by faculties followed by Conference/ Seminar Proceedings (13.6%), Book Chapters (12.8%), Authored Books (11.4%), Edited Books (10.1%), Co-authored Books (9.3%), Reviews (6.1%), Technical Reports (5.4%), News Items (4.6%), Editorials (4.5%), Abstract (2.5%) and others (1.2%). Table 4.8 represents the preferred medium of publications by the faculties belonging to different academic positions. It has been found that the Assistant Professor category has responded more than Associate Professor and Professor. More than 51% share of frequency value has been given by Assistant Professor followed by Professor and Associate Professor.

Table 4.8: Preferred Medium of Research Publications

Publication Medium	Total Frequency of Preference Order	%	Frequency of Preference Order by Academic Position		
			Assistant Professor	Associate Professor	Professor
Authored Books	251	11.4	133	32	86
Co-authored Books	206	9.3	113	22	71
Book Chapters	281	12.8	141	41	99
Edited Books	223	10.1	118	31	74

Journal Articles	391	17.8	204	56	131
Conference/ Seminar Papers	300	13.6	151	33	116
Technical Reports	119	5.4	60	17	42
News Items	103	4.6	48	13	42
Reviews	136	6.1	71	12	53
Editorials	100	4.5	47	8	45
Abstract	57	2.5	25	7	25
Other	28	1.2	12	3	13
Total	2195	100	1123	275	797

(Source: Survey Data)

Fig. 4.4 shows that Journal Articles are the most preferred medium of scholarly publication by LIS faculties of all categories i.e. Assistant Professor, Associate Professor, and Professor. Further, similar results found for Conference/Seminar Proceedings, Book Chapters (except in the case of Associate Professor), Authored Books, Co-authored Books, etc.

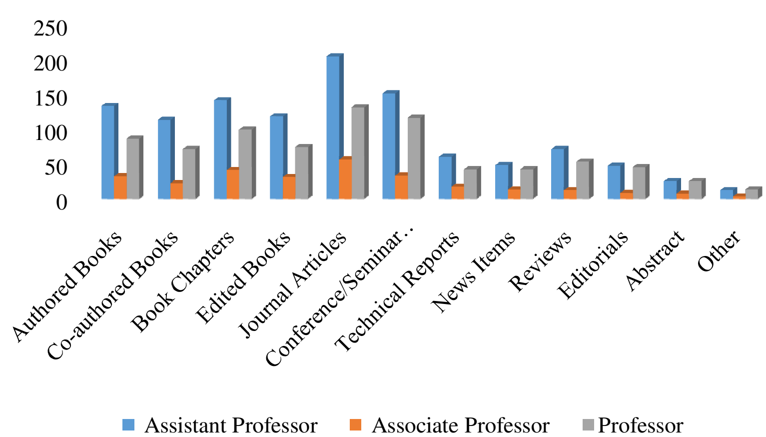


Fig. 4.4: Preferred Medium of Scholarly Communication

4.2.1.10 Academic Position * Google Scholar Profile

From the analysis of Fig. 4.5, it has been observed that 61.9% faculties (39) from total responded the question regarding availability of Google Scholar (GS) profile and out of that 82% faculty (32) have Google Scholar profiles. From among the responded category, 53.12% were Assistant Professor (17), 15.62% were Associate Professor (5) and 31.25% were Professor (10).

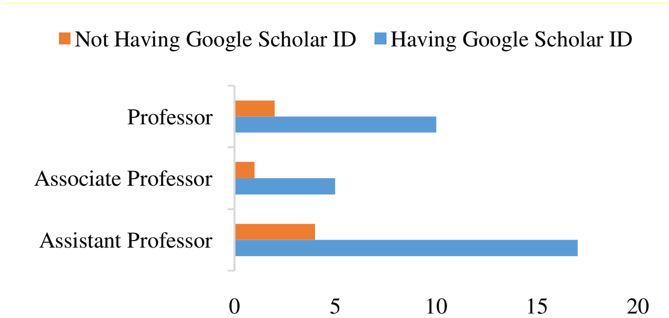


Fig. 4.5: Academic Position * Google Scholar Profile

4.2.1.11 University-wise Google Scholar Profile

Table 4.9 represents the Google Scholar (GS) profile for 61.9% of total responded faculties belongs to 16 Central Universities of India. It has been observed that LIS faculties belong to MZU have the highest GS profile (25%) followed by BHU (18.75%), AMU, AU, BBAU, and PU (9.37% each).

Table 4.9: University-wise Google Scholar Profile of Faculties

University →	AMU	AU	BBAU	BHU	CUG	CUH	CUHP	CUTN	DU	GGU	IGNOU	MU	MZU	NEHU	PU	TU
Have GS ID	3	3	3	6	1	0	1	1	1	0	0	0	8	2	3	0
No GS ID	0	0	1	0	0	0	0	0	0	0	0	1	0	3	0	2
No Response	4	0	1	0	1	1	2	4	6	1	1	0	0	0	2	1
Total	7	3	5	6	2	1	3	5	7	1	1	1	8	5	5	3

(Source: Survey Data)

4.2.1.12 Research Projects Completed

Fig. 4.6 represents faculties' performance in research projects based on their academic position in Central Universities of India. Out of a total of 63 faculties, data were found for 57.14% of faculties (36) of which 38.8% was Assistant Professor (14), 22.2% was Associate Professor (8) and 38.8% was Professor (14). In the category of Assistant Professor, 21.4% were having research projects while the majority (78.6%) of them has no research projects. In the category of Associate Professor, 50% were having research projects and the remaining 50% were not having any research projects. Similarly in the category of Professor, 71.4% have research projects while 28.6% have no research projects.

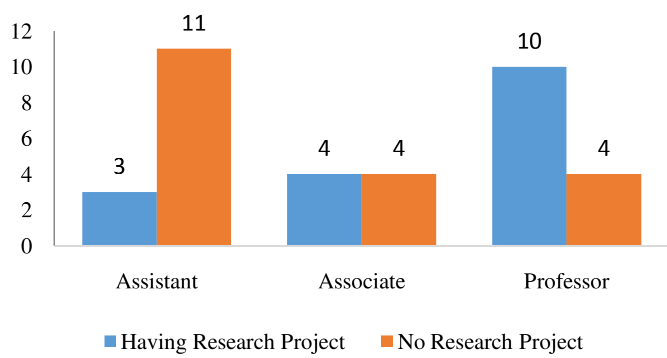


Fig. 4.6: Research Projects * Academic Position

Data on research projects were found from 13 Central Universities of India, of which 9 Central Universities affiliated LIS faculties have completed their research projects while the rest of the Central Universities faculties have no research projects as shown in Table 4.10. Based on the analysis of Table 4.10, it has been found that faculties belong to MZU were most interested to have research projects in terms of faculties (5 faculties) followed by DU (3 faculties) and AMU (2 faculties) & BHU (2 faculties). Out of all faculties having no research projects, the highest number belongs to AMU (4 faculties) followed by BBAU (3 faculties), BHU (3 faculties) &

NEHU (3 faculties). In the case of more than 1 faculty, the highest 71.4% faculties belong to MZU have research projects followed by AU (50%) and BHU (40%).

Table 4.10: University-wise Faculty in Research Projects

Name of University	AMU	AU	BBAU	BHU	CUHP	CUTN	DU	IGNOU	MU	MZU	NEHU	PU	TU
Having Research Projects	2	1	0	2	1	0	3	1	1	5	0	1	0
No Research Projects	4	1	3	3	0	1	0	0	0	2	3	0	2
Total	6	2	3	5	1	1	3	1	1	7	3	1	2
% having Research Project	33.3	50	0	40	100	0	100	100	100	71.4	0	100	0

(Source: Survey Data)

As per Fig. 4.7, there are 53 research projects from 17 faculties belongs to 9 Central Universities of India. On the observation of Fig. 4.7, it has been found that number of research projects found the highest for PU (20.75% of total research projects) followed by AMU (18.8%), DU (17%), IGNOU (11.3%) & MU (11.3%), MZU (9.43%), AU (3.7%), BHU (3.7%) and CUHP (3.7%). Further from amongst research projects, 54.7% were Major Research Projects (29) while 22.6% were Minor Research Projects (12). There were 22.6% research projects (12) have no information related to their category i.e. Major or Minor. In Major Research Projects (29), AMU has the highest number (8, 27.5%) followed by IGNOU (6, 20.6%), DU (4, 13.7%), MZU (4, 13.7%), PU (3, 10.3%), MU (2, 6.9%), AU (1, 3.4%) and BHU (1, 3.4%). In Minor Research Projects (12), MU has the highest number (3, 25%) followed by AMU (2, 16.6%), DU (2, 16.6%) and PU (2, 16.6%). Research projects with no category information, it has been found that PU has the highest (6, 50%)

number of research projects with no information related to category of financial details followed by DU (3, 25%), CUHP (2, 16.67%) and MU (1, 8.33%).

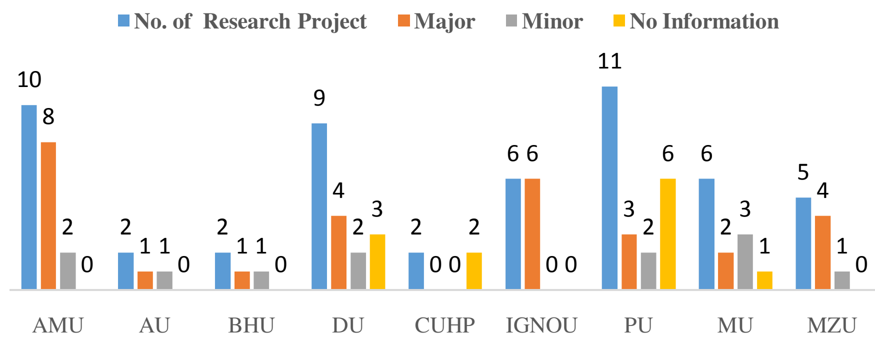


Fig. 4.7: University-wise Research Projects

Out of a total of 53 completed research projects, the study found a total of 16 funding agencies for 41 research projects while 12 research projects related details have not been provided by the faculties. Out of total funding agencies, the highest funding received from UGC (39%) followed by DRDO (12.19%), ICSSR (9.75%), MHRD (7.3%), DST (4.8%), ICCR (4.8%), and RRRLF (2.4%) as shown in Fig. 4.8. Further, for these 41 research projects, the study observed 80.4% were individual (33) while 19.5% were in collaboration (8) with LIS faculties.

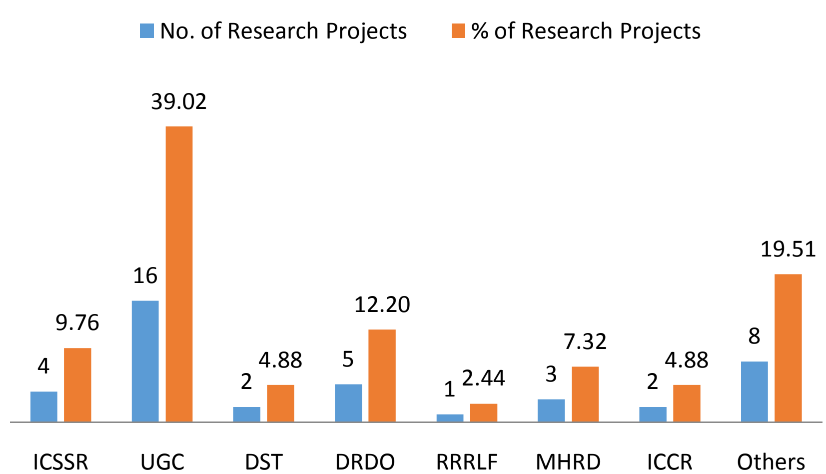


Fig. 4.8: Research Projects by Funding Agency

4.2.1.13 Research Supervision

Fig. 4.9 represents overall M. Phil. & Ph. D. awarded under the supervision of LIS faculties from Central Universities of India. It has been found that a total of 444 M. Phil. & Ph. D. research has been awarded, of which 232 (52.2%) are M. Phil. and 212 (47.8%) are Ph.D.

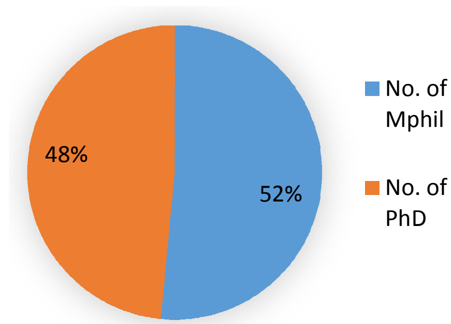


Fig. 4.9: M. Phil. & Ph. D. Awarded

The number of awarded dissertations was distributed on the basis of the academic position of the faculties as shown in Table 4.11. It is found that out of total 232 M. Phil., 41 (17.6%) were awarded under Assistant Professor, 82 (35.3%) were awarded under Associate Professor and 109 (46.98%) were awarded under Professors. Similarly, out of 212 Ph.D., 21 (9.9%) were awarded under Assistant Professor, 93 (43.8%) were awarded under Associate Professor and 98 (46.2%) were awarded under Professor.

Table 4.11: Number of Research Awarded

M. Phil.			Ph. D.		
Assistant Professor	Associate Professor	Professor	Assistant Professor	Associate Professor	Professor
41	82	109	21	93	98
17.6%	35.3%	46.98%	9.9%	43.8%	46.2%

(Source: Survey Data)

4.2.1.14 Faculty-wise Research Supervision

Table 4.12 represents the total number of M. Phil. & Ph. D. awarded under the supervision of LIS faculties of Central Universities of India. It has been found that out of total 63 LIS faculties, 23 faculties (36.5%) have been supervised M. Phil. degree while 31 faculties (49.2%) have been supervised Ph.D. degrees. Among the faculties, the highest number of M. Phil. supervised by Shailendra Kumar (42, 18.1%) followed by Mahender Pratap Singh (39, 16.8%), Margam Madhusudhan (21, 9%), P. K. Walia (18, 7.75%), R. Sevukan (14, 6%), R. N. Mishra (13, 5.6%), Manoj Kumar Sinha (11, 4.7%) and Sharad Kumar Sonker (11, 4.7%). Less than 10 M. Phil. supervised by 15 faculties who shared 27.1% of total M. Phil. while no M. Phil. supervised by 40 LIS faculties which may have various reasons. Among the faculties, the highest number of Ph.D. supervised by R. K. Mahapatra (24, 11.3%) followed by H. N. Prasad (18, 8.5%), Shailendra Kumar (18, 8.5%), Brajesh Tiwari (13, 6.1%), P. M. Naushad Ali (10, 4.7%), Mahender Pratap Singh (9, 4.2%), Pravakar Rath (9, 4.2%), Inder Vir Malhan (8, 3.8%), S. Haridasan (8, 3.8%), Margam Madhusudhan (7, 3.3%), P. K. Walia (7, 3.3%), S. N. Singh (7, 3.3%), and Ch. Ibohal Singh (7, 3.3%). The rest of the faculty have supervised less than 7 Ph.D. and shared 31.6% of the total Ph.D.

Table 4.12: Faculty-wise M. Phil. / Ph. D. Awarded

Name of Faculty	M. Phil. Awarded	Ph. D. Awarded	Affiliation
Aditya Tripathi	0	5	BHU
Akhandanand Shukla	7	1	MZU
Bhaskar Mukherjee	0	2	BHU
Bikika Laloo	0	3	NEHU
Brajesh Tiwari	0	13	GGU
C. K. Ramaiah	1	2	PU
Ch. Ibohal Singh	3	7	MU

H. N. Prasad	0	18	BHU
Inder Vir Malhan	5	8	CUHP
K. G. Sudhier	8	6	CUTN
Lalngaizuali	3	0	MZU
Mahender Pratap Singh	39	9	BBAU
Manoj Kumar Sinha	11	6	AU
Manoj Kumar Verma	6	3	MZU
Margam Madhusudhan	21	7	DU
Masoom Raza	3	6	AMU
Meera Yadav	0	2	DU
Moses M. Naga	0	6	NEHU
Naushad Ali P. M.	2	10	AMU
Nishat Fatima	0	5	AMU
Paokholun Hangsing	0	6	NEHU
Paramjeet Kaur Walia	18	7	DU
Pravakar Rath	5	9	MZU
R. N. Mishra	13	5	MZU
R. K. Mahapatra	1	24	TU
R. Sevukan	14	2	PU
R. K. Ngurtinkhuma	9	1	MZU
Rajani Mishra	0	2	BHU
Shailendra Kumar	42	18	DU
Sharad Kumar Sonker	11	4	BBAU
Shyam Narayan Singh	6	7	MZU
Sudharma Haridasan	1	8	AMU
Vinit Kumar	3	0	BBAU
Total	232	212	---

(Source: Survey Data)

4.2.1.15 Faculty-wise Publications

The data has been collected from all the responded faculties regarding their publications and found a total of 2900 publications from 59 LIS faculties up to the year 2018 as shown in Table 4.13. There are 10 LIS faculties who contributed more than 100 publications and falls under the category of top 10 LIS authors. The highest publication contribution found for Manoj Kumar Sinha (168, 5.79%) followed by

Ch. Ibohal Singh (138, 4.75%), Manoj Kumar Verma (132, 4.55%), Sharad Kumar Sonker (128, 4.41%), Shilpi Verma (120, 4.13%), C. K. Ramaiah (117, 4.03%), Inder Vir Malhan (115, 3.96%), R. K. Bhatt (107, 3.68%), Mahender Pratap Singh (102, 3.51%) and K. P. Singh (101, 3.48%). Further >100 publications but <50 publications found for 12 faculties while >50 publications found for 37 faculties, of which 7 faculties have >10 publications. Interestingly, the top 13 faculties are responsible for more than 50% publications while the rest of the faculties (46) have contributed 48% of total publications.

Table 4.13: Faculty-wise Publications

Name of Faculty	Affiliation	No. of Publications	%
Aditya Tripathi	BHU	58	2.0
Akhandanand Shukla	MZU	66	2.27
Amit Kumar	MZU	40	1.37
Anila Sulochana	CUTN	5	0.17
Augustine Zimik	TU	3	0.10
Bhakti Gala	CUG	5	0.17
Bhaskar Mukherjee	BHU	54	1.86
Bikika Laloo	NEHU	31	1.06
Brajesh Tiwari	GGU	27	0.93
C. K. Ramaiah	PU	117	4.03
Ch. Ibohal Singh	MU	138	4.75
Dimple Patel	CUHP	29	1
H. N. Prasad	BHU	41	1.41
Inder Vir Malhan	CUHP	115	3.96
Jiarlimon Khongtim	NEHU	12	0.41
K. G. Sudhier	CUTN	97	3.34
K. P. Singh	DU	101	3.48
Kunwar Singh	BHU	24	0.82
Lalngaizuali	MZU	13	0.44
M. Leeladharan	PU	11	0.37
Mahender Pratap Singh	BBAU	102	3.51
Mangkhollen Singson	PU	23	0.79
Manish Kumar	DU	24	0.82
Manoj Kumar Sinha	AU	168	5.79

Manoj Kumar Verma	MZU	132	4.55
Margam Madhusudhan	DU	83	2.86
Masoom Raza	AMU	72	2.48
Meera Yadav	DU	32	1.10
Mehtab Alam Ansari	AMU	42	1.44
Mithu Anjali Gayan	TU	14	0.48
Mohammad Nazim	AMU	48	1.65
Mukut Sarmah	AU	57	1.96
Muzamil Mushtaq	AMU	27	0.93
Nabin Chandra Dey	AU	4	0.13
Naushad Ali P. M.	AMU	54	1.86
Nimmala Karunakar	CUHP	1	0.03
Nishat Fatima	AMU	44	1.51
Paokholun Hangsing	NEHU	19	0.65
Paramjeet Kaur Walia	DU	64	2.20
Pawan Kumar Saini	CUH	11	0.37
Pravakar Rath	MZU	20	0.68
R. K. Mahapatra	TU	92	3.17
R. K. Ngurtinkhuma	MZU	27	0.93
R. Sevukan	PU	38	1.31
R. K. Bhatt	DU	107	3.68
R. N. Mishra	MZU	66	2.27
Rajani Mishra	BHU	24	0.82
Rashmi T Kumbar	CUG	23	0.79
Rekha R. V.	PU	26	0.89
S. Ravi	CUTN	5	0.17
Shailendra Kumar	DU	76	2.62
Sharad Kumar Sonker	BBAU	128	4.41
Shilpi Verma	BBAU	120	4.13
Shriram Pandey	BHU	24	0.82
Shyam Narayan Singh	MZU	43	1.48
Sudharma Haridasan	AMU	32	1.10
Taddi Murali	CUTN	17	0.58
V. K. Dhanyasree	CUTN	5	0.17
Vinit Kumar	BBAU	19	0.65
Total		2900	100

(Source: Survey Data)

4.2.1.16 University-wise Publications

Table 4.14 represents university-wise publications along with responded LIS faculty from each Central University. It has been observed that 59 faculties from 15 Central Universities have responded and published 2900 publications till December 2018. Among the top five LIS departments, the highest publications seen for DU (487, 16.79%) followed by MZU (406, 14%), BBAU (369, 12.72%), AMU (319, 115) and AU (229, 7.89%). Less than 100 publications found for NEHU (62, 2.13%), CUG (28, 0.96%), GGU (27, 0.93%) and CUH (11, 0.37%).

Table 4.14: University-wise Publications

University Name	Faculty Responded	Total Publications	% of Publications	Publication Rank
AMU	7	319	11	4
AU	3	229	7.89	5
BBAU	4	369	12.72	3
BHU	6	225	7.75	6
CUG	2	28	0.96	13
CUH	1	11	0.37	15
CUHP	3	146	5.03	8
CUTN	5	129	4.44	10
DU	7	487	16.79	1
GGU	1	27	0.93	14
MU	1	138	4.75	9
MZU	8	406	14	2
NEHU	3	62	2.13	12
PU	5	215	7.41	7
TU	3	109	3.75	11
Total	59	2900	100	---

(Source: Survey Data)

4.2.1.17 Year-wise Publications

Table 4.15 represents year-wise publications by the LIS faculties of Central Universities in India from 1978 – 2018. Out of the total of 2900 publications, the publication year found missing for 20 publications. From Fig. 4.10, it has been observed that publication's growth per year increased from the year 2000. From the analysis of Table 4.15, it has been found that the highest publications (1166, 40.2% of total publications) have been observed during last 5 years i.e. 2014 – 2018 followed by the year 2009 – 2013 (940, 32.4%), and year 2004 – 2008 (444, 15.3%). In the case of the individual year, the highest publications observed in the year 2015 (282, 9.72%) followed by the year 2017 (257, 8.86%), the year 2012 (252, 8.68%), the year 2014 (224, 7.72%) and so on. From the study, it has been an inference that the number of publications is increasing continuously since 1978.

Table 4.15: Year-wise Publications

Year	No. of Publications	% of Publications	CAGR (%)
1978	8	0.27	---
1979	8	0.27	0
1980	7	0.24	-12.5
1981	5	0.17	-28.57
1982	7	0.24	40
1983	6	0.20	-14.29
1984	2	0.06	-66.67
1985	4	0.13	100
1986	3	0.10	-25
1987	4	0.13	33.33
1988	9	0.31	125
1989	7	0.24	-22.22
1990	6	0.20	-14.29
1991	1	0.03	-83.33
1992	11	0.37	1000
1993	7	0.24	-36.36
1994	7	0.24	0
1995	11	0.37	57.14
1996	14	0.48	27.27
1997	13	0.44	-7.14
1998	21	0.72	61.54

1999	16	0.55	-23.81
2000	21	0.72	31.25
2001	47	1.62	123.81
2002	37	1.27	-21.28
2003	48	1.65	29.73
2004	74	2.55	54.17
2005	63	2.17	-14.86
2006	81	2.79	28.57
2007	83	2.86	2.47
2008	143	4.93	72.29
2009	114	3.93	-20.28
2010	184	6.34	61.4
2011	212	7.31	15.22
2012	252	8.68	18.87
2013	178	6.13	-29.37
2014	224	7.72	25.84
2015	282	9.72	25.89
2016	212	7.31	-24.82
2017	257	8.86	21.23
2018	191	6.58	-25.68

(Source: Survey Data)

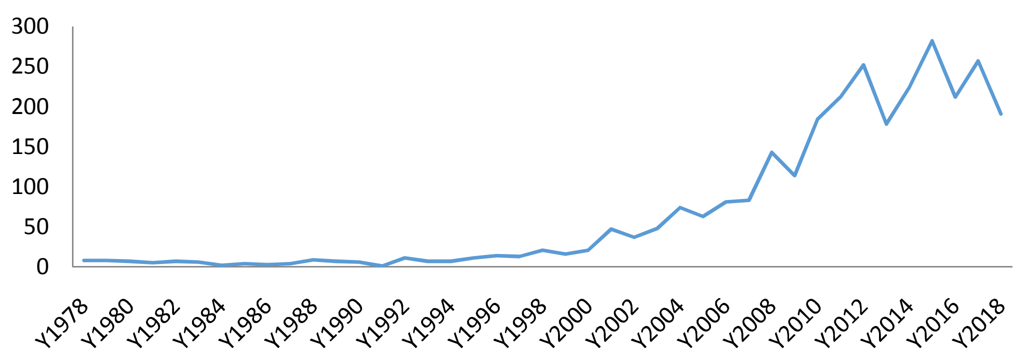


Fig. 4.10: Year-wise Publications

4.2.1.18 Forms of Publication

Table 4.16 represents different forms of publication used by the LIS faculties of Central Universities of India. It has been observed that *Journal Articles* are the most prevalent form of publication by the LIS faculties that shares 41.38% (1200 publications) of total publications followed by *Conference Proceedings* (1068, 36.83%), *Book Chapters* (467, 16.10%) and *Books* (165, 5.68%). Out of the total *Books*, 81 books (49%) are *Authored Books* while 75 books (45.5%) are *Edited Books* and no information found for 9 *Books* (5.5%).

Table 4.16: Forms of Publication

Forms of Publication	No. of Publications	% of Publications
Books	165	05.69
Book Chapters	467	16.10
Conference Proceedings	1068	36.83
Journal Papers	1200	41.38
Total	2900	100

(Source: Survey Data)

4.2.1.19 University-wise Forms of Publication

University-wise forms of publication are shown in Table 4.17 that represents the trends of different forms of publication. In the case of *Books*, the highest number of books have been published by DU (34, 20.6% of total book publication) followed by BBAU (24, 14.5%) and BHU (20, 12.1%). In the case of *Book Chapters*, the highest number of book chapters have been published by MZU (68, 14.5% of total book chapters) followed by AMU (65, 13.9%) and DU (64, 13.7%). In the case of *Conference Proceedings*, the highest number of conference papers have been published by BBAU (161, 15.07% of total conference proceedings) followed by MZU (150, 14.04%) and DU (137, 12.82%). Similarly, in the case of *Journal Articles*, the highest number of journal papers have been published by DU (252, 21% of total journal articles) followed by MZU (171, 14.25%) and AMU (136, 11.33%).

Table 4.17: University-wise Forms of Publication

University Name ↓	Forms of Publication				Total
	Books	Book Chapters	Conference Proceedings	Journal Papers	
AMU	14	65	104	136	319
AU	3	58	97	71	229
BBAU	24	56	161	128	369
BHU	20	19	62	124	225
CUG	1	5	20	2	28
CUHP	0	0	9	2	11
CUHP	10	44	39	53	146
CUTN	2	15	57	55	129
DU	34	64	137	252	487
CUG	1	5	19	2	27
MU	19	17	62	40	138
MZU	17	68	150	171	406
NEHU	4	2	38	18	62
PU	12	24	70	109	215
TU	4	25	43	37	109
Total	165	467	1068	1200	2900

(Source: Survey Data)

4.2.1.20 Year-wise Forms of Publication

Year-wise forms of publication are found for 2880 publications while missing the year of publications for 20 books which have been shown in Table 4.18. The *Book* is found to be published the highest in the year 2017 (20, 12.7% of total book publications) followed by the year 2015 (17, 10.8%) and year 2010 (16, 10.1%). The highest number of books (64, 40.7%) has been published during the year 2014 – 2018 followed by 56 books (35.6%) during the year 2009 – 2013. In the case of *Book Chapters*, the highest number of publications found in the year 2012 (52, 11.2% of total book chapter publications) followed by the year 2017 (44, 9.4%) and year 2015 (43, 9.2%). The highest number of book chapters (178, 38.2%) has been published during the year 2014 – 2018 followed by the year 2009 – 2013 with 148 book chapters (31.8%).

Table 4.18: Year-wise Forms of Publication

Year	Books	Book Chapters	Conference Proceedings	Journal Articles	Total Publications
1978	0	1	1	6	8
1979	0	0	1	7	8
1980	1	1	2	3	7
1981	0	0	0	5	5
1982	1	0	2	4	7
1983	0	3	1	2	6
1984	0	0	0	2	2
1985	0	0	1	3	4
1986	2	0	0	1	3
1987	0	0	1	3	4
1988	0	0	2	7	9
1989	0	0	0	7	7
1990	0	1	0	5	6
1991	0	1	0	0	1
1992	1	0	1	9	11
1993	0	1	2	4	7
1994	0	2	0	5	7
1995	1	5	2	3	11
1996	2	6	4	2	14
1997	1	4	2	6	13
1998	0	8	3	10	21
1999	0	2	10	4	16
2000	0	4	9	8	21
2001	1	10	19	17	47
2002	4	10	12	11	37
2003	0	6	29	13	48
2004	3	17	38	16	74
2005	4	8	30	21	63
2006	5	9	47	20	81
2007	3	7	51	22	83
2008	8	33	53	49	143
2009	10	11	52	41	114
2010	16	18	82	68	184

2011	7	38	81	86	212
2012	13	52	100	87	252
2013	10	29	59	80	178
2014	6	25	88	105	224
2015	17	43	93	129	282
2016	14	38	58	102	212
2017	20	44	77	116	257
2018	7	28	45	111	191
Total	157	465	1058	1200	2280

(Source: Survey Data)

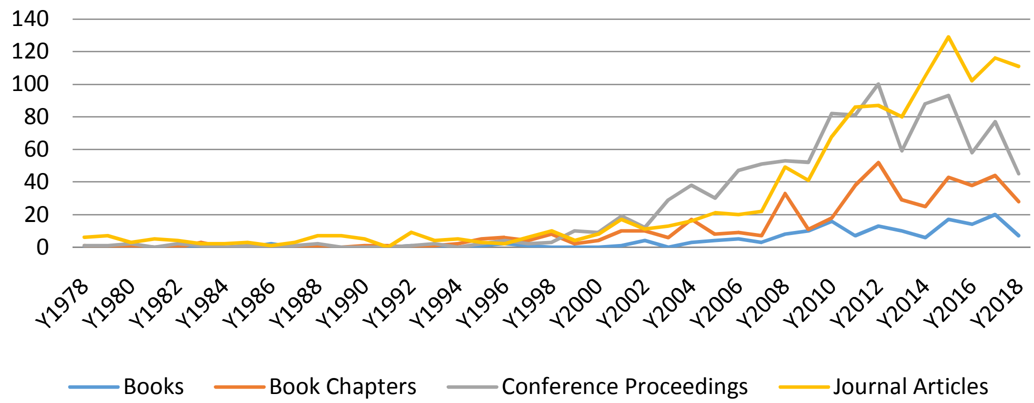


Fig. 4.11: Year-wise Forms of Publication

Conference Proceeding has been found highest in the year 2012 (100, 9.4% of total conference proceeding publications) followed by the year 2015 (93, 8.8%) and year 2014 (88, 8.3%). The highest number of conference proceeding publications (374, 35.3%) was observed during the year 2009 – 2013 followed by the year 2014 – 2018 with 361 conference proceeding publications (34.1%). In the case of *Journal Articles*, the highest publications found in the year 2015 (129, 10.7% of total journal publications) followed by the year 2017 (116, 9.6%) and year 2018 (111, 9.2%). The highest number of journal articles (563, 46.9%) has been published during the year 2014 – 2018 followed by the year 2009 – 2013 with 362 journal articles (30.2%). From Fig. 4.11, it has been an inference that *Journal Articles* prevails over other forms of publications while conference papers have become the second choice of publication.

4.2.1.21 Authorship Pattern of LIS Faculty

Authorship pattern of the 2569 publications out of total 2900 publications are shown in Table 4.19, as the number of authors was not found for 331 publications. The study found a total of 4794 authors with an average number of authors per article as 1.86. Among 2569 publications, the highest publications found for two authors (1327, 51.65% of total publications) followed by a single author (825, 32.11%), three authors (366, 14.24%) and four authors (41, 1.59%). On the observation, it has been found that only 10 publications with having more than four authors. Further, the authorship pattern reveals that single-authored (825) publications are less as compared to multiple-authored (1744) publications. Thus, the study found that multi-authored research is predominating over solo-authored research in the field of LIS by faculties of Central Universities of India.

Table 4.19: Authorship Pattern of LIS Faculty

SN	No. of Authors	No. of Publications	No. of Authors	% of Publications	% of Authors	Cumulative % of Publications
1	Single	825	825	32.11	17.2	32.11
2	Two	1327	2654	51.65	55.36	83.76
3	Three	366	1098	14.24	22.9	98.01
4	Four	41	164	1.59	3.42	99.61
5	Five	8	40	0.31	0.83	99.92
6	Six	1	6	0.03	0.12	99.96
7	Seven	1	7	0.03	0.14	99.99

(Source: Survey Data)

4.2.1.22 Degree of Author's Collaboration

Degree of Collaboration (C) has been proposed to calculate the degree of research collaboration by the formula proposed by Subramanyam (Subramanyam, 1983). As per the formula,

The Degree of Collaboration (C) = Nm / (Nm + Ns)

Where, C = Degree of Collaboration

Nm = Number of multiple authors

Ns = Number of single authors

Here, Nm = 1744 & Ns = 825

Then C = 1744 / (1744 + 825) = 0.67

So, the Degree of Collaboration is found as 0.67 among the LIS faculties of Central Universities of India.

4.2.1.23 Lotka's Law

Lotka's Law describes the scientific productivity of an author i.e. the number of authors making n contribution is about $1/n^2$ of those making one and the proportion of all contributors that makes a single contribution is about 60% (Lotka, 1926). Table 4.20 shows the distribution of the number of publications published by each faculty. A total of 59 faculties have contributed 2900 publications in the field of Library and Information Science. The study reveals that 16.94% faculties have contributed more than 100 publications, 20.33% faculties have contributed between 50-100 publications, 16.94% faculties have contributed between 30-50 publications and 45.76% faculties have contributed less than 30 publications.

Table 4.20: Distribution of Faculty Productivity

SN	No. of Contributions	No. of Author(s)	% of Author	Cumulative %
1	1	1	1.69	1.69
2	3	1	1.69	3.38
3	4	1	1.69	5.08
4	5	4	6.77	11.86
5	11	2	3.38	15.25
6	12	1	1.69	16.94
7	13	1	1.69	18.64
8	14	1	1.69	20.33
9	17	1	1.69	22.03
10	19	2	3.38	25.42
11	20	1	1.69	27.11
12	23	2	3.38	30.50
13	24	4	6.77	37.28
14	26	1	1.69	38.98
15	27	3	5.08	44.06
16	29	1	1.69	45.76
17	31	1	1.69	47.45
18	32	2	3.38	50.84
19	38	1	1.69	52.54
20	40	1	1.69	54.23
21	41	1	1.69	55.93
22	42	1	1.69	57.62
23	43	1	1.69	59.32
24	44	1	1.69	61.01
25	48	1	1.69	62.71
26	54	2	3.38	66.10
27	57	1	1.69	67.79
28	58	1	1.69	69.49
29	64	1	1.69	71.18
30	66	2	3.38	74.57
31	72	1	1.69	76.27
32	76	1	1.69	77.96
33	83	1	1.69	79.66
34	92	1	1.69	81.35
35	97	1	1.69	83.05

36	101	1	1.69	84.74
37	102	1	1.69	86.44
38	107	1	1.69	88.13
39	115	1	1.69	89.83
40	117	1	1.69	91.52
41	120	1	1.69	93.22
42	128	1	1.69	94.91
43	132	1	1.69	96.61
44	138	1	1.69	98.30
45	168	1	1.69	100

(Source: Survey Data)

Lotka's Inverse Power Law states the function describing the pattern of productivity of faculty in the field of LIS has been applied which is mathematically represented as

$$y = C \times x^{-n} \qquad \text{eq. (1)}$$

Where, x is the number of publication of interest (1, 2, 3……..etc.)

n is an exponent that is constant for a given set of data

y is the expected percentage of authors with frequency x publications

C is constant

Pao (1985) forwarded the formula for calculating constant (C) and n value as,

$$C = 1 / \Sigma\, 1/x^{n} \qquad \text{eq. (2)}$$

The exponent n is often fixed at 2, in such case, the Law is known as Inverse Square Law of Scientific Productivity. However, given that the exponent predicts the relative number of authors at each productivity level, it would seem useful to calculate it. The Least Square Method is used that can be expressed as follows:

$$n = \frac{N\, \Sigma XY - X\, \Sigma Y}{N\, \Sigma X^{2} - (\Sigma X)^{2}} \qquad \text{eq. (3)}$$

Where N is the number of data pairs considered

X is the logarithm of x (number of articles)

Y is the logarithm of y (number of authors)

$$\text{CV (Critical Value)} = \frac{1.63}{\{\Sigma YX + (\Sigma YX/10)^{1/2}\}^{1/2}} \qquad \text{eq. (4)}$$

It is appropriate to examine and analyze the implications of Lotka's Law in relation to LIS faculty publication productivity. To validate Lotka's Law, a calculation is done using the equation (2) & equation (3) that gives *n* value as 0.893 and constant (C) value as 0.0305. Kolmogorov Smirnov (K-S test) is used to convert the observed and expected number of authors into fractional values, and calculate the difference between cumulative fractional values of the observed and expected number of authors as represented in Table 4.21 that gives D_{max} value as 0.069. For the calculation of Critical Value (CV) which will help to compare the maximum difference (D_{max}), equation (4) is used that results in CV value as 0.102 at a centrality level of α=0.01. Here the real value of D_{max} (0.069) is less than the critical value of D in K-S test statistics (0.102), therefore these data fit modified Lotka's Law with the value $n = 0.893$.

Table 4.21: Productivity of LIS Faculty based on Lotka's Law

SN	X	Y	$Log_{10}X$	$Log_{10}Y$	$(Log_{10}X)^2$	$Log_{10}X$* $Log_{10}Y$	Y/ΣY	Σ (Y/ ΣY)	$(1/X^{n})$	$C*(1/X^n)$	Σ $C*(1/X^n)$	D_{max}
1	1	1	0	0	0	0	0.016949	0.016949	1	0.030556	0.030556	-0.01361
2	3	1	0.477121	0	0.227645	0	0.016949	0.033898	0.906464	0.027698	0.058254	-0.02436
3	4	1	0.60206	0	0.362476	0	0.016949	0.050847	0.883451	0.026995	0.085248	-0.0344
4	5	4	0.69897	0.60206	0.488559	0.420822	0.067797	0.118644	0.866004	0.026461	0.11171	0.006934
5	11	2	1.041393	0.30103	1.084499	0.31349	0.033898	0.152542	0.80707	0.024661	0.136371	0.016171
6	12	1	1.079181	0	1.164632	0	0.016949	0.169492	0.800817	0.02447	0.16084	0.008652
7	13	1	1.113943	0	1.24087	0	0.016949	0.186441	0.795107	0.024295	0.185135	0.001306
8	14	1	1.146128	0	1.313609	0	0.016949	0.20339	0.789858	0.024135	0.20927	-0.00588
9	17	1	1.230449	0	1.514005	0	0.016949	0.220339	0.776268	0.02372	0.23299	-0.01265
10	19	2	1.278754	0.30103	1.635211	0.384943	0.033898	0.254237	0.768588	0.023485	0.256474	-0.00224
11	20	1	1.30103	0	1.692679	0	0.016949	0.271186	0.765072	0.023377	0.279852	-0.00867
12	23	2	1.361728	0.30103	1.854303	0.409921	0.033898	0.305085	0.755573	0.023087	0.302939	0.002146
13	24	4	1.380211	0.60206	1.904983	0.83097	0.067797	0.372881	0.752704	0.023	0.325939	0.046942
14	26	1	1.414973	0	2.00215	0	0.016949	0.389831	0.747338	0.022836	0.348774	0.041057
15	27	3	1.431364	0.477121	2.048802	0.682934	0.050847	0.440678	0.744821	0.022759	0.371533	0.069145
16	29	1	1.462398	0	2.138608	0	0.016949	0.457627	0.740079	0.022614	0.394146	0.063481
17	31	1	1.491362	0	2.22416	0	0.016949	0.474576	0.73568	0.022479	0.416626	0.05795
18	32	2	1.50515	0.30103	2.265476	0.453095	0.033898	0.508475	0.733595	0.022416	0.439041	0.069434
19	38	1	1.579784	0	2.495716	0	0.016949	0.525424	0.722412	0.022074	0.461115	0.064309
20	40	1	1.60206	0	2.566596	0	0.016949	0.542373	0.719107	0.021973	0.483088	0.059285
21	41	1	1.612784	0	2.601072	0	0.016949	0.559322	0.717522	0.021924	0.505013	0.054309
22	42	1	1.623249	0	2.634938	0	0.016949	0.576271	0.715978	0.021877	0.52689	0.049381
23	43	1	1.633468	0	2.668219	0	0.016949	0.59322	0.714473	0.021831	0.548721	0.044499
24	44	1	1.643453	0	2.700937	0	0.016949	0.610169	0.713007	0.021787	0.570508	0.039661
25	48	1	1.681241	0	2.826572	0	0.016949	0.627119	0.707483	0.021618	0.592126	0.034993

SN	X	Y	$Log_{10}X$	$Log_{10}Y$	$(Log_{10}X)^2$	$Log_{10}X^*$ $Log_{10}Y$	$Y/\Sigma Y$	Σ (Y/ ΣY)	$(1/X^{n)}$	$C^*(1/X^n)$	Σ $C^*(1/X^n)$	D_{max}
26	54	2	1.732394	0.30103	3.001188	0.521502	0.033898	0.661017	0.700073	0.021391	0.613517	0.0475
27	57	1	1.755875	0	3.083097	0	0.016949	0.677966	0.696698	0.021288	0.634805	0.043161
28	58	1	1.763428	0	3.109678	0	0.016949	0.694915	0.695615	0.021255	0.65606	0.038855
29	64	1	1.80618	0	3.262286	0	0.016949	0.711864	0.689521	0.021069	0.677129	0.034735
30	66	2	1.819544	0.30103	3.31074	0.547737	0.033898	0.745763	0.687627	0.021011	0.69814	0.047623
31	72	1	1.857332	0	3.449684	0	0.016949	0.762712	0.6823	0.020848	0.718988	0.043724
32	76	1	1.880814	0	3.53746	0	0.016949	0.779661	0.67901	0.020748	0.739736	0.039925
33	83	1	1.919078	0	3.682861	0	0.016949	0.79661	0.673683	0.020585	0.760321	0.036289
34	92	1	1.963788	0	3.856463	0	0.016949	0.813559	0.667512	0.020396	0.780717	0.032842
35	97	1	1.986772	0	3.947262	0	0.016949	0.830508	0.664362	0.0203	0.801018	0.02949
36	101	1	2.004321	0	4.017304	0	0.016949	0.847458	0.661966	0.020227	0.821244	0.026214
37	102	1	2.0086	0	4.034475	0	0.016949	0.864407	0.661384	0.020209	0.841454	0.022953
38	107	1	2.029384	0	4.118399	0	0.016949	0.881356	0.65856	0.020123	0.861576	0.01978
39	115	1	2.060698	0	4.246476	0	0.016949	0.898305	0.65433	0.019994	0.88157	0.016735
40	117	1	2.068186	0	4.277393	0	0.016949	0.915254	0.653322	0.019963	0.901533	0.013721
41	120	1	2.079181	0	4.322995	0	0.016949	0.932203	0.651845	0.019918	0.921451	0.010752
42	128	1	2.10721	0	4.440334	0	0.016949	0.949153	0.648095	0.019803	0.941254	0.007899
43	132	1	2.120574	0	4.496834	0	0.016949	0.966102	0.646315	0.019749	0.961002	0.0051
44	138	1	2.139879	0	4.579083	0	0.016949	0.983051	0.643752	0.01967	0.980673	0.002378
45	168	1	2.225309	0	4.952001	0	0.016949	1	0.632531	0.019328	1	-2.3E-07
Total	2554	59	70.7208	3.487421	121.3827	4.565416	1	25.37288	32.72697	0.969444	24.13654	

(Source: Survey Data)

Where

Y = Relative frequency of faculty with X research publication

$Y/\Sigma Y$ = Fraction of observed number of faculty

$\Sigma (Y/ \Sigma Y)$ = Cumulative of observed values of faculty

$C^*(1/X^n)$ = Fraction of expected number of faculty

$\Sigma C^*(1/X^n)$ = Cumulative of expected values of faculty

$D_{max =}$ Difference of the observed and expected cumulative value of faculty

4.2.1.24 Bradford's Law

Bradford's Law deals in the scattering of literature to identify the core journals of any subject field. According to Bradford's Law:

> "*if scientific journals of any subject field are arranged in decreasing order of productivity, they may be divided into a nucleus of periodicals particularly devoted to the subject i.e. core zone and other succeeding zones containing the same number of article as the nucleus and the number of periodicals in the nucleus and succeeding zone will be as 1:n:n^2, where n is a multiplier*".

In this study, a total of 255 unique journals were found that published a total of 1200 publications. The rank of journal productivity in descending order is shown in Table 4.22.

Table 4.22: Journal Productivity in Descending Order

Rank	No. of Journals	No. of Papers	Cumulative No. of Papers
1	1	82	82
2	1	62	144

3	1	52	196
4	1	44	240
5	1	37	277
6	1	34	311
7	2	23	357
8	1	22	379
9	2	20	419
10	2	18	455
11	2	17	489
12	4	16	553
13	2	15	583
14	3	14	625
15	2	13	651
16	2	12	675
17	3	10	705
18	5	9	750
19	2	8	766
20	6	7	808
21	3	6	826
22	14	5	896
23	13	4	948
24	17	3	999
25	37	2	1073
26	127	1	1200

(Source: Survey Data)

To test the applicability of Bradford's Law for the journal productivity, the number of papers is roughly divided into three equal parts i.e. in zones. Each zone accounts for about 400 papers as represented in Table 4.22 that depicts the publications in three Bradford's zones. It has been found that the Bradford multiplier in the second zone is 3.27 and in the third zone is 5.77. The difference in the value of the multiplier is high i.e. almost 1.76 times; hence we can assume that the dataset does not fit into Bradford's

Law. To test the given dataset in Leimkuhler's formula (Leimkuhler, 1967) who developed a model based on Bradford's verbal formulation as:

$$R(r) = a \log(1+br) \qquad \text{(Eq. 1)}$$

Egghe (1986) considered, $R(r) = y_0$ and $1+br = K$

Using the above value in (Eq. 1) would be:

$$y_0 = a \log K$$

Thus, $a = y_0 / \log K$ (Eq. 2)

And $b = (K-1) / r_0$ (Eq. 3)

Here, r_0 is the number of sources in the first Bradford's group

y_0 is the number of items in every Bradford group

K is the Bradford multiplier

R (r) is the cumulative number of the item produced by the sources of rank 1, 2, 3... r

a and b are the constant appearing in the law of Leimkuhler.

To forming Bradford groups, it is shown that the number of groups (p) is a parameter that can be chosen freely. Egghe (1986) has forwarded a formula to calculate the Bradford multiplier as:

$$K = (e^y y_m)^{1/p} \qquad \text{(Eq. 4)}$$

Where e^y is the Euler number and its value is (1.781)

y_m is the number of publications in most productive journal (i.e. first rank journal)

Now by putting the value of e^y in (Eq. 4), we get,

$K = (1.781\ y_m)^{1/p}$ (Eq. 5)

By considering the total number of journals in the Bradford group as T, and $T = r_0K^{i-1}$

Where i = (1, 2, 3, ..., p)

So, $T = r_0K^0 + r_0K^1 + r_0K^2 + r_0K^3 + \ldots\ldots\ldots + r_0K^{p-1}$ (P^{th} term of sequence = p-1)

And $r_0 = T / [(1- K^p) / (1- K)]$ (the sum of numbers in geometric progression i.e. $K^0 + K^1 + K^2 + \ldots. + K^{p-1}$)

$r_0 = T (K-1) / (K^p – 1)$

Table 4.23: Distribution of Data in Bradford Zones

SN	No. of Journals	No. of Papers	%	Bradford Multiplier
1	11	419	34.91	1
2	36	407	33.91	3.27
3	208	374	31.16	5.77
Total	255	1200	100	

(Source: Survey Data)

A & T can be obtained from a given dataset, and so r_0 and y_0 can be calculated. P is calculated by the formula.

Maximum number of publication $y_m = 82$

Total numbers of journals T = 255

p is the number of zones i.e. = 3

$y_0 = A / p$ where A is the total number of publications

= 1200 / 3

= 400

$K = (1.781 \times 82)^{1/3} = (146.042)^{1/3}$

By taking log value of both sides

Log K = (1/3) log (146.042)

Log K = (1/3) (2.16)

Log K = 0.71

K = antilog of 0.71

K = 5.12

$r_0 = T (K-1) / (K^p - 1)$

$= 255 (5.12 - 1) / (5.12^3 - 1)$

$= 7.88$

$a = y_0 / \log K$

$= 400 / 0.71$

$= 563.38$

$b = (K - 1) / r_0$

$= (5.12 - 1) / 7.88$

$= 0.52$

$7.88: 7.88 \times 5.12: 7.88 \times (5.12)^2 = 7.88: 40.34: 206.56$

Table 4.24: Distribution of Papers in Zones

Zone	No. of Journals	No. of Papers	%
1	8	357	29.75
2	36	451	37.58
3	211	392	32.66
Total	255	1200	100

(Source: Survey Data)

Table 4.24 indicates that the number of journals in the first zone is 8 with 357 papers which fall short by 62 papers with a negative deviation of 14.8%. In the second zone, the number of papers increases by 44 papers indicating a positive deviation of 10.81%. Similarly in the third zone, the number of papers increases by 18 papers indicating a positive deviation of 4.81%. It has been observed that there is a positive and negative deviation in the observed and expected number of papers ranging from 14.8% to 10.81% except in the third zone which comes closest to the expected deviation of only 4.81%.

So, it can be declared that the dataset does not follow Bradford's Law by using Leimkuhler formulation as Bradford Law straightforwardly underline that each zone should have the same number of the journal article, a slight variation say 4 to 5 percent in expected and observed value in the zones may be considerable. Bradford's Law never emphasizes Bradford's multiplier for its verification, also equal multiplier does not provide surety that the dataset will follow Bradford Law (Tripathi & Sen, 2016).

Table 4.25: List of Top 20 Productive (Core) Journals

SN	Journal Name	No. of Papers	% of Papers
1	DESIDOC Journal of Library and Information Technology	82	6.83
2	Library Philosophy and Practice	62	5.16
3	Journal of Library and Information Science	52	4.33
4	Annals of Library and Information Studies	44	3.66
5	IASLIC Bulletin	37	3.08
6	SRELS Journal of Information Management	34	2.83
7	Gyankosh-The Journal of Library & Information Management	23	1.91
8	International Journal of Library & Information Studies	23	1.91
9	International Journal of Information Research	22	1.83
10	Indian Journal of Information, Library and Society	20	1.66
11	World Digital Libraries	20	1.66
12	ILA Bulletin	18	1.5
13	Kelpro Bulletin	18	1.5
14	Electronic Library	17	1.41
15	Library Review	17	1.41
16	Librarian-Journal of Library and Information Science	16	1.33
17	Library Wave	16	1.33
18	Pearl: A Journal of Library and Information Science	16	1.33
19	COLLNET Journal of Scientometrics and Information Management	16	1.33
20	VSRD International Journal of Technical & Non-Technical Research	15	1.25

(Source: Survey Data)

Table 4.25 shows the top 20 core journals of productivity used by the faculty member of the Central Universities of India. It has been found that out of 255 unique journals for 1200 journal articles & among top three journals, the highest number of journal articles have published in *DESIDOC Journal of Library and Information Technology* (82, 6.83% of total articles) followed by *Library Philosophy and Practice* (62, 5.16%) and *Journal of Library and Information Science* (52, 4.33%). Nearly one-third of total publications (33.25%) are found only from the top 10 journals.

4.2.1.25 Major Findings

a) There are a total of 81 LIS faculties in 18 Central Universities of India, out of which 63 LIS faculties responded to the questionnaire and the response rate was 77.77%.

b) The universities like AMU, CUHP, CUTN, DU, GGU, MZU, PU, and TU have 100% response rate while no response has been received from HSGU.

c) Out of total LIS faculties, 73% were male and 27% were female.

d) Categorically, 47.6% faculties were Assistant Professor, 23.8% were Associate Professor and 28.6% were Professor.

e) Among the Assistant Professor category, 70% faculties belong to males; in the Associate Professor category, 73.3% faculties belong to male; and in Professor category, 77.7% faculties belong to male. The ratios of female faculties are less than 30% in each category.

f) Age-related information has been shared by 40 LIS faculties and all the LIS faculties have more than 30 years of age. The highest percentage (37.5%) of faculty belongs to the age group 41-50 followed by the age group 31-40 (30%) and age group 51-60 (22.5%).

g) There were 30% faculties of age group 31-40 which belongs to Assistant Professor only; 37.5% faculties belong to age group 41-50 of which 60% were Assistant Professor. In the age group of 51-60, no faculty belongs to Assistant Professor while 55.5% were Associate Professor and the remaining 44.5% were Professor. Similarly, faculties having >60 years of age belong to Professor only.

h) There were 93.6% faculties have Ph.D. degrees as their highest qualification. All Associate Professor and Professor have a Ph.D. degree while 86.66% Assistant Professor have a Ph.D. degree, 6.6% were pursuing Ph.D. and 3.3% have only a Master's degree as the highest qualification.

i) The highest number of faculties (22.4%) has 6-10 years of teaching experience followed by 17.4% faculties have 11-15 years of teaching experience and 12.8% faculties have 16-20 years of teaching experience. The majority (23.9%) of faculties have not responded to the question.

j) The highest number of faculties (20.6%) has 6-10 years of research experience followed by 15.9% faculties have 11-15 years and 11.1% faculties have 21-25 years of research experience. The majority (30.1%) of faculties have not responded to the question.

k) The *English* language has been found as the most preferred language (98%) for research publications.

l) The *journal articles* (17.8%) have been found as the most preferred media of scholarly communication followed by *conference/seminar proceedings* (13.6%) and *book chapters* (12.8%).

m) Google Scholar (GS) profile is found for 61.9% faculties (39), of which 82% faculties (32) have a Google Scholar profile. Among responded faculties, 53.12% were Assistant Professor (17), 15.62% were Associate Professor (5) and 31.25% were Professor (10).

n) Among the LIS departments of Central Universities of India, all faculties belong to MZU, BHU and AU have GS profile ID.

o) There were 57.14% faculties (36) who have research projects (finally submitted) of which 38.8% were Assistant Professor, 22.2% were Associate Professor and 38.8% were Professor. Categorically, 71.4% Professor, 50% Associate Professor and 21.4% Assistant Professor have research projects. The Professor category has more research projects than any other category.

p) There were 53 research projects found from the 17 faculties belongs to the 9 Central Universities of India. The number of research projects found the highest for PU (20.7%) followed by AMU (18.8%) and DU (17%). Out of total research projects, 54.7% were Major Research Projects (29) and 22.6% were Minor Research Projects (12) while 22.6% research projects (12) have no information related to their category i.e. Major or Minor.

q) Major Research Projects found the highest for AMU (8, 27.5%) followed by IGNOU (6, 20.6%), DU (4, 13.7%), MZU (4, 13.7%) and PU (3, 10.3%). Minor Research Projects found the highest for MU (3, 25%) followed by AMU (2, 16.6%), DU (2, 16.6%) and PU (2, 16.6%).

r) The study found 16 funding agencies for 41 research projects (77.35 %), and the highest funding received from UGC (39%) followed by DRDO (12.19%) and ICSSR (9.75%). Further, of these research projects, the majority (33, 80.4%) were individual while the rest of them (8, 19.5%) were collaborative in nature.

s) A total of 444 research degrees were awarded, of which majority (232, 52.2%) were M. Phil. while 47.8% (212) were Ph.D. Out of total M. Phil. degree, 41 degrees (17.6%) were supervised by Assistant Professor, 82 degrees (35.3%) were supervised Associate Professor and 109 degrees (43.3%) were supervised by Professor. Similarly, out of 212 Ph.D. degrees, 21 degrees (9.9%) was awarded under Assistant Professor, 93 degrees (43.8%) was awarded under Associate Professor and 98 degrees (46.2%) was awarded under Professor.

t) Among the LIS faculties, the highest number of M. Phil. supervised by Shailendra Kumar (42, 18.1%) followed by Mahender Pratap Singh (39, 16.8%) and Margam Madhusudhan (21, 9%). Similarly, the highest number of Ph.D. supervised by R. K. Mahapatra (24, 11.3%) followed by H. N. Prasad (18, 8.5%), Shailendra Kumar (18, 8.5%) and Brajesh Tiwari (13, 6.1%).

u) A total of 2900 publications observed from 59 LIS faculties (93.6% of total respondents). Among the 59 LIS faculties, study found top ten productive authors which were M. K. Sinha (168, 5.79% of total publications) followed by C. I. Singh (138, 4.75%), M. K. Verma (132, 4.55%), S. K. Sonker (128, 4.41%), Shilpi Verma (120, 4.13%), C. K. Ramaiah (117, 4.03%), I. V. Malhan (115, 3.96%), R. K. Bhatt (107, 3.68%), M. P. Singh (102, 3.51%) and K. P. Singh (101, 3.48%).

v) Among the top five LIS departments, the highest publications seen for DU (487, 16.79%) followed by MZU (406, 14%), BBAU (369, 12.72%), AMU (319, 11.5%) and AU (229, 7.89%).

w) The highest number of publications (1166, 40.2% of total publications) were observed during 2014 – 2018, followed by 940 (32.4%) publications during 2009 – 2013, and 444 publications (15.3%) during 2004 – 2008. The lowest number of publications (76, 2.56%) was found during 1978 – 1990.

x) Journal Articles found to be the most prevalent form of publication by the LIS faculties that share 41.38% (1200 publications) of total publications followed by Conference Proceedings (1068, 36.83%) and Book Chapters (467, 16.10%).

y) The highest number of Books have been published by DU (34, 20.6% of total books), the highest number of Book Chapters have been published by MZU (68, 14.5% of total book chapters), the highest number of Conference Proceedings have been published by BBAU (161, 15.07% of total conference proceedings) and the highest Journal Articles have been published by DU (252, 21% of total journal articles) followed by MZU (171, 14.25%) and AMU (136, 11.33%).

z) The authorship pattern has been found for 2569 publications, out of total publications, with 4794 authors. The highest number of publications have been published by two authors (1327, 51.65% of total publications) followed by a single author (825, 32.11%), three authors (366, 14.24%) and four authors (41, 1.59%). Multiple authorship has been found prevalent than solo authorship in the field of LIS.

aa) Lotka's Law is found to be fit with *n* value (0.893).

bb) Dataset is found unfit for Bradford's Law as the deviation is found 14.8%, 10.81% and 4.81% in the first, second and third zones between observed and expected value respectively.

cc) Among the top three highly productive LIS journals, the highest number of articles published in *DESIDOC Journal of Library and Information Technology* (82, 6.83% of total articles) followed by *Library Philosophy and Practice* (62, 5.16%) and *Journal of Library and Information Science* (52, 4.33%).

4.2.1.26 Conclusion

The study conducted on faculty members of 18 Central Universities having Library and Information Science (LIS) departments using scientometric indicators. The study found 81 LIS faculties in 18 Central Universities of India, out of which 63 LIS faculties responded to the questionnaire. Hemvati Nandan Bahuguna Garhwal University does not have any faculty in the LIS department. Faculties of some Central Universities were interested to share their academic and research related data for the study while some were not interested. LIS departments have more male faculty than females. The numbers of Assistant Professors are more than Associate Professors and Professors. About half of the faculty members belong to Assistant Professor. The gender perspective of LIS faculties biased towards the male in the case of Assistant Professor (70% male), Associate Professor (73.3% male), and Professor (77.7% male) also.

The age factor of LIS faculties has been studied to know their level of experience in the field and to ascertain the professional experience and found that 40 LIS faculties have shared their age-related information. All the LIS faculties belong to more than 30 years of age while the majority of them belonged to the age group 41-50 years followed by age group 31-40 years. In a categorical study, it has been found that all Assistant Professor belongs to the age group 31-40 years while among the age group of 41-50 years, 60% faculties were Assistant Professor. The study observed that faculties related to the Assistant Professor category have the age range of 30-50 years while Associate Professor and Professor have a higher age range as per their designation. LIS faculties have a tendency to achieve higher academic as well as professional qualifications while some new entrants in the profession are pursuing higher degrees.

Working experience and designation of the faculty have a direct relationship as observed from the study. The period of academic and research experience fully depends upon the faculty's designation, and experience increases with the change of designation. Language is the medium of communication and thus scholarly communication also needs some language to disseminate research findings and *the English* language has been found as the most preferred language for research publications. Simultaneously, scholarly communication needs some medium to publish the research finding besides language requirements and observed *journal articles* as the most preferred medium of research publication followed by *conference/ seminar proceedings* and *book chapters*.

Google Scholar (GS) has provided the facility to everyone to showcase his/her research achievement in the online domain using Google Scholar profile. In the case of LIS faculties of Central Universities of India, the majority of the faculties have a GS profile but still, there is a significant number of faculties who do not have a GS profile. The younger faculties have a tendency to showcase their research achievement through GS profile than senior faculties. Funded research projects have been found for more than 50% faculties (amongst responded). Senior LIS faculties have more research projects and others. Faculties have a tendency to get major research projects rather than minor research projects from funding agencies. UGC, DRDO, and ICSSR were the main funding agencies for research projects in the field. Research supervision is one of the important research activities of faculties, and LIS faculties have produced significant number of research degree in terms of M. Phil. and Ph.D. Study observed more production of M. Phil. than Ph.D.; and found that designation has the direct impact in research supervision and research production especially in the case of M. Phil. and Ph.D.

Research activities are one of the core areas of faculties for subject development and bringing innovation in the field. Research activities depend upon the capability of the individual faculty as well as his/her interest in research. There are some faculties who are producing more research while others are far from that. The LIS faculties also have the same pattern where some faculties and universities are more productive while other faculties and universities are dull in the whole research landscape. In terms of research supervision, Shailendra Kumar, Mahender Pratap Singh, Margam Madhusudhan, R. K. Mahapatra, H. N. Prasad, and Brajesh Tiwari are some more productive faculties. In terms of research papers published in journals, conference proceedings, book chapters, books etc., M. K. Sinha, C. I. Singh, M. K. Verma, S. K. Sonker, Shilpi Verma, C. K. Ramaiah, I. V. Malhan, R. K. Bhatt, M. P. Singh and K. P. Singh are more productive LIS faculties.

The department-wise research performance has been analyzed based on total faculties' performance and found that DU, MZU, BBAU, AMU, and AU are the top performers among LIS departments of Central Universities of India. Nowadays, there is a tendency to share research activities among many researchers and the same has been observed for the LIS field also. LIS faculties have strong authorship collaboration for research publications. Lotka's Law displays the trends of the author's research productivity and found fit for the present study also while dataset found unfit for Bradford's Law with a significant deviation of values in first, second and third zones. The source items, where scholarly communication published, have been analyzed using Bradford's Law and found some highly productive LIS journals of the filed like *DESIDOC Journal of Library and Information Technology*, *Library Philosophy and Practice* and *Journal of Library and Information Science*.

4.2.2: Part 2 – Analysis of Web Visibility of Online Scholarly Communications

This section covers the analysis of the fifth objective proposed for the study. The objective covers the data available in the open domain and collected from online platforms (websites, databases) using various tools and techniques. There are several online platforms available from where required data can be obtained but observed variation in data due to their coverage. Simultaneously, all the online platforms are not freely available as well as faculty have no interest to supply their data in every online platform. The study uses popular as well as major online platforms like Scopus, Web of Science and Google Scholar databases for measuring the web visibility of LIS faculties.

4.2.2.1 Web Visibility based on Google Scholar

4.2.2.1.1 Introduction

Google Scholar (GS) is a discovery tool for finding scholarly communication available over WWW in different formats, freely accessible within the campus or off the campus without putting any financial burden on individuals or institutions. It provides more effective user performance and user satisfaction than the journal portal or the link resolver form of library systems and services (Dixon et al., 2010). Citation feature of GS allows one to increase their online visibility and recognition by creating an author profile that simultaneously influences the impact of publications. The major force behind the success of GS is its' relevancy ranking and wide coverage over the universe of subjects. The GS features include both simple and advanced search facilities through the single user interface for exploring the scholarly communications by an author, publisher, citations and other similar works. The GS provides an opportunity for every faculty to create their publication profile and if the GS profile is created by every faculty then it would be easy for faculties and researchers to conduct citation measurement related studies very easily (Vucetic et al., 2017). Apart from measuring scholarly work of an individual, GS also provides an opportunity to add researchers & inform their scholarly work to other researchers interested in the similar research area, improving future research, expanding scholarly networking for collaborations, and marketing of their research (Zientek et al., 2018). The GS has become a useful complementary tool for bibliometric research concerned with the identification of the most influential scientific works (Martin-Martin et al., 2017). Despite the advantageous features of GS, it has been widely criticized due to its' lack of transparency in selecting items, poor standardization, duplication, lack of control over self-citation, and the high chance of gaming the system (Martínez & Anderson, 2015). This study is an attempt to visualize the performance of Library and Information Science (LIS) faculties indexed in GS.

4.2.2.1.2 Literature Review

The GS is an open and freely accessible bibliometric tool widely used all over the world for citation metrics like Web of Science (WoS) and Scopus (Meho & Yang, 2007). The GS serves not only for the information search mechanism but also for the research evaluation process. Its' dynamic, broad coverage and uncontrolled indexing features allow its' comparison with other traditional bibliometric databases (Delgado López-Cózar et al., 2017). Its' citation metrics help for promoting early career researchers and preserving scholarly publications particularly for those researchers/ authors having few or no indexed articles or poorly visible on Scopus and WoS (Gasparyan et al., 2017). It has good coverage for Social Sciences and Humanities subjects rather than WoS and Scopus but GS has less reliable data and fewer data tools for bibliometric analysis (Delgado-López-Cózar & Cabezas-Clavijo, 2012; Mingers & Meyer, 2017). The GS crawlers scan repository's Web address particularly the local documents published on the Web in different language formats and simultaneously increases its coverage in terms of publications and citations but bibliometric evaluation should be done carefully due to duplication of data (Aguillo, 2012). The publications which are not well covered in WoS, as well as citations data related to those publications, are easily accessible through GS without putting any financial burden on their parent institutions (Harzing & van der Wal, 2008). Repanovici (2011) suggested that GS citations and *h*-index obtained from Publish or Perish (PoP) has been utilized as an important tool for assessing scientific research in university and evaluating Professors also. The GS has better indexing for conference proceedings and non-English language publications. Diem & Wolter (2013) found that in GS, Professor is more visible than their lower-ranking colleagues and also found that female Professors achieve fewer cites per publication than their male colleagues.

4.2.2.1.3 Scope and Limitations of the Study

LIS faculties working in the Central Universities of India have been considered as population. Our approach is to visualize the research performance of LIS faculties based on their publications and citations with the help of scientometric tools. In India, 18 Central Universities are offering LIS courses but no permanent faculties were found for Hemvati Nandan Bahuguna Garhwal University and thus excluded from the study. Finally, 81 LIS faculties have been found from 17 Central Universities and their information was retrieved through the concerned university website. In GS, no publication data were retrieved for 6 LIS faculties and so the study is limited to 75 LIS faculties.

4.2.2.1.4 Methodology

The raw data is collected in October 2018 with the help of Publish or Perish software (https://harzing.com/resources/publish-or-perish) that retrieve and analyze academic citations from GS. Extracted data are analyzed and presented with the help of VOSviewer (https://www.vosviewer.com) that constructs and visualizes the bibliometric network. MS-Excel application has been used also for further analysis. The study was conducted through GS search queries for 81 LIS faculty by their names which results the publication details, searching of publications by faculty's name found difficult for some faculties due to no GS profile as well as retrieval of a similar name from other disciplines by the GS. In such a difficult situation, the term "LIS" or "Library and Information Science" or "affiliating institution name" separated by a comma after the name of the faculty has been added during GS search. Some faculty members have publications other than the LIS field also, and thus filtered the publications belongs to the LIS field only by matching the publication titles from the concerned faculty's bio-data or CV, if available or from journal websites itself. Further, duplication of publications retrieved from GS has been checked and excluded. It is noticeable that GS profile has not been used for any faculty in the study for retrieving required data as it creates differences in determining the coverage of GS for the LIS faculties having no profile.

4.2.2.1.5 Results

4.2.2.1.5.1 University-wise Performance

Publication performance of faculties depends on their research interest, dedication towards reaching the milestone in exploring new research areas results to build a strong research career, impact of research work, and addition of new ideas in the existing knowledge domain. Further, in India, the University Grants Commission, New Delhi (UGC) has also provided an opportunity to faculties by setting standards in the form of Academic Performance Indicators (API) to perform the best at their level for further promotion and simultaneously upgrade the quality of research. Scientometric indicators help to analyze the scholarly publications and their impact (in the form of citations) which is applicable for institutions as well as for individual level too. University-wide performance has been retrieved for 17 Central Universities of India and a total of 1186 LIS publications were found with 4684 citations to them. The data are analyzed at three levels of performance which is based on the average publication, average citation, and citations per publication for all the Central Universities. In terms of publication productivity, MZU has the highest share of publications (13.82%, 164) followed by AMU (12.39%, 147), BHU (12.14%, 144), DU (11.72%, 139) and PU (9.02%, 107). The highest citations share have been found for AMU (24.33%, 1140) followed by DU (21.13%, 990), BHU (14.38%, 674), PU (10.46%, 490) and MZU (5.97%, 280). Citations per Publication (CPP) are calculated the highest for AMU (7.75) followed by DU (7.12), HSGU (5.64), BHU (4.68), and PU (4.57). The performance level is found unsatisfactory for three Central Universities viz. TU, GGU and CUH respectively. Less number of faculties and newly established LIS departments may also be the one reason for poor performance by some Central Universities which further needs to be scrutinized after a reasonable time lag.

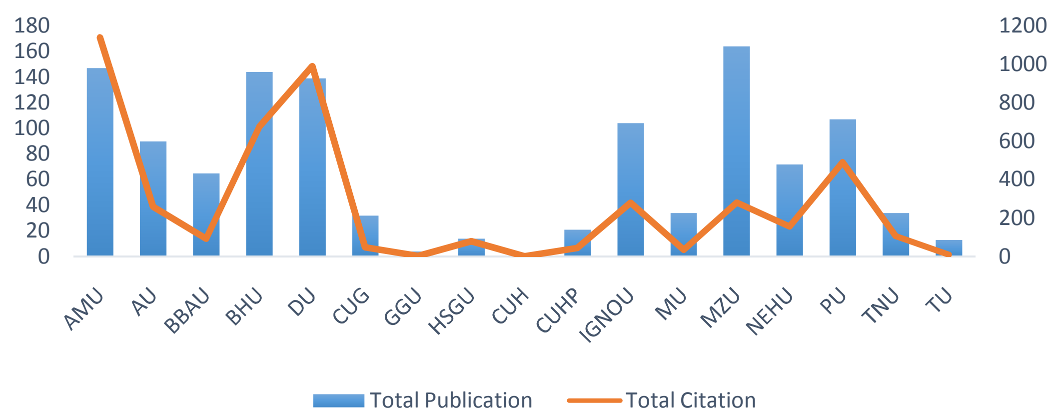


Fig. 4.12: University-wise publications and citations

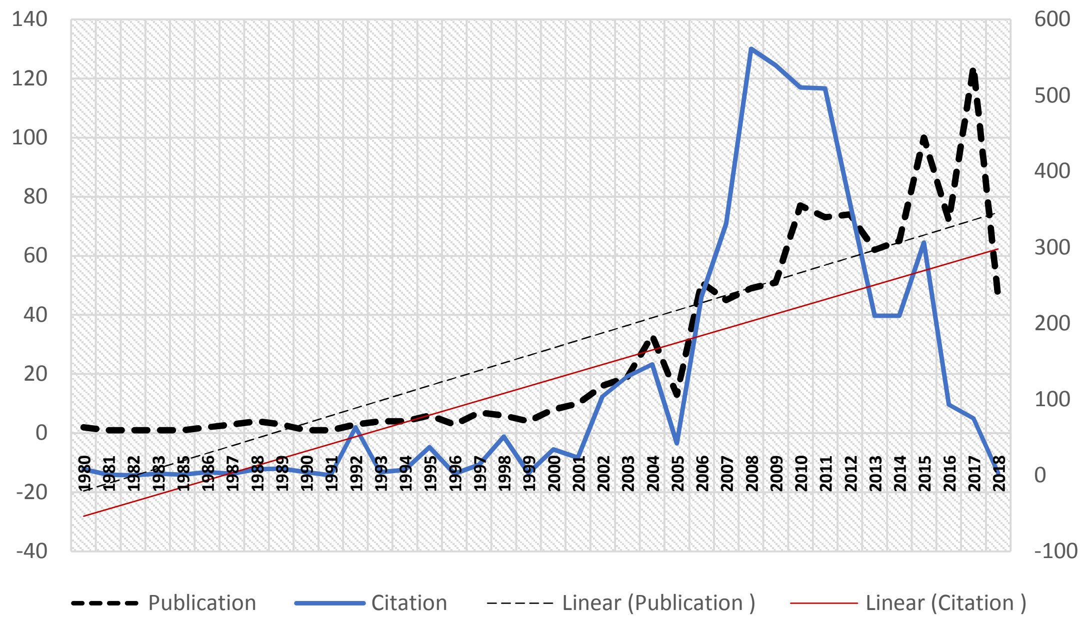


Fig. 4.13: Year-wise growth of publications and citations

4.2.2.1.5.2 Year-wise Performance

The GS has some advantages over other citation databases as it offers extensive search facility and potential to provide access to grey literature and to find citations for old as well as outdated items of publications (Shultz, 2007). The coverage of GS in terms of year of publications, number of results, keyword searching, and time of searching is comparatively better than other commercial bibliographic databases (Stirbu et al., 2015). The year-wise growth of publications and citations of LIS faculties are represented in Fig. 4.13 which illustrates the remarkable growth in publications and citation patterns over the years. In Fig. 4.13, the y-axis represents the number of publications while the z-axis represents the number of citations over the period. In our study, publication coverage year of GS is found to 38 years which ranges from 1980 to the present date i.e. 2018. More than 50% of publications and 37% of citations were observed after 2011 onward. An increasing trend of publications has been observed from 2006 onwards which reached the maximum 124 publications in the year 2017 and simultaneously increasing trend has been observed for citations from the year 2006 to 2008 and after that decreasing trend of citations has been observed from the highest 561 citations in 2008 to 75 citations in 2017. The publication performance of LIS faculties increased during 2006 – 2017 but the citation impact of research is not at par. As per Fig. 4.13, the linear (citation) and linear (publication) show steady growth in the number of publications as well as citations over the period.

4.2.2.1.5.3 Forms of Document

Mayr & Walter (2007) studied that GS hits were categorized into link, citation, pdf and other formats (like PS, DOC, RTF, etc.) and the high ratio of journals found were reflected as Citations (28%) followed by full-text in PDF (19%) while other forms of documents were negligible in ratios. In the study, mainly five categories of documents were observed in GS that covers 56.66% of total documents and rests (43.33%) were found blank i.e. without any forms. The highest number of publications found in PDF (33%) while 1% DOC files and 1% HTML files were observed. There has been 1% Book forms of documents observed while 21% observed as citations. The GS failed to categorize the forms of documents that appeared in its' database. Significantly more than 43% of publications do not have any forms of documents and represent 'blank'.

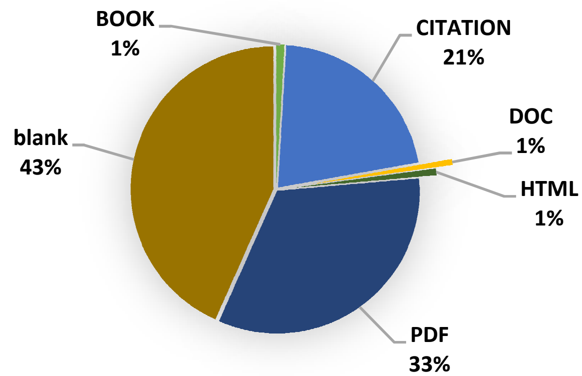


Fig. 4.14: Forms of document coverage in GS

4.2.2.1.5.4 Highly Productive Author, Cited Author, and Cited Publications

The representation of most influential authors adopted research methods, most used titles & frequently used sources of publications are some of the important aspects of bibliometric research (Martin-Martin et al., 2017). Citation count act as an indicator to measure the impact of paper and its author as citation attracts researchers having similar research interest and influences one's effort in the development of science (Bauer, Leydesdorff, & Bornmann, 2016). Counting citation is not a perfect method of measuring an author's impact on the field though it is far better evaluation indicator than counting numbers of papers a person has authored (Stern & Arndt, 1999). We analyzed individual contributions of LIS faculties and it has been observed that the number of publications is highly skewed. Out of the total of 1186 publications by 75 LIS faculties, 18.66% faculties altogether contributed more than 50.75% publications. Moreover, more than 50% faculties have 10 or less than 10 publications and out of which 24% faculties have contributed 3.87% of total publications.

Table 4.26: Top 10 Highly Productive LIS Authors (Faculty)

SN	Author & Affiliation	Publications	Citations	CPP	CPY
1	MK Verma, MZU	76	96	1.26	5.65
2	MK Sinha, AU	68	229	3.37	8.18
3	U Kanjilal, IGNOU	62	84	1.35	3.5
4	CK Ramaiah, PU	47	284	6.04	11.36
5	A Shukla, MZU	44	46	1.05	4.6
6	B Mukherjee, BHU	43	364	8.47	20.22
7	KP Singh, DU	43	192	4.47	12
8	M Madhusudhan, DU	40	621	15.53	56.45
9	HN Prasad, BHU	32	152	4.75	4.11
10	R Sevukan, PU	31	157	5.06	13.08

(Source: Survey Data)

Table 4.26 depicts the top ten most productive LIS faculties account for more than 40% of total publications which received more than 47% of total citations. Among the top ten most productive LIS faculties, MK Verma has contributed the highest share (6.4%) of total publications followed by MK Sinha (5.7%) and U Kanjilal (5.2%). In terms of total citations, M Madhusudhan has the highest share (13.25%) of citations followed by B Mukherjee (7.77%) and CK Ramaiah (6.06%). Cites per Publication (CPP) and Cites per Year (CPY) is found the highest for M Madhusudhan (15.53 & 56.45 respectively) followed by B Mukherjee (8.47 & 20.22) and CK Ramaiah (6.04 CPP) while Cites per Year is the third-highest for R Sevukan (13.08) rather than CK Ramaiah. Table 4.26 reveals the impact of research by using CPP and CPY and found that the quality of research publications among the top productive authors varies. The faculties having more number of research publications have less research impact and vice-versa. The research impact of individual faculty members also affects the research quality of their parent department as well as the university.

To increase the impact of scholarly communications, scholars (Ali & Richardson, 2017; Jan & Anwar, 2013) have suggested that the faculties who are getting fewer citations and having low indices should publish their work in reputed journals having good impact factor, create academic networking site for collaboration and sharing of information among peers to increase their online visibility. To measure the impact of faculties, the most common method adopted is counting the total number of citations against each publication; which gains the momentum over the period of time and nowadays acts as an indicator to rank the faculties and measuring the quality of research (Adkins & Budd, 2006; Dev et al., 2015). From Table 4.27, out of a total of 4684 citations received for 1186 publications by 75 LIS faculties, it has been found that the top ten faculties (13.33% of total faculty) altogether received more than 57% citations. Table 4.27 depicts that the top ten most-cited LIS authors have contributed more than 32% publications and received more than 57% citations. Among all LIS faculties, M Madhusudhan has received the highest share (13.25%) of total citations in 3.37% publications followed by B Mukherjee (7.77% & 3.62%) and CK Ramaiah (6% & 3.96%). Among all LIS faculties, CPP is calculated maximum for SN Singh (20) followed by M Madhusudhan (15.53) and N Fatima (10.83). Moreover, CPY is found the maximum for M Madhusudhan (56.45) followed by N Fatima (26) and B Mukherjee (20.22). The total number of citations, CPP and CPY are one of the indices to evaluate the quality of research produced by the researcher. In terms of citation study of LIS faculties, it has been observed that research efforts (publications) are more than research impact (Citations, CPP & CPY). Overall we can say that the research impact of the maximum LIS faculties is less effective. The attention should be paid towards qualitative research work rather than quantitative.

Table 4.27: Top Ten Highly Cited LIS Authors (Faculty)

SN	Author & Affiliation	Citations	Citation %	Publications	Pub. %
1	M Madhusudhan, DU	621	13.25	40	3.37
2	B Mukherjee, BHU	364	7.77	43	3.62
3	CK Ramaiah, PU	284	6.06	47	3.96
4	M Nazim, AMU	281	5.99	29	2.44
5	N Fatima, AMU	260	5.55	24	2.02
6	MK Sinha, AU	229	4.88	68	5.73
7	KP Singh, DU	192	4.09	43	3.62
8	MA Ansari, AMU	160	3.41	25	2.11
9	R Sevukan, PU	157	3.35	31	2.61
10	HN Prasad, BHU	152	3.24	32	2.69

(Source: Survey Data)

Analysis of highly cited publications will provide valuable information about the high impact research topics in the LIS literature for a particular period and simultaneously it also provides information about high impact journals in the field (Blessinger & Hrycaj, 2010). From the LIS researcher's point of view, the highly cited publications display the top trending research areas of the field. In general, highly cited papers have been known for its excellence in scientific research of any discipline. In general, articles published in high impact factor journals obtain more citations in comparison to less impact factor journals. Moreover, multi-authored and international collaborative publications were often more cited because of an increase in the scientific mind, economic and technical resource accessibility (Aksnes, 2003). Analysis has been conducted to trace the top ten highly cited journal publications by LIS faculties and found 2 publications (0.16%) out of 1186 publications that have received more than 100 citations and altogether the top ten publications have received more than 17% citations. Among the top ten highly cited publications, 3 single-authored publications have the highest number of citations than multi-authored papers which partially fails the concept of Aksnes (2003). Table 4.28 displays top-cited papers with their CPY (Citations per Year) and Scopus CiteScore as per 2017. CiteScore metrics calculate the journal impact based on all documents published in a year to all documents published in the prior three years in that journal.

Table 4.28: Top Ten Highly Cited Publications by LIS Faculties

Journal Publication	Citations	CPY	Publishing Journal	CiteScore as per Scopus
Use of UGC-Infonet e-journals by research scholars and students of the University of Delhi, Delhi: A study by *M Madhusudhan*	118	11.8	Library Hi Tech	0.9
Use of social networking sites by research scholars of the University of Delhi: A study by *M Madhusudhan*	103	17.17	International Information & Library Review	0.24
Use of electronic resources by research scholars of Kurukshetra University by *M Madhusudhan*	95	11.88	Electronic Library	0.99
Impact and use of e-resources by social scientists in National Social Science Documentation Centre (NASSDOC), India by *S Haridasan, M Khan*	95	10.56	Electronic Library	0.99
Usage of e-journals by researchers in Aligarh Muslim University: a study by *MMRaza, AK Upadhyay*	84	7	International Information & Library Review	0.24
Internet use by research scholars in University of Delhi, India by *M Madhusudhan*	81	7.36	Library Hi Tech News	0.33
Information seeking behaviour of the students at Ajmal Khan Tibbiya College, Aligarh Muslim University: a survey by *N Fatima, N Ahmad*	62	6.2	Annals of Library and Information Studies	0.39
Use of e-journals among research scholars at Central Science Library, University of Delhi by *PM Naushad Ali, N Fatima*	60	8.57	Collection Building	0.6
Mapping the intellectual structure of scientometrics: A co-word analysis of the journal Scientometrics (2005–2010) by *S Ravikumar, A Agrahari, SN Singh*	58	19.33	Scientometrics	2.72
Use of electronic journals by doctoral research scholars of Goa University, India by *R Chirra, M Madhusudhan*	54	6	Library Hi Tech News	0.33

(Source: Survey Data)

4.2.2.1.5.5 Co-occurrence of Keywords

The co-occurrence in scientometric studies represents "*keywords based on common presence, the frequency of occurrence, the proximity which may be similar to each other but are not exactly the same and generally based on the same topic*" (https://seo-hacker.com/cocitation-cooccurrence-overview/). The similar studies have been found (Bornmann et al., 2018; Sedighi, 2016; Sharma et al., 2018, p. 1990; Xing et al., 2018) in which co-occurrence of keywords was analyzed based on different research areas. A keyword co-occurrence network helps in understanding the meaningful knowledge components, knowledge structure and insight of the scientific field which based upon the strength of links between keywords used in literature (Radhakrishnan et al., 2017). A co-occurrence link is a connection or relation between two items and there is no more than one link between any pair of items. Further, link strength represents the number of times the paired keyword occurs together. The value of link strength is always in positive and more the value, stronger the link strength.

In VOSviewer, the group of items is represented in the form of clusters based on the similarity of items in weight and score attributes. Clusters are generally non-overlapping and may not include all available items. Different clusters appear in the VOSviewer map represented by the different colors for clear visualization (Van Eck & Waltman, 2011). In our study, keyword co-occurrence is analyzed only from the title of a total of 1186 publications of which a total of 2211 keywords extracted out. To generate co-occurrence of keywords in VOSviewer, binary counting method has been chosen and selected keyword occurrence 5 or more times which gives the result of total 186 keywords and then 60% (111 keywords) of selected keywords were used for visualization which resulted in 10 clusters to create the map (Fig. 4.15). Total links and link strength for all 111 keywords were found as 494 & 731 respectively. Table 4.29 represents top frequently occurred keywords (10-time occurrence as minimum frequency) with the frequency of occurrence and total link strength among them. From Table 4.29, we can see that keywords like Development, Journal, Information Science, Education, Knowledge Management, etc. are the most frequently occurred keywords with higher link strength. In Fig. 4.15, keywords of different clusters have been displayed by different colors and each similar color represents more or less identical selected topics of LIS research by authors (faculty members).

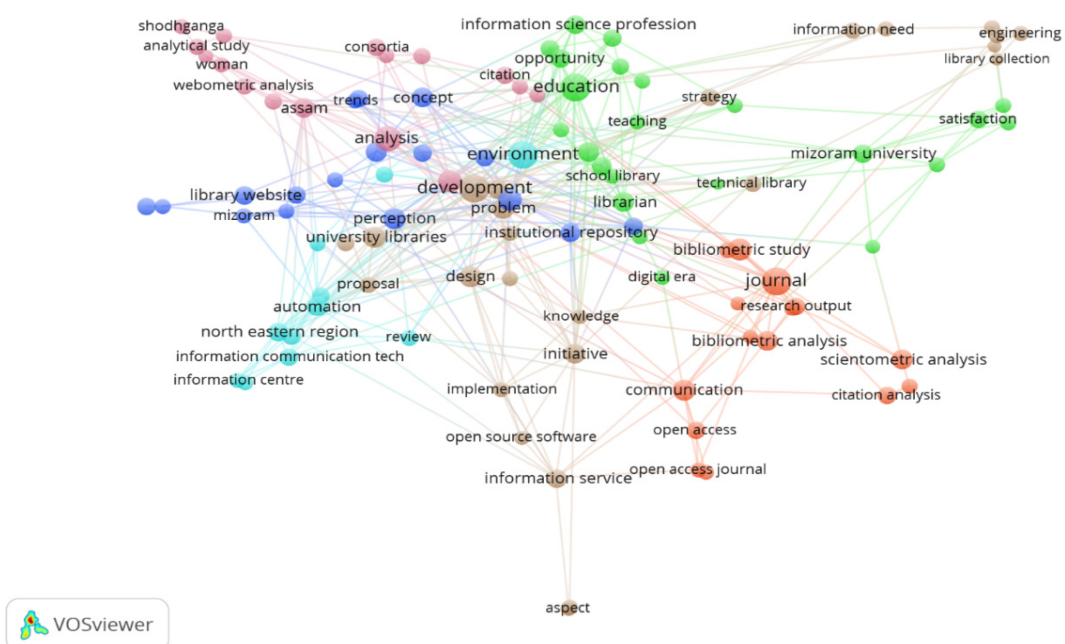


Fig. 4.15: Co-occurrence of Keywords

Table 4.30 represents the number of keywords and some selected keywords out of them represented in 10 clusters. From the observation of Table 4.30, we can see that cluster-1 has the highest number of keywords (18) and this is the most centralized cluster representing core areas of faculties research towards selecting keywords for publication titles (Chen et al., 2016). From the cluster of keywords, the possible areas of research interest of LIS authors (faculties) have been proposed. Table 4.30 represents the proposed areas of research interest of LIS authors (faculties) based on selected keywords of each cluster. The keywords of 10 clusters are extracted out from publication titles and proposed areas of research interest based on these clusters of keywords show the publication trends in the LIS field.

Table 4.29: Top Keywords with Frequency of Occurrence

Keywords	No. of Occurrence	Total Links	Total Link Strength	Keywords	No. of Occurrence	Total Links	Total Link Strength
Development	45	30	58	Automation	14	19	29
Journal	44	21	41	Information Science Education	14	10	12
Information Science	29	19	36	Digital Literacy	13	7	13
Education	28	23	27	Scientometric Analysis	12	6	8
Knowledge Management	28	16	27	Information Technology	12	8	14
Scientist	26	10	16	Digital Environment	12	12	16
Academic Library	25	15	24	Social Science	11	10	16
Bibliometric Study	23	6	16	Citation Analysis	11	5	7
Website	20	5	8	Information service	11	11	12
Librarian	17	16	17	Contribution	10	6	7
University Libraries	17	12	15	Information Retrieval	10	3	4

Bibliometric Analysis	16	9	18	Collection Development	10	6	7
Communication	16	17	22	Information Literacy	10	7	7
Information Communication	15	10	19	Behaviour	10	12	15
Internet	15	8	11	LIS Professional	10	10	12

(Source: Survey Data)

Table 4.30: Ten (10) Clusters of Keywords

Cluster	No. of Keywords	Selected Keyword	Proposed Research Area
1	18	Digital Library, Distance mode, education, Information Literacy, information retrieval, Internet, Knowledge Management, Marketing, Teaching, Training	ICT, Digital Information Management, Marketing of Digital Information, Knowledge Management
2	13	Challenges, Issues, Collection development, Digital environment, digital era, Higher education, Information science education, Opportunity, Librarian, reference	LIS Education, Collection Development
3	12	Digital preservation, Digitization, Preservation, Knowledge, information service, Online exhibition	Digital Preservation, Knowledge Dissemination
4	12	Bibliometric analysis, Bibliometric study, Citation analysis, Scientometric analysis, research performance, research output, Information management	Metric Studies, Information Management
5	11	Automation, ICT, Networking, Internet, Information centre, university libraries, Awareness	Library Automation& Networking
6	11	Usage, Behaviour, Assam University, Mizoram University, Physical Science, Social science, Aizawl, Silchar	Field and Institutions based Study
7	10	Library consortia, Resource sharing, LIS education, Distance education, academic library	Library Consortia, LIS Education
8	10	Communication, Contribution, Growth, Open access, Open access journal, Shodhganga, Scientometric study	Open Access Information Management, Metrics Study
9	7	Faculty Members, PG students, Information need, Library collection, engineering	Information Collection, Population Study
10	7	Website, Webometric analysis, Content analysis, Technical library, Library profession	Metrics Study, Librarianship

(Source: Survey Data)

4.2.2.1.5.6 Co-authorship Network among LIS Faculties

Research publication with more than one author is likely to be more influential than the single-authored publication (Aksnes, 2003) when counts in terms of citations and high level of author collaboration as well as can be an indicator of more inter-disciplinary research (Singh et al.,2015). Co-authorship network represents a group of authors with the most relationship in and the greatest productivity in the center, the less connected authors in the relationship are situated on the periphery (Muñoz-Muñoz & Mirón-Valdivieso, 2017).

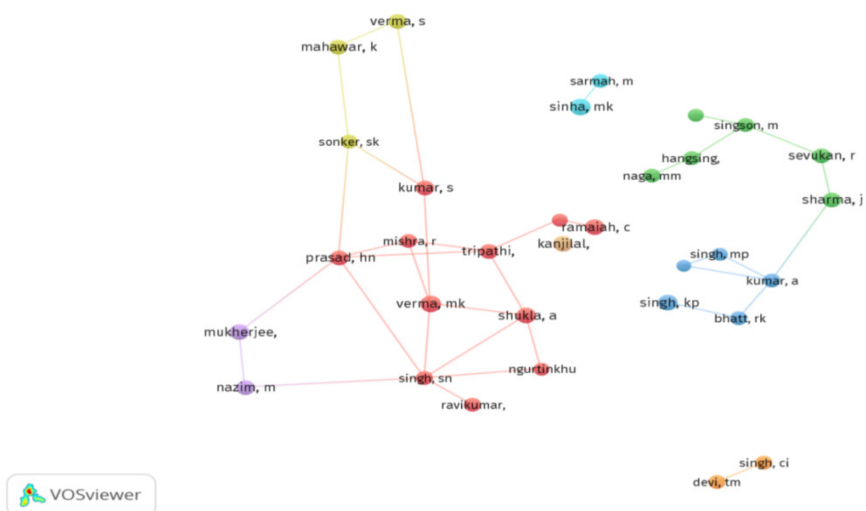


Fig. 4.16: Co-authorship Network among LIS Faculties

Fig. 4.16 represents the co-authorship network of LIS faculties created by using VOSviewer. The study found a total of 663 authors for 1186 publications having at least 1 publication. By considering 4 publications by an author as a minimum threshold, a total of 118 authors met the threshold. Again from 118 authors, 63 authors (only LIS faculties) have been chosen and excluded remaining authors (research scholars and non-teaching staffs) which do not falls under the scope of the study. Due to error in parsing of names in VOSviewer, some faculties name appears twice like ‘Ali, pm naushad’ and ‘Ali, pmn’, ‘Koganuramath, mm’ and ‘Koganuramath, m’, ‘Laloo, bt’ and ‘Tariang, bl’, ‘Kumbar, r’ and ‘Kumbar, rt’ etc. For such cases, the only prevalent name of an author has been considered like ‘Laloo, bt’ which have comparatively more links than other variant names. The major disadvantages of the co-authorship network through link analysis are seen in the case of publications having more than two authors. The link strength between two LIS faculties, in terms of shared publications, is represented in Table 4.31 which depicts that some LIS faculties like KL Mahawar, B Mukherjee, A Tripathi, A Shukla, HN Prasad, and R Mishra have co-authored publications with more LIS faculties whereas LIS faculties TM Devi, R Sevukan, RK Bhatt, P Hangsing, etc. have more co-authored publications with single LIS faculty collaboration. Among the top co-authored publications, 2/3rd collaboration found between the faculties belongs to the same LIS department and the remaining 1/3rd collaboration found between faculties belongs to inter-university LIS departments (Table 4.31). Link strength between KL Mahawar – S Verma is found the highest followed by B Mukherjee – M Nazim, and TM Devi – CI Singh. More the link strength tends to more collaborative publications between authors and vice-versa.

Table 4.31: Top Co-authored LIS Faculties

1st Author & Affiliation	2nd Author & Affiliation	Total Link Strength
KL Mahawar, BBAU	S Verma, BBAU	16
B Mukherjee, BHU	M Nazim, AMU	14
TM Devi, MU	CI Singh, MU	10
A Shukla, MZU	A Tripathi, BHU	8
R Sevukan, PU	J Sharma, IGNOU	6

HN Prasad, BHU	A Tripathi, BHU	5
RK Bhatt, DU	A Kumar, MZU	5
B Mukherjee, BHU	HN Prasad, BHU	4
P Hangsing, NEHU	MM Naga, NEHU	4
R Mishra, BHU	HN Prasad, BHU	3
R Mishra, BHU	A Tripathi, BHU	3
A Shukla, MZU	MK Verma, MZU	3
RK Ngurtinkhuma, MZU	A Shukla, MZU	3
S Ravikumar, NEHU	SN Singh, MZU	3
KL Mahawar, BBAU	SK Sonker, BBAU	3

(Source: Survey Data)

4.2.2.1.6 Major Findings

a) Out of the total 81 LIS faculties in 18 Central Universities of India, publication performance in Google Scholar was found for 75 LIS faculties (92.59% of total faculties).

b) University-wise performance has been retrieved for 17 Central Universities of India and a total of 1186 LIS publications were found with 4684 citations to them.

c) Among the university-wise publication productivity, MZU has the highest share of publications (164, 13.82%) followed by AMU (147, 12.39%), BHU (144, 12.14%), DU (139, 11.72%) and PU (107, 9.02%).

d) The highest citations share have been found for AMU (1140, 24.33%) followed by DU (990, 21.13%), BHU (674, 14.38%), PU (490, 10.46%) and MZU (280, 5.97%).

e) Citations per Publication (CPP) have been found the highest for AMU (7.75) followed by DU (7.12), HSGU (5.64), BHU (4.68), and PU (4.57).

f) Publication coverage of Google Scholar is found for 38 years which ranges from 1980 to the present date i.e. 2018. More than 50% of publications and 37% of citations were observed after 2011 onwards.

g) An increasing trend of publications has been observed from 2006 onwards which reached the maximum 124 publications in the year 2017 and simultaneously increasing trend has been observed for citations from the year 2006 to 2008 and after that decreasing trend of citations has been observed from the highest 561 citations in 2008 to 75 citations in 2017.

h) Among the top ten most productive LIS faculties, MK Verma has contributed the highest share (6.4%) of total publications followed by MK Sinha (5.7%) and U Kanjilal (5.2%).

i) Among the top ten most-cited LIS faculties, M Madhusudhan has the highest share (13.25%) of citations followed by B Mukherjee (7.77%) and CK Ramaiah (6.06%).

j) Cites per Publication (CPP) and Cites per Year (CPY) is found the highest for M Madhusudhan (15.53 & 56.45 respectively) followed by B Mukherjee (8.47 & 20.22) and CK Ramaiah (6.04 CPP) while Cites per Year is the third-highest for R Sevukan (13.08) rather than CK Ramaiah.

k) Citations per Publication are calculated and found maximum for SN Singh (20) followed by M Madhusudhan (15.53) and N Fatima (10.83).

l) Citations per Year have been found maximum for M Madhusudhan (56.45) followed by N Fatima (26) and B Mukherjee (20.22).

m) Only 2 papers received more than 100 citations and the top 10 cited publications received more than 17% of total citations.

n) Among the top ten highly cited papers, the paper named "Use of UGC-Infonet e-journals by research scholars and students of the University of Delhi, Delhi: A study" published in *Library Hi Tech* (CiteScore 0.9) by M Madhusudhan received the highest (118) citations with 11.8 Citations per Year.

o) Among the top ten highly cited papers, the paper named "Mapping the intellectual structure of scientometrics: A co-word analysis of the journal Scientometrics (2005–2010)" published in *Scientometrics* (CiteScore 2.72) and authored by S Ravikumar, A Agrahari, SN Singh received the highest 19.33 Citations per Year.

p) Among the top frequently occurred keywords (10-time occurrence as minimum frequency), "Development", "Journal", "Information Science", "Education", "Knowledge Management", "Scientist", "Academic Library" etc. are the most frequently occurred keywords with higher link strengths.

q) Co-authorship network with multiple LIS faculties found strong for faculties like KL Mahawar, B Mukherjee, A Tripathi, A Shukla, HN Prasad, and R Mishra while TM Devi, R Sevukan, RK Bhatt, P Hangsing, etc. have more co-authored publications with single LIS faculty.

r) Among the top co-authored publications, $2/3^{rd}$ collaboration found between the faculties belongs to the same LIS department and the remaining $1/3^{rd}$

collaboration found between faculties belongs to inter-university LIS departments.

s) More the link strength tends to more collaborative publication between authors; and the highest link strength found between KL Mahawar – S Verma (16) followed by B Mukherjee – M Nazim (14) and TM Devi – CI Singh (10).

4.2.2.1.7 Conclusion

The efforts have been put to draw a portrait of LIS faculty's performance based on GS which is one of the most used, popular and powerful scholarly search tools. Various studies confirmed that the number of citations in GS is found higher than WoS or Scopus as GS includes various forms of literature like journal papers, conference papers, books, book chapters, reports, theses, patents, publications from repositories and websites, etc. A total of 75 LIS faculties have produced 1186 publications and received 4684 citations. The variation in citations and publications is measured university-wise that indirectly reflects the quality of research work done at the university; and at the same time, very fewer contributions are seen for three central universities like TU, GGU and CUH. The year-wise growth rate of publications and citations is analyzed up to October 2018 which shows the continuous growth in terms of publications and fluctuations in terms of citations. Over the years, citations have shown growth but CPP reduced after 2008 (see Fig. 4.13) due to the downfall of citations in comparison to the number of publications. There may be several reasons for the downfall of citations but it simply implies the possibility of the low quality of research during the period, if we consider the CPP. This downfall of citations leaves a gap to find out all the possible reasons behind it. It is quite unclear about the types of document retrieved through GS as it categorized documents into link, citation, pdf and other formats like PS, DOC, RTF which can be considered as the limitations of GS; and has to be categorized in proper forms of document like journal article, conference proceedings, reports, book, book chapters, patents, etc.

Based on the publications of top highly productive authors, top-cited authors, and top-cited journal articles, it can be the inference that faculties like M Madhusudhan, B Mukherjee, CK Ramaiah, R Sevukan and HN Prasad have performed a remarkable contribution in terms of publications and citations also. The preferred areas of research by LIS faculties are proposed through the co-occurrence of keywords extracted from the title of the publications. It is found that the proposed areas of research cover the core areas of LIS research. Finally, through the co-authorship network, the study identified highly linked LIS faculties in terms of sharing of publication; and reached to the conclusion that both inter-& intra-departmental collaboration is weak among LIS faculties.

4.2.2.2 Web Visibility based on Web of Science

4.2.2.2.1 Introduction

Effectiveness of teaching and research productivity is the major criterion for evaluating faculties engaged in institutions of higher education. But, which is the best method to evaluate the effectiveness of faculties has still become an issue for the evaluator as there is no certain fixed metrics available to solve the problem. In this regard, to some extent bibliometric and scientometric studies influenced to analyze the qualitative and quantitative research with the help of mathematical and statistical methods. Basically in these studies, three types of indicators are considered as an effective tool that measures the quantity through publication productivity, quality through publication performance and structural indicators to measure the connection between publications, authors and thrust areas of research. These indicators are widely used and influenced the higher institutions in selection, promotion and funding decisions and thus become unparalleled parameters to evaluate the research productivity and simultaneously impact the researchers as well.

4.2.2.2.2 Literature Review

Research productivity of Malaysian authors and LIS institution were analyzed by Yazit & Zainab (2007) to determine the total number of publication, active authors, authorship pattern, authors affiliation during the period 1965 to 2005 and they found that a total 506 authors contributed 1045 publications of which 309 authors as first-time contributors, National Library of Malaysia is the top productive institution, and the core subject areas of publication includes collection development and management, information centers and services, and ICT applications in LIS. Meho & Spurgin (2005) analyzed 68 faculties of 18 ALA-accredited LIS schools and found 2625 publications from 1982-2002. Journal articles were the most widely distributed document, core subject areas of publication are found in bibliometrics, information retrieval, and public libraries, etc. Carol Tenopir (43), Peter Jacso (32), and Blaise Cronin (26) were the topmost productive authors in the number of journal publications. Patra & Chand (2006) analyzed the growth of LIS research in India during the period 1967 to 2004 and found a total of 3396 documents. The highest number of publications was observed during the year 1999; single authorship was most prevalent with 1.24 articles per author; P. N. Kaula (65), S. R. Ranganathan (29), P. B. Mangla (29), and B. M. Gupta (27) were the highest contributing authors during the period of study. Adkins & Budd (2006) examined the productivity of LIS faculty of U.S. during the year 1999-2004 and found that Carol Tenopir (59), Peter Jacso (32) & Blaise Cronin (25) were the topmost productive authors; Tefko Sarasevic (438), N. J. Belkin (395) & Pual Resnick (365) were the top most-cited authors.

Shaw & Vaughan (2008) analyzed the publication and citation pattern of LIS faculty according to their designation and found that Assistant Professor produced fewer journal articles and more conference proceedings in comparison to Associate Professors and Full Professors. Similarly, full Professors published a large number of publications in comparison to Assistant Professors and Associate Professors. Weller, Hurd & Wiberley (1999) examined the contribution of Librarian of the US in peer-reviewed literature during the period 1993 to 1997 and they observed that out of 3624 journal articles, 1579 articles were authored by academic librarians; 78.35% of the total Librarians has published only single article while co-authorship pattern is found the maximum

(55.03%) for the single articles; Pennsylvania State University libraries ranked top in terms of research productivity (46 articles by 35 authors) in the study. Onyancha & Ocholla (2007) analyzed country-wise collaborations in HIV/AIDS research in Kenya and South Africa during 1980-2005. They found that the USA is the topmost collaborating country; the stronger links, as well as the higher impact of the publications, is found for Kenya than South Africa; co-authored papers have a higher average impact than single-authored papers. Gautam & Mishra (2015) analyzed research trends of Banaras Hindu University during 2004-2013 based on the Indian Citation Index and found a total of 1041 articles. They identified year-wise distribution; prolific authors; collaboration with other institutions, countries & states. Out of 1041 publications, 60 (5.76%) publications collaborated with 18 countries of which the USA is the topmost collaborating country followed by Japan & the UK.

Tian, Wen & Hong (2008) evaluated global scientific production on GIS during 1997 to 2006 and found that research productivity increased nearly three times during the decade; *International Journal of Geographical Information Science* ranked as the top journal in GIS; the USA contributed maximum cited papers; also keywords were identified in top producing countries. Bornmann & Bauer (2015) analyzed the global distribution of highly cited researchers across the institution and found that the University of California, USA has the highest number of highly cited researchers per institution. Ho (2013) analyzed and identified the characteristics of top highly cited publications indexed in Web of Science (WoS) from 1991 to 2000. They found 71% of top-cited publications originated from the US; *Science*, *Nature*, *New England Journal of Medicine* & *Cell* were the topmost cited journals; journal articles are the most preferred medium of publication; the USA is the topmost cited country while Harvard University is the topmost productive institution.

Fetscherin & Heinrich (2015) mapped consumer-brand relationship research in objective to find the most influential journal, articles & trending papers, most influential institution, the ranking of journals, ranking of top articles based on total & global citation. Igoumenou, Ebmeier, Roberts & Fazel (2014) examined the citation practices in the field of Psychiatry of different countries, institutions, journals in terms of total local and total global citations. Liao et al. (2018) visualized Medical Big Data research based on the WoS database by using VOSviewer, CiteSpace & GraphPad Prism 5 software. They analyzed keyword co-occurrence network, keyword density visualization, keywords timeline, co-authorship analysis of countries, institutions & references. Further co-citation analysis of the journals was also discussed. Lv et al. (2011) analyzed trends of global research on *Graphene* indexed in WoS by using visualization technology during the year 1991 to 2010. They found that the USA is the topmost productive country; the authorship pattern is increased; the collaboration between one or two organizations is 76% of the total; Carbon Nanotubes and Graphite were the most popular author keywords. Gao & Guo (2014) evaluated global Nitrogen research by selecting 9748 articles from WoS during the period 1900 to 2011. They analyzed the influence of authors, institutions, and countries in terms of publication and citation; co-occurrence of keywords was analyzed to determine the cooperation among countries and research hotspot.

4.2.2.2.3 Scope and Limitations of the Study

LIS faculties working in the Central Universities of India have been considered as population. In India, 18 Central Universities are offering LIS courses but no permanent faculties were found for Hemvati Nandan Bahuguna Garhwal University and thus excluded from the study. Finally, the study observed 81 LIS faculties from 17 Central Universities and their information was retrieved through the concerned university website. In Web of Science (WoS), 42 LIS faculties' data have been retrieved and thus study is limited to 42 LIS faculties.

4.2.2.2.4 Methodology

Data is collected through the Web of Science (WoS) databases provided by Clarivate Analytics during the period from 15th March – 20th March 2019. In India, 18 Central Universities offer LIS education at different program levels. At first, central university websites are accessed to determine the list of faculty of LIS working in the respective departments. The *Web of Science Core Collection* is selected to get the required data. *The Author search* field has been selected under *the Basic Search* domain and the last name followed by the initial name of authors has been entered. Further, for each author, the subject domain is searched under *Social Science* and finally by selecting the organization associated with the author's name. By using such parameters, full-text data for 42 LIS faculties were retrieved out of a total of 81 faculties; the data retrieved for 42 faculties belongs to 14 Central Universities of India. The retrieved bibliographic and citation data are analyzed by using scientometric techniques. Microsoft Excel, R-Package, Bibliometrix & VOSviewer software tools are also utilized for processing and analysis of data for the purpose.

4.2.2.2.5 Results

4.2.2.2.5.1 Research Productivity of LIS Authors

Table 4.32 shows the research productivity of the LIS faculty of Central Universities of India based on the WoS database. There are a total of 191 publications having 117 authors that include LIS faculty, LIS professionals from the same or other institutes also. After filtration of publications data, there are 157 unique publications found for 42 LIS faculty. From the observation of data, it has been found that 14 LIS faculties have contributed single (1) publication, 12 LIS faculties have 2 publications, 5 LIS faculties have 3 publications and 11 LIS faculties have more than 3 publications. Among the top three authors, Bhaskar Mukherjee (44, 23.03%) of BHU has contributed the highest number of publications followed by Mohammad Nazim (28, 14.65%) of AMU and M. Madhusudhan (13, 6.8%) of DU. Remarkably, the top 3 authors published 44.5% of total publications while the rest of the authors (39) have published 55.5% publications.

Table 4.32: Productivity of LIS Faculty

SN	Name of Author	No. of Documents	% of Total Publications	Author's Affiliation
1	Mukherjee B	44	23.03	BHU
2	Nazim M	28	14.65	AMU
3	Madhusudhan M	13	6.80	DU
4	Ramaiah CK	10	5.23	PU
5	Tripathi A	10	5.23	BHU
6	Kumar V	8	4.18	BBAU
7	Verma MK	6	3.14	MZU
8	Kumar S	5	2.61	DU
9	Shukla Ar	5	2.61	IGNOU
10	Singson M	5	2.61	PU
11	Sinha MK	4	2.09	AU
12	Kanjilal U	3	1.57	IGNOU
13	Sonker SK	3	1.57	BBAU
14	Ravikumar S	3	1.57	NEHU
15	Sharma J	3	1.57	IGNOU
16	Ansari MA	3	1.57	AMU
17	Singh SN	2	1.04	MZU
18	Rekha RV	2	1.04	PU
19	Rath P	2	1.04	MZU
20	Hangsing P	2	1.04	NEHU
21	Bhatt RK	2	1.04	DU
22	Fatima N	2	1.04	AMU
23	Yanthan Z	2	1.04	IGNOU
24	Leeladharan M	2	1.04	PU
25	Patel D	2	1.04	CUH
26	Laloo B	2	1.04	NEHU
27	Singh KP	2	1.04	DU
28	Walia PK	2	1.04	DU
29	Prasad HN	1	0.52	BHU
30	Verma S	1	0.52	BBAU
31	Thapa N	1	0.52	HSGU
32	Ali PMN	1	0.52	AMU
33	Sulochana A	1	0.52	CUTN
34	Phuritsabam B	1	0.52	MU
35	Kanungo NT	1	0.52	IGNOU
36	Shukla A	1	0.52	MZU

37	Haridasan S	1	0.52	AMU
38	Mushtaq M	1	0.52	AMU
39	Mishra R	1	0.52	BHU
40	Meera	1	0.52	DU
41	Kumar A	1	0.52	MZU
42	Mahapatra RK	1	0.52	TU
Total = 191				

(Source: Survey Data)

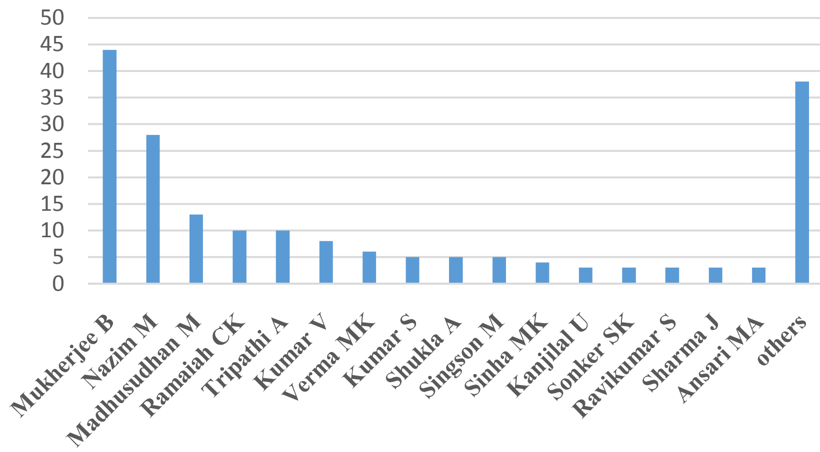


Fig. 4.17: Productive LIS Authors

Fig. 4.17 represents the topmost productive LIS faculty from the LIS department of central universities of India. Average publication performance is found to be 4.54 per faculty while out of 42 faculties only 11 has ≥4 publications. The remaining 31 faculties have published on an average 1.7 publications per faculty and out of which single publications are seen from 14 LIS faculties.

Table 4.33 depicts the university-wise share of publications along with the total number of LIS faculty indexed in WoS from each LIS department. The study observed maximum 6 LIS faculties from AMU & DU, both, who shares 18.82% and 13.05% of total publications respectively, followed by IGNOU and MZU with 5 LIS faculties with share of 7.31% & 6.26% respectively while BHU and PU has 4 faculties indexed in WoS who contributed 29.3% & 9.92% of total publications respectively.

Table 4.33: University-wise Productivity of LIS Faculty

Name of the University	No. of Faculty in WoS	Total No. of Publications	% Share of Publications
AMU	6	36	18.82
DU	6	25	13.05
IGNOU	5	14	7.31
MZU	5	12	6.26
BHU	4	56	29.3
PU	4	19	9.92
BBAU	3	12	6.27
NEHU	3	7	3.65
AU	1	4	2.09
CUH	1	2	1.04
HSGU	1	1	0.54
MU	1	1	0.52
CUTN	1	1	0.52
TU	1	1	0.52
Total	42	191	100

(Source: Survey Data)

Further, BBAU & NEHU with 3 LIS faculty shares 6.27% and 3.65% of the total publications respectively. There are six central universities from where single (1) LIS faculty have been found and collectively share 5.23% of total publications. Fig. 4.18 represents the university-wise number of publications with faculties involved for publications. It has been found that BHU (54) is the top productive LIS department followed by AMU (28) and DU (18). Moreover, publications per faculty are analyzed and found that BHU has 14 publications per faculty followed by AMU (6) and PU

(4.75). AU, BBAU & DU have nearly 4 publications per faculty while HSGU, MU, CUTN, TU have 1 publication per faculty.

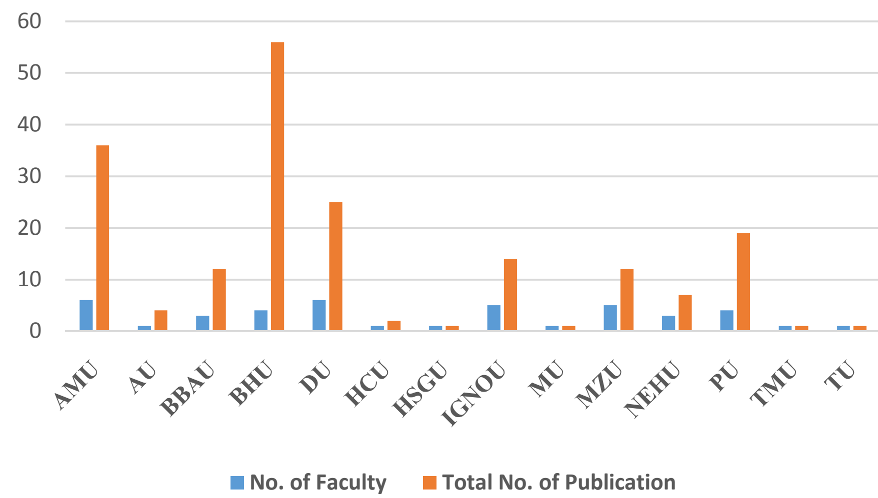


Fig. 4.18: University-wise Publications

4.2.2.2.5.2 Author's Impact

Table 4.34 represents the publication impact of LIS faculties based on scientometric indicators of research. A total of 435 citations are found for 191 publications with an average of 2.27 citations per publication. Fig. 4.19 depicts the decreasing order of top-cited LIS faculty, it has been observed that among top three cited faculty, B. Mukherjee (76 citations) has received the highest citations which are 17.47% of total citations followed by S. Ravikumar & S. N. Singh (74, 17.01%) and M. Madhusudhan (61, 14.02%). Altogether these, top four faculty shares more than 65% of total citations and the remaining 38 faculty shares 34.48% of total citations. There are 8 LIS faculty who have received ≥10 citations while remaining 34 LIS faculty has received <10 citations, out of which 13 LIS faculty has not received any citations.

Table 4.34: Publication Impact of LIS Faculty

Author	h-index	g-index	TC	PY-start
Mukherjee B	5	8	76	2009
Madhusudhan M	5	7	61	2008
Ramaiah CK	4	5	35	1993
Kumar S	2	3	7	2015
Singson M	2	3	10	2015
Ravikumar S	2	3	74	2015
Hangsing P	2	2	8	2015
Singh SN	2	2	74	2015
Nazim M	1	2	5	2015
Kumar V	1	3	9	2011
Verma MK	1	1	5	2016
Shukla A	1	1	3	2014
Ansari MA	1	2	8	2008
Kanjilal U	1	1	2	2010
Sharma J	1	1	1	2015
Fatima N	1	1	2	2017
Leeladharan M	1	1	2	2016
Patel D	1	1	3	2009
Rath P	1	1	3	1999
Singh KP	1	2	12	2009
Walia PK	1	1	1	2015
Yanthan Z	1	1	1	2017
Ali PMN	1	1	2	2017
Haridasan S	1	1	22	2009
Kanungo NT	1	1	3	2015
Mishra R	1	1	1	2015
Mushtaq M	1	1	1	2015
Prasad HN	1	1	3	2017
Verma S	1	1	1	2016
Tripathi A	0	0	0	2016
Sinha MK	0	0	0	2013
Sonker SK	0	0	0	2015
Bhatt RK	0	0	0	2012
Laloo B	0	0	0	2016
Rekha RV	0	0	0	2017

Kumar A	0	0	0	2016
Mahapatra RK	0	0	0	2013
Meera	0	0	0	2011
Phuritsabam B	0	0	0	2017
Shukla, A	0	0	0	2018
Sulochana A	0	0	0	2016
Thapa N	0	0	0	2015

(Source: Survey Data)

The *h*-index is used as an indicator to determine the productivity and impact of the researcher based on their top-cited publications (Cronin & Meho, 2006; Noruzi, 2016; Oppenheim, 2007). Table 4.34 shows the *h*-index and *g*-index of LIS faculties; the highest *h*-index 5 is found for B. Mukherjee & M. Madhusudhan followed by C. K. Ramaiah (4 *h*-index). The *h*-index value for five faculties namely S. Kumar, M. Singson, S. Ravikumar, P. Hangsing & S. N. Singh is found as 2 while 21 LIS faculty have 1 *h*-index. There are 13 LIS faculty without any *h*-index value. The *g*-index determines the impact of researchers based on the total number of publications and citation distribution for those publications (Egghe, 2006; Huang & Chi, 2010; Schreiber, 2008). The *g*-index is found maximum for B. Mukherjee (8) followed by M. Madhusudhan (7) and C. K. Ramaiah (5). Out of the remaining 39 LIS faculty, 4 LIS faculty have 3 *g*-index values, 5 LIS faculty have 2 *g*-index, 17 LIS faculty have 1 *g*-index while 13 LIS faculty did not have *g*-index value.

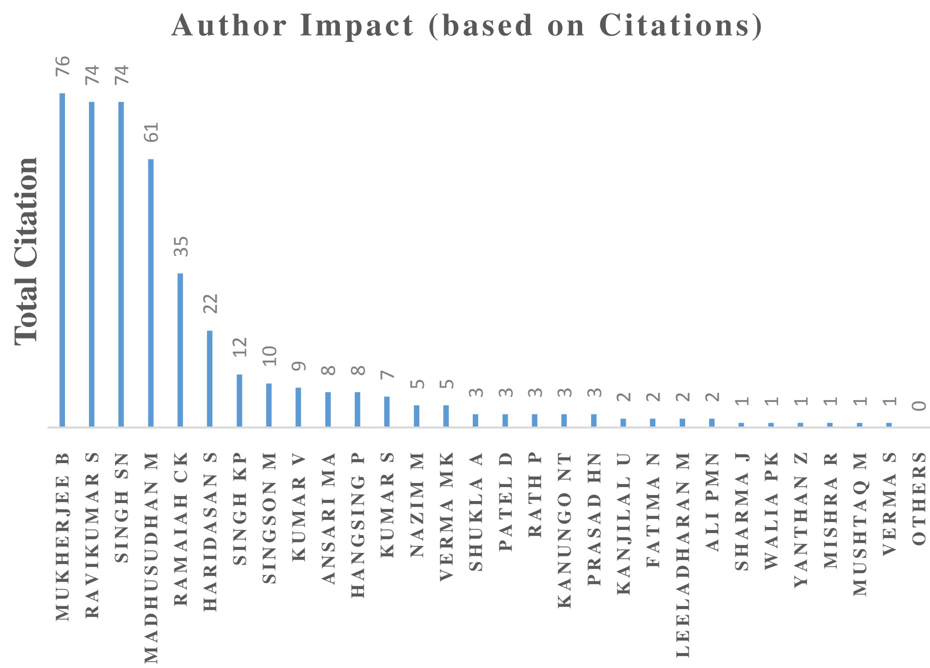


Fig. 4.19: Faculty-wise Citations

4.2.2.2.5.3 Co-Authorship Pattern

Table 4.35 represents the co-authorship pattern among LIS faculties of central universities of India. Out of a total of 191 publications, 33 publications (17.27%) are co-authored between the LIS faculties of central universities of India, while 1 publication is co-authored by LIS faculty with other faculty (which is retired and not selected in the study). Finally, the study determined the co-authorship pattern of LIS faculties based on 157 unique publications. Out of 157 publications, 37 (23.56%) publications are authored by the single author while 120 publications (76.43%) are authored by multiple authors as shown in Fig. 4.20.

Table 4.35: Collaboration between LIS Faculty

Shared Docs.	Author 1	Author 2
24	Mukherjee B	Nazim M
2	Leeladharan M	Singson M
2	Ravikumar S	Singh S N
2	Shukla Ar	Sonker S
2	Hangsing P	Singson M
1	Bhatt R	Kumar A

(Source: Survey Data)

From the observation of Table 4.35, top collaboration has been observed between B Mukherjee and M Nazim with 24 publications (15.28% of 157 publications). M Leeladharan & M Singson, S Ravikumar & S N Singh, Ar Shukla & S Sonker, and P Hangsing & M Singson each shared 2 publications while R Bhatt & A Kumar has shared 1 publication. The co-authorship network of LIS faculties is found to be more with other researchers belongs to the same or different institutions and represented in Fig. 4.20.

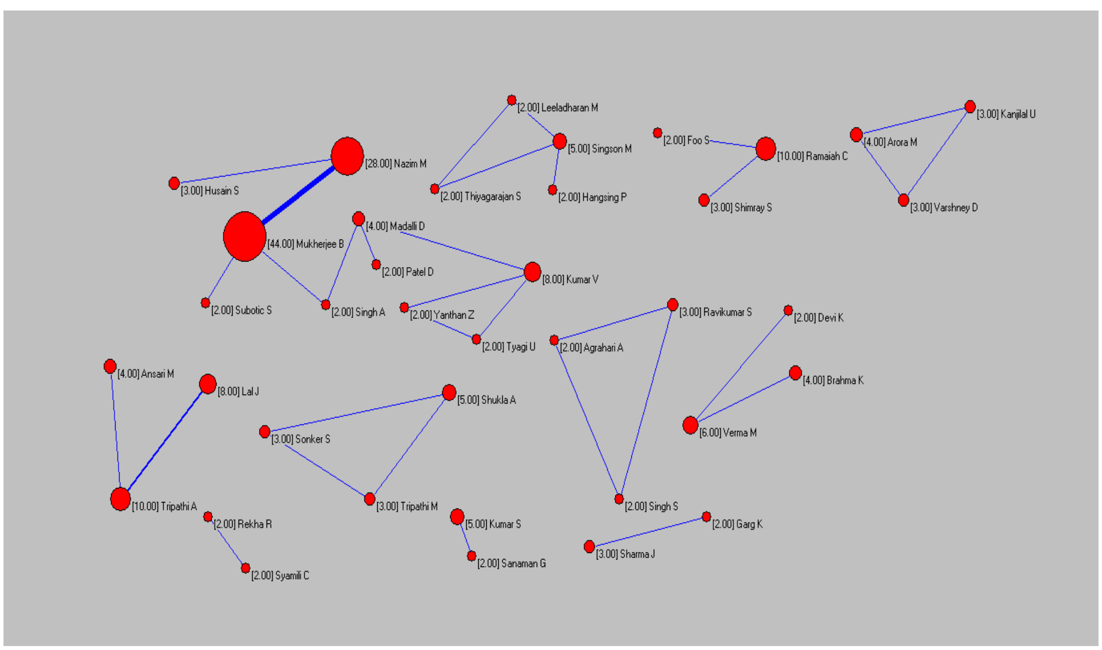


Fig. 4.20: Co-authorship Pattern of LIS Faculty

4.2.2.2.5.4 Country-wise Collaboration

Fig. 4.21 represents the number of publications based on the author's country of affiliation and collaboration among them. Single Country Publications (SCP) represent publications in which all collaborated authors have same country affiliation i.e. intra-country collaboration while Multiple Country Publications (MCP) represent publications in which all collaborated authors have different country affiliation i.e. inter-country collaboration (Sweileh, 2016). All of the 157 publications belong to 5 affiliated countries including India and it is found that India has maximum 150 (95.54%) publications followed by Singapore (4 publications, 2.56%), Bosnia (1, 0.64%), UAE (1, 0.64%) & UK (1, 0.64%). SCP is found highest for India (150) followed by Singapore (4) while MCP is found 3 for India in collaboration with Bosnia, UAE & UK. CK Ramaiah has published 4 SCP from Singapore during his service tenure in Singapore.

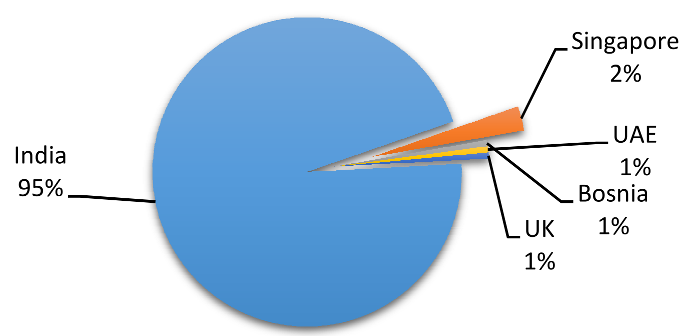


Fig. 4.21: Country Collaboration

4.2.2.2.5.5 Productive Source of Publications

A total of 47 sources are found for 157 publications as presented in Table 4.36 based on the highest number of publications in each source. Among top five sources of publication, *DESIDOC Journal of Library & Information Technology* has contributed the highest number of publications (27 articles, 17.19% of total) followed by *Knowledge Management in Libraries: Concepts Tools and Approaches* (24, 15.28%), *Electronic Library* (10, 6.36%), *Scholarly Communication in Library and Information Services: The Impacts of Open Access Journals and E-Journals on a Changing Scenario* (10, 6.36%), and *Annals of Library and Information Studies* (8, 5.09%).

Table 4.36: Productive Source of Publications

Sources	No. of Articles
DESIDOC JOURNAL OF LIBRARY & INFORMATION TECHNOLOGY (J)	27
KNOWLEDGE MANAGEMENT IN LIBRARIES: CONCEPTS TOOLS AND APPROACHES (BC)	24
ELECTRONIC LIBRARY (J)	10
SCHOLARLY COMMUNICATION IN LIBRARY AND INFORMATION SERVICES: THE IMPACTS OF OPEN ACCESS JOURNALS AND E-JOURNALS ON A CHANGING SCENARIO (BC)	10
ANNALS OF LIBRARY AND INFORMATION STUDIES (J)	8
LIBRARY CONSORTIA: PRACTICAL GUIDE FOR LIBRARY MANAGERS (BC)	8
COLLNET JOURNAL OF SCIENTOMETRICS AND INFORMATION MANAGEMENT (J)	6
PROGRAM-ELECTRONIC LIBRARY AND INFORMATION SYSTEMS (J)	5
LIBRARY REVIEW (J)	4
SCIENTOMETRICS (J)	4
2015 4TH INTERNATIONAL SYMPOSIUM ON EMERGING TRENDS AND TECHNOLOGIES IN LIBRARIES AND INFORMATION SERVICES (ETTLIS) (CP)	3
IEEE 5TH INTERNATIONAL SYMPOSIUM ON EMERGING TRENDS AND TECHNOLOGIES IN LIBRARIES AND INFORMATION SERVICES (ETTLIS 2018) (CP)	3

JOURNAL OF ACADEMIC LIBRARIANSHIP (J)	3
LIBRARY HI TECH (J)	3
COLLECTION BUILDING (J)	2
DESIGN DEVELOPMENT AND MANAGEMENT OF RESOURCES FOR DIGITAL LIBRARY SERVICES (BC)	2
JOURNAL OF SCIENTOMETRIC RESEARCH (J)	2
NEW LIBRARY WORLD (J)	2
OPEN SOURCE TECHNOLOGY: CONCEPTS METHODOLOGIES TOOLS AND APPLICATIONS (BC)	2
QUALITATIVE & QUANTITATIVE METHODS IN LIBRARIES (J)	2
AGENTS AND DATA MINING INTERACTION (CP)	1
ASSISTIVE TECHNOLOGY (J)	1
CATALOGING & CLASSIFICATION QUARTERLY (J)	1
COLLECTION AND CURATION (J)	1
CURRENT SCIENCE (J)	1
GLOBAL KNOWLEDGE MEMORY AND COMMUNICATION (J)	1
INFORMATION PROCESSING & MANAGEMENT (J)	1
INNOVATIONS IN COMPUTING SCIENCES AND SOFTWARE ENGINEERING (BC)	1
INTERNATIONAL JOURNAL OF INDIAN CULTURE AND BUSINESS MANAGEMENT (J)	1
JOURNAL OF INFORMATION SCIENCE (J)	1
JOURNAL OF KNOWLEDGE MANAGEMENT (J)	1
JOURNAL OF LIBRARY ADMINISTRATION (J)	1
JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE AND TECHNOLOGY (J)	1
JOURNAL OF WEB LIBRARIANSHIP (J)	1
KNOWLEDGE ORGANIZATION (J)	1
LEARNED PUBLISHING (J)	1
LIBRARIES IN THE EARLY 21ST CENTURY VOL 2: AN INTERNATIONAL PERSPECTIVE (BC)	1
LIBRARY & INFORMATION SCIENCE RESEARCH (J)	1
LIBRARY AND INFORMATION SERVICES FOR BIOINFORMATICS EDUCATION AND RESEARCH (BC)	1
LIBRARY MANAGEMENT (J)	1
LIBRI (J)	1
PROCEEDINGS OF ISSI 2011: THE 13TH CONFERENCE OF THE INTERNATIONAL SOCIETY FOR SCIENTOMETRICS AND INFORMETRICS VOLS. 1 AND 2 (CP)	1
PROCEEDINGS OF KNOWLEDGE MANAGEMENT INTERNATIONAL CONFERENCE (KMICE) 2012 (CP)	1

PROCEEDINGS OF THE ASIA-PACIFIC CONFERENCE ON LIBRARY & INFORMATION EDUCATION & PRACTICE 2006: PREPARING INFORMATION PROFESSIONALS FOR LEADERSHIP IN THE NEW AGE (CP)	1
QUALITY ASSURANCE IN DISTANCE HIGHER EDUCATION (BC)	1
SOCIAL NETWORK ANALYSIS AND MINING (J)	1
STUDIES IN INDIAN POLITICS (J)	1

(Source: Survey Data)

4.2.2.2.5.6 Year-wise Growth of Publications

Year-wise growth of publications is calculated for 157 publications from 47 different sources of publications (journals/books/proceedings) and publication duration is observed from 1993 to 2019. Fig. 4.22 shows the year-wise growth of publications during the observed period. The calculated growth rate of publications from 1993 to 2018 is 296.15% while the Compound Annual Growth Rate (CAGR) is 18.24%.

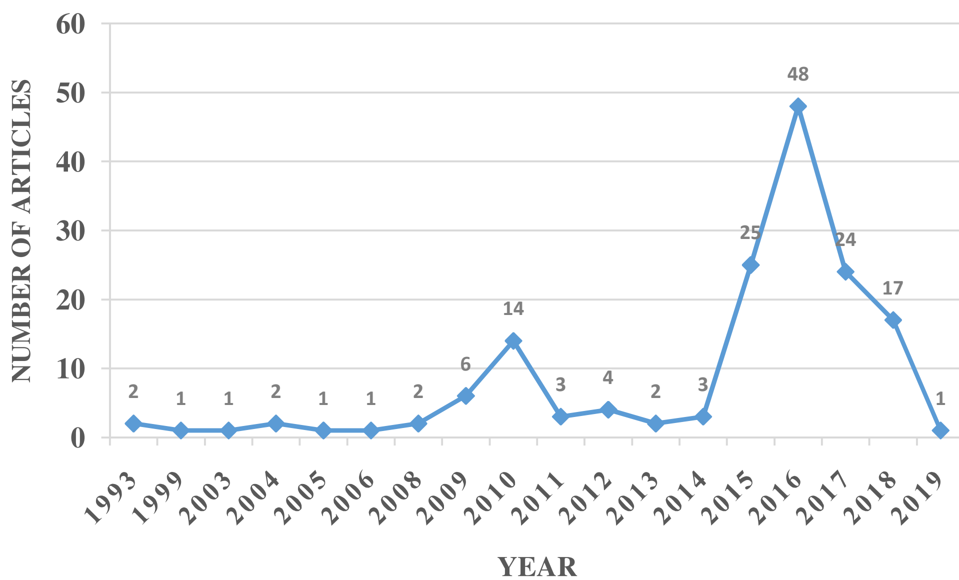


Fig. 4.22: Year-wise Growth of Publications

4.2.2.2.5.7 Types of Publication

Fig. 4.23 represents the types of publications for a total of 47 different sources observed during 1993 – 2019 in which 157 unique publications were published by the LIS faculties of Central Universities of India. The majority of sources are found in the form of *Journal Articles* (32, 68.08%) followed by *Book Chapter* (9, 19.24%) and papers in *Conference Proceedings* (6, 12.76%). Fig. 4.23 represents that *Journal Articles* are the most preferred type of publication by the LIS faculties.

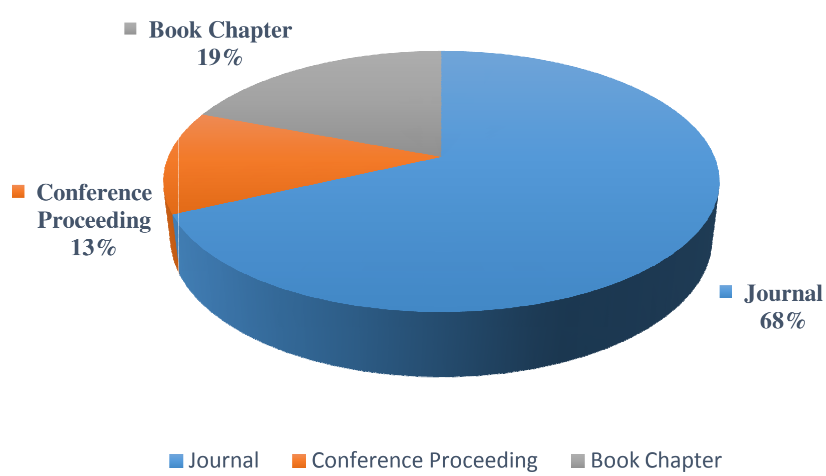


Fig. 4.23: Types of Documents

4.2.2.2.5.8 Occurrence of Keyword

Keywords are important words and phrases of a research paper that express its uniqueness and relation of the core ideas to determine trends of research (Tripathi, Kumar, Sonker, & Babbar, 2018). Table 4.37 represents the top 50 most frequently occurred keywords in the publications with their occurrence. From 157 publications, a total of 390 keywords have been traced and their total number of occurrences was 502. The occurrence of keywords is shown in Fig. 4.24 based on word cloud and it represents highly occurred keywords used by faculties in their publications. Some highly occurring keywords are “India” (23 times) followed by “Academic Libraries” (6 times), “Information Retrieval” (6 times), and “Libraries” (5 times), etc. Out of total keywords, 21 keywords (5.38%) occurred more than 2 times.

Table 4.37: Top 50 Most Frequent Keyword by LIS Faculty

Keywords	Occurrence	Keywords	Occurrence
India	23	Bradford’s Law	2
Academic Libraries	6	Citations	2
Information Retrieval	6	Co-Word Analysis	2
Libraries	5	Collaborative Coefficient	2
Collection Development	4	Data Curation	2
Knowledge Management	4	Data Preservation	2
UGC Infonet	4	Download	2
Citation	3	E-Resource	2
Citation Analysis	3	Education	2
Data Repositories	3	Electronic Books	2
Higher Education	3	Electronic Journal	2
Information	3	Electronic Journal Usage	2
Knowledge	3	Electronic Media	2
Library Automation	3	Electronic Resources	2
Link Analysis	3	Evaluation	2
Open Access	3	INFLIBNET	2
Research Data Management	3	Information Management	2
Scientometrics	3	Library Consortia	2
Social Media	3	Library Professionals	2
Web Impact Factor	3	Libsys	2
World Wide Web	3	NCR	2
Altmetrics	2	Online Catalogues	2
Assistive Technology	2	Pareto 80 20 Rule	2
Author Productivity	2	Research Data	2

(Source: Survey Data)

Fig. 4.24: Occurrence of Author's Keyword

4.2.2.2.5.9 Keyword Clustering

The author's keyword describes the core subject of the publication (article) and generally, it used to analyze the research trends in any field (Gao & Guo, 2014). Clustering denotes grouping of terms, documents or other items together based on criteria of similarity; and similarity is the distance between distributions associated with keywords by counting co-occurrences in a document (Wartena & Brussee, 2008). For a total of 390 keywords from 157 publications, we found 41 clusters of author's keywords by using the software (Bibexcel). Among 41 clusters of author's keyword, top keywords were taken according to their frequency of occurrences as shown in Table 4.38.

Table 4.38: Cluster of Keywords

No. of Times	Cluster Keywords	
3	Citation Analysis	Impact
3	Citation Analysis	Collaboration
3	Information-Science	Impact
5	Information-Science	Library
3	Citation Analysis	Internet
2	Libraries	LIS
2	Libraries	Assets
2	Information-Science	LIS Professionals
2	Knowledge Management	Acidification
2	Knowledge Management	Co-citation
2	Knowledge Management	Information
2	Knowledge Management	Technology
2	Knowledge Management	Science
2	Knowledge Management	Field
2	Knowledge Management	Trends
2	Information	Intranet
2	Impact Factor	Future
2	Impact Factor	Counts
2	Impact	Articles
2	Impact Factor	Metrics
2	Information-Science	Authorship
2	Information	Services
2	Libraries	Strategy
2	Services	India
2	University-Libraries	India
2	University-Libraries	Communication Technologies
2	World-Wide-Web	Citation Analysis
2	Initiatives	University
2	University	INFLIBNET
2	Services	Curation
2	Neural-Network Research	Co-citation
2	Neural-Network Research	Bibliometric Cartography
2	Number	Impact
2	Students	Usage
2	Citation Analysis	Bibliometrics
2	Assessment Exercise Ratings	Counts
2	Academic-Libraries	University-Libraries

2	Electronic Journals	Articles
2	Academic-Libraries	Culture
2	Academic-Libraries	University
1	Research Performance	Counts

(Source: Survey Data)

The most popular keywords like "citation analysis", "information science", "libraries", "knowledge management", "impact factor", "university libraries", "neural network research", "academic libraries" are basically clustered with the keywords like "impact", "citation analysis", "usage", "bibliometric analysis", "ICT", and "Internet" etc. which can be clearly seen through Fig. 4.25. The high frequency of keywords implies the core areas of research preferred by the LIS faculties in their publications.

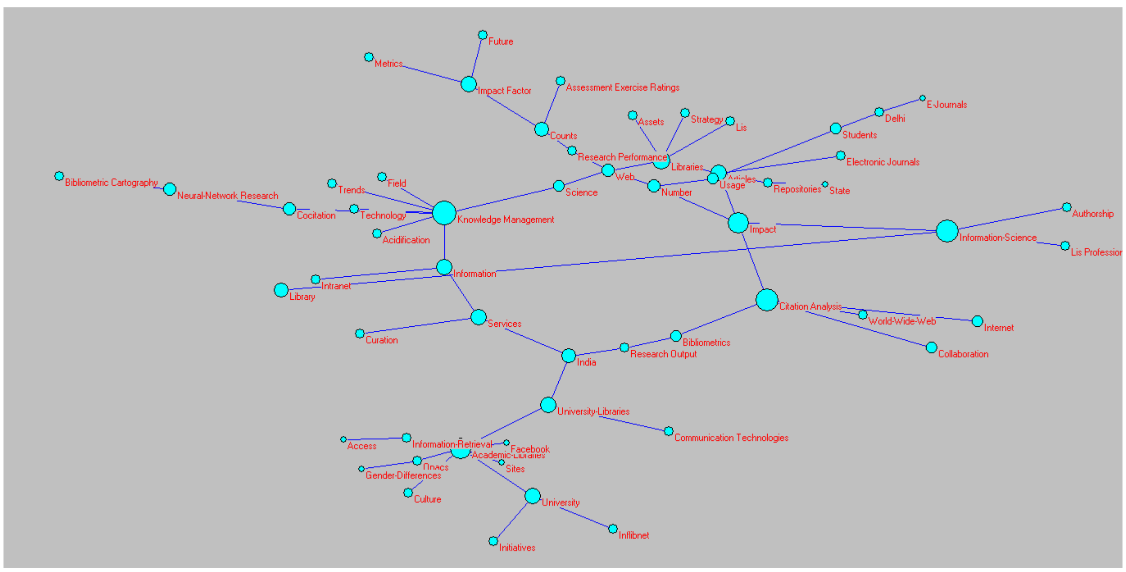


Fig. 4.25: Clustering of Keywords

4.2.2.2.5.10 Bibliographic Coupling of Sources

Fig. 4.26 shows the bibliographic coupling of sources of publication. From a total of 47 sources, a minimum of 3 documents are selected from each source as a result and thus 13 sources meet the threshold. For each of the 13 sources, the links of the bibliographic coupling with other sources are found like 23 in 30 clusters. The strongest link strength (114) is found for *Knowledge Management in Libraries: Concepts Tools and Approaches* followed by *Library Review* (100), *DESIDOC Journal of Library & Information Technology* (38), *Scholarly Communication in Library and Information Services: The Impacts of Open Access Journals and E-journals on Changing Scenario* (36) and *Scientometrics* (30). The least link strength is found for *Program: Electronic Library and Information Systems* (1). The more strength link denotes more bibliographic coupling of sources with other sources.

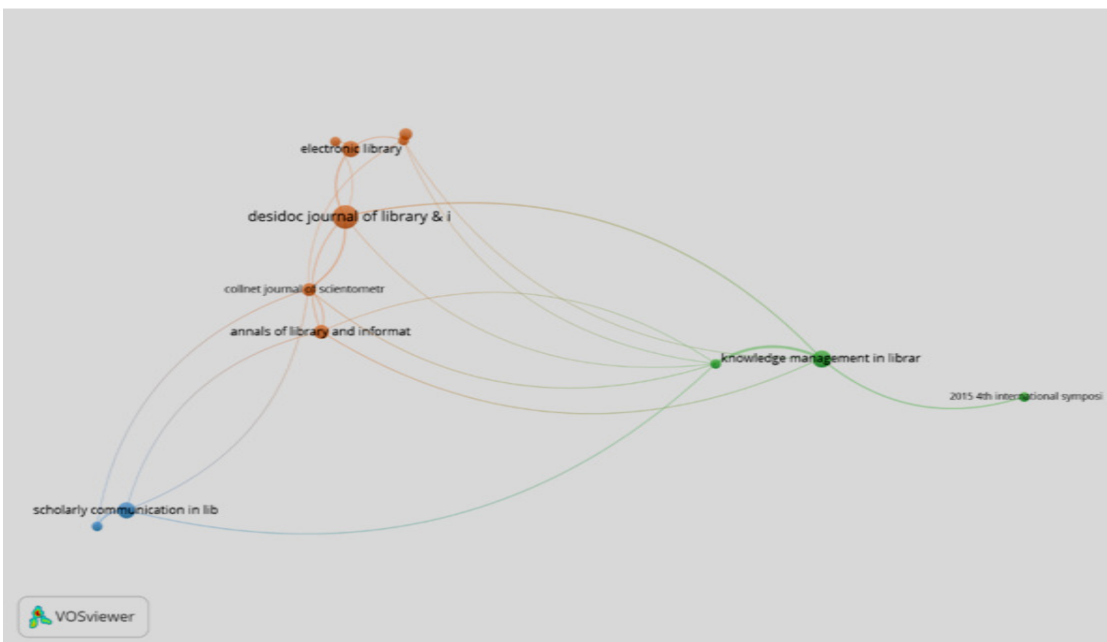


Fig. 4.26: Bibliographic Coupling of Sources

4.2.2.2.5.11 Bibliographic Coupling of Institution

Fig. 4.27 shows the bibliographic coupling of LIS departments in Central Universities of India. From selected universities, a minimum of 3 publications are selected and as a result, 14 universities meet the threshold. For each of the universities, the total link of the bibliographic coupling with other universities is found like 29 in 4 clusters. The strongest link strength (1765) is found for *Banaras Hindu University* followed by *Aligarh Muslim University* (1729), *University of Delhi* (58), *Mizoram University* (57), *Babasaheb Bhimrao Ambedkar University* (46) and *North-Eastern Hill University* (45). The least link strength is found for *the Central University of Gujarat* (1) and *Manipur University* (1).

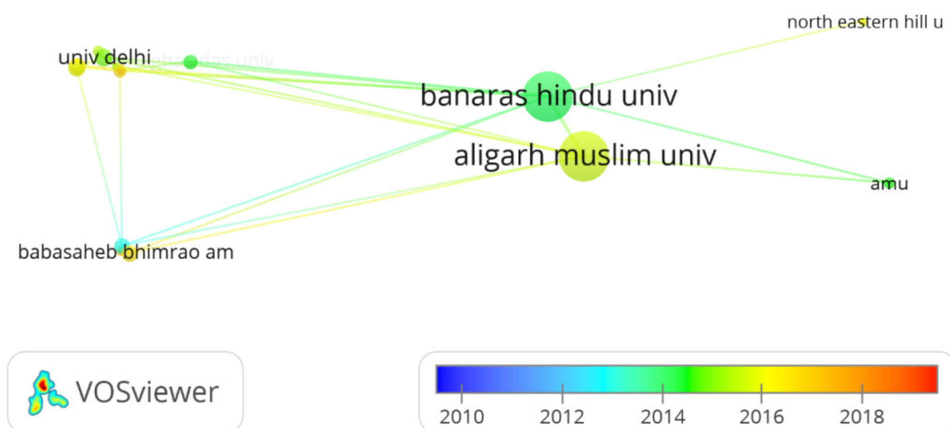


Fig. 4.27: Bibliographic Coupling of Institutions

4.2.2.2.5.12 Co-Citation of Cited Sources

Fig. 4.28 shows the co-citation of cited sources, out of a total of 1786 cited sources by taking a minimum of 15 citations, 26 sources meet the threshold i.e. co-cited by other sources. Further, link strength of top 10 co-cited sources is analyzed that results journal *Scientometrics* with the highest co-citation (86) and link strength (2964) followed by *Journal of the Association for Information Science and Technology* (70 co-citation, 3307 link strength), *Electronic Library* (55, 1846), *Knowledge Management* (51, 2704), *Journal of Academic Librarianship* (49, 2188), *Journal of the American Society for Information Science* (46, 2747), *DESIDOC Journal of Library & Information Technology* (33, 673), *Library Review* (30, 1589), *Program – Electronic Library* (29, 886) and *Information Research* (28, 1038).

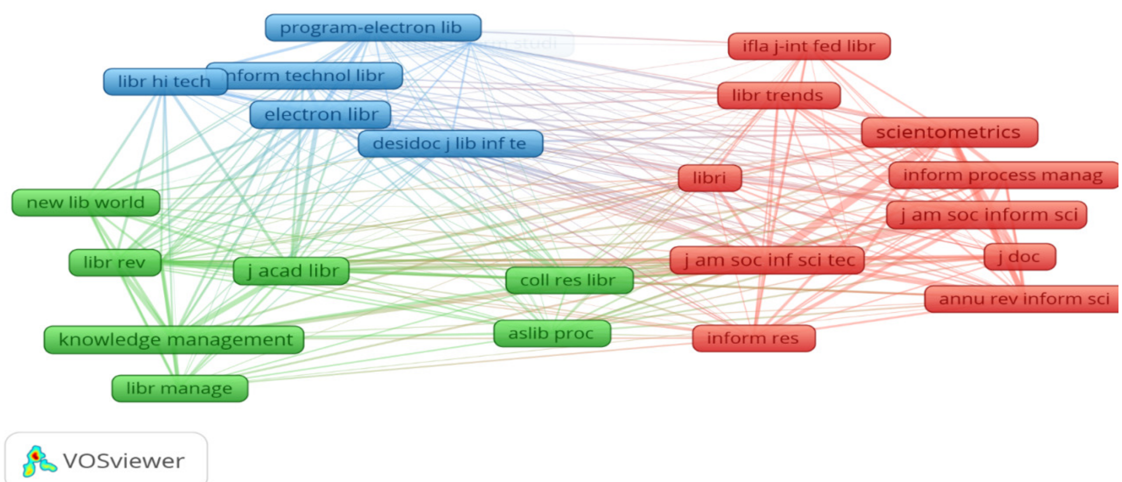


Fig. 4.28: Co-Citation of Cited Sources

4.2.2.2.6 Major Findings

a) In Web of Science Core Collection, research productivity has been found for 42 LIS faculties (51.85%) out of 81 LIS faculties and observed 157 unique publications affiliated to 14 Central Universities of India.

b) Out of 42 LIS faculties, 14 LIS faculties have single publications each, 12 LIS faculties have 2 publications each, 5 LIS faculties have 3 publications each and 11 LIS faculties have more than 3 publications each.

c) Among the top three most productive LIS faculties (authors), Bhaskar Mukherjee has contributed the highest number of publications (44, 23.03%) followed by Mohammad Nazim (28, 14.65%) and M. Madhusudhan (13, 6.8%).

d) Top three LIS authors published 44.5% of total publications while the rest of the LIS authors (39) have published 55.5% of total publications.

e) Study observed the maximum LIS faculties indexed in WoS database from AMU (6 faculties) & DU (6 faculties), and both shares 18.82% and 13.05% of total publications respectively followed by IGNOU (5 faculties, 7.31%), MZU (5 faculties, 6.26%), BHU (4 faculties, 29.3%) and PU (4 faculties, 9.92%).

f) BHU (54) is the top productive LIS department followed by AMU (28) and DU (18). Again, BHU has 14 publications per faculty followed by AMU (6) and PU (4.75).

g) Among the top three cited LIS faculty, B. Mukherjee has received the highest citations (76) which are 17.47% of total citations followed by S. Ravikumar & S.N. Singh (74, 17.01%) and M. Madhusudhan (61, 14.02%). Altogether, these four faculties share more than 65% of total citations while the remaining 38 faculties share 34.48% citations.

h) The highest *h*-index (5) is found for B. Mukherjee & M. Madhusudhan followed by C.K. Ramaiah (4); the highest *g*-index is found maximum for B. Mukherjee (8) followed by M. Madhusudhan (7) and C.K. Ramaiah (5).

i) Out of 157 unique publications, 37 publications (23.56%) were authored by single-authored while 120 publications (76.43%) were multi-authored.

j) Among LIS faculties, top collaboration has been found between B Mukherjee and M Nazim with 24 publications (15.28% of 157 publications).

k) All of the 157 publications belong to 5 affiliated countries including India and it is found that India has the maximum 150 (95.54%) corresponding publications followed by Singapore (4 publications, 2.56%), Bosnia (1, 0.64%), UAE (1, 0.64%) & UK (1, 0.64%).

l) A total of 47 sources were found for 157 publications, of which top five productive sources are, *DESIDOC Journal of Library & Information Technology* (27 articles, 17.19%), *Knowledge Management in Libraries: Concepts Tools and Approaches* (24, 15.28%), *Electronic Library* (10, 6.36%), *Scholarly Communication in Library and Information Services: The Impacts of Open Access Journals and E-Journals on a Changing Scenario* (10, 6.36%), and *Annals of Library and Information Studies* (8, 5.09%).

m) The year-wise growth rate of publications from 1993 to 2018 is found to be 296.15% while the Compound Annual Growth Rate (CAGR) is 18.24%. The highest number of publications were published from 2015 to 2018 (114, 72.59%) of which the maximum number of publications is observed for the year 2016 (48, 30.57%).

n) The majority of sources were found in the form of *Journal Articles* (32, 68.08%) followed by *Book Chapter* (9, 19.24%) and papers in *Conference Proceedings* (6, 12.76%).

o) Out of total publications, a total of 390 author keywords have been traced and their total number of occurrence was found to be 502. Some of the highly occurring keywords are "India" (23 times) followed by "Academic Libraries" (6 times), "Information Retrieval" (6 times), and "Libraries" (5 times), etc.

p) Out of a total of 390 keywords from 157 publications, the study observed 41 clusters of author's keywords and top keywords were identified according to their frequency of occurrences that help in identifying core areas of research. Some of the most popular keywords are: "citation analysis", "information science", "libraries", "knowledge management", "impact factor", "university libraries", "neural network research", "academic libraries" etc. which were basically clustered with the keywords like "impact", "citation analysis", "usage", "bibliometric analysis", "ICT", and "Internet" etc.

q) Bibliographic coupling among the sources were identified and the strongest link strength (114) is found for *Knowledge Management in Libraries: Concepts Tools and Approaches* followed by *Library Review* (100), *DESIDOC Journal of Library & Information Technology* (38), *Scholarly Communication in Library and Information Services: The Impacts of Open Access Journals and E-journals on Changing Scenario* (36) and *Scientometrics* (30). The least link strength is found for *Program: Electronic Library and Information System*s (1). The more strength link denotes more bibliographic coupling of sources with other sources.

r) Bibliographic coupling among the universities (institutions) were identified and the strongest link strength has been found for *Banaras Hindu University* (1765) followed by *Aligarh Muslim University* (1729), *University of Delhi* (58), *Mizoram University* (57), *Babasaheb Bhimrao Ambedkar University* (46) and *North-Eastern Hill University* (45). The least link strength has been found for *the Central University of Gujarat* (1) and *Manipur University* (1).

s) Co-citation among top 10 cited sources were analyzed and found that journal *Scientometrics* has the highest co-citation (86) with link strength (2964) followed by *Journal of the Association for Information Science and Technology* (70 co-citation, 3307 link strength), *Electronic Library* (55, 1846), *Knowledge Management* (51, 2704), *Journal of Academic Librarianship* (49, 2188), *Journal of the American Society for Information Science* (46, 2747), *DESIDOC Journal of Library & Information Technology* (33, 673), *Library Review* (30, 1589), *Program – Electronic Library* (29, 886) and *Information Research* (28, 1038).

4.2.2.2.7 Conclusion

The study presents the publication productivity and its result based on scientometric indicators for LIS faculties belongs to Central Universities of India based on the WoS database. A total of 157 publications were observed from 47 different sources during the year 1993 to 2019 by the 42 LIS faculties out of 81 LIS faculties. The individual publication is found to be 191 with an average of 4.54 publications per author. The total number of publications for every single faculty is counted and ranked according to the individual and affiliating institutional level. Publication impact of faculties is observed based on total citations and *h*-index while *the* *g*-index score is determined based on citations of publications. Co-authorship pattern is found maximum for multiple authors (76.43%) than single authors. Collaboration among faculties belongs to the same or different institution is analyzed and the highest collaborated publications (24, 15.28%) are found between faculties.

Most productive sources are evaluated based on the number of publications, *DESIDOC Journal of Library & Information Technology* contributed the highest (17.19%) publication. Year-wise growth of publications was found maximum during the year 2015 to 2018 and within this duration, 72.59% of total publications were published and of which 30.57% publications have been witnessed during the year 2016. Positive growth trend is observed for the sources like *DESIDOC Journal of Library and Information Technology*, *Knowledge Management in Libraries: Concepts, Tools and Management*, *Annals of Library and Information Studies*, *COLLNET Journal of Scientometrics and Information Management* while negative growth trend is found for the journals like *Library Review*, *Electronic Library*, *Scientometrics*, and *Program: Electronic Library and Information Systems*. Almost 68% of the total source documents are available in the form of a *journal article* that represents that a journal article is the most preferred type of communication channel by the LIS faculties.

The occurrence of keyword, conceptual structure map of keywords and clustering of keywords are analyzed from the total 390 author keywords. The high frequency of keywords implies the core areas of research preferred by the LIS faculties in their publications. Grouping of keywords is observed in the form of clusters, the number of the link between keywords & link strength between keywords which are determined based on criteria of similarity. The similarity denotes the distance between distributions associated to keywords by counting co-occurrences in author keywords. Keywords like "India", "Academic Libraries", "Information Retrieval", "Libraries" etc. are the most co-occurred keywords. Closeness relation of core keywords with each related keywords is mapped based on the *conceptual structure of keywords* and observed that core keywords like "Academic Libraries", "Knowledge Management", and "Link Analysis" are closely related while "Citation Analysis" is less related with other keywords. The "citation analysis", "information science", "libraries", "knowledge management", "impact factor", "university libraries", "neural network research", "academic libraries" are the most popular keywords that are basically clustered with the keywords like "impact", "citation analysis", "usage", "bibliometric analysis", "ICT", and "Internet" etc.

Bibliographic coupling of sources and institutions were analyzed based on the link strength of the same. Among sources, the strongest link strength is observed for the journals like "*Library Review*", "*DESIDOC Journal of Library & Information Technology*" and "*Scientometrics*" while weak link strength is found for the journal "*Program: Electronic Library and Information Systems*" and "*Library Hi Tech*." Under institutions, the strongest link strength is found for BHU, AMU & DU while weak link strength is found for CUG and MU. Co-citation of cited reference was analyzed along with the number of times the references were cited by the faculties. For total 1786 cited sources, co-citation of cited sources is observed maximum for the journal "*Scientometrics*", "*Journal of the Association for Information Science and Technology*", "*Electronic Library*", "*Knowledge Management*", "*Journal of Academic Librarianship*", "*Journal of the American Society for Information Science*", "*DESIDOC Journal of Library & Information Technology*", "*Library Review*", "*Program: Electronic Library and Information Systems*" and "*Information Research*".

4.2.2.3 Web Visibility based on Scopus

4.2.2.3.1 Introduction

Online visibility of faculties in databases provides the facility to extract the communication for the wider community throughout the world. With the emergence of ICT and software applications, a dynamic change occurred in the universe of literature. The concept of a traditional way of scholarly communication varies nowadays and the academic landscape is changing fast. Measuring impact and tracking citations for publication is not a new concept today but the new emerging tools & indicators have changed the scenario of approach to measure through various perspectives. One of the challenges is to measure the impact of ever-increasing literature and thrust as well as core areas of research and usability. As much as the scholarly communications will be produced by the researchers, the concept of measuring those communications will become an interesting area of research. Faculties of higher education institutions are playing an important role in imparting quality education and research to the students.

Qualification and research innovation skills of faculties enrich the productivity at their personal as well as institutional level. Further for promotion, designation, increment, grant renewal, progress report, funding request, research reputations, etc. are the major force behind to increase the publication performance by the faculties. Measuring scholarly communications of faculties at all levels with the help of bibliometric/ scientometric studies is one of the most popular approaches by the researchers to evaluate the effectiveness and impact of faculties. Scientometrics and its related concepts provide an opportunity to analyze quantitatively and qualitatively scientific literature to determine its impact with the help of authorship analysis, citation analysis, keyword analysis, index, etc. that not only measure individual research performance but also the institution and country-level too. Scientometric indicators are helpful mainly at three-level matrix i.e. Article level matrix (citation count, year-wise citation, sources of publication etc.), Author level matrix (total output, journal count, *h*-index etc.) and Journal level matrix (SCImago Journal and Country Rank, Impact per publication, Source Normalized Impact per Paper etc.). Though using matrices for measuring scholarly communication will not prove quality as exception like, devoid of favoritism, biasness, misused and misunderstood of publication. In the race of ranking, individual authors and journal editors may also be involved in “game the system” to increase their usability and recognition.

4.2.2.3.2 Literature Review

Yang (2016) studied 176 Korean faculties from 2001 to 2010 in terms of citation and publication patterns. Year-wise growth of publication, citation, and the number of unique authors involved, the ranking of subject areas by author, publication & citation count were identified. The study found 2351 unique papers with 9922 citations and subject area "bibliographic studies" is almost twice productive but received less citation as compared to others working in different subject fields. Darmadji, Prasojo, Riyanto, Kusumaningrum & Andriansyah (2018) analyzed the research output of the Islamic University of Indonesia from 2005 to 2017 by using the Scopus database. They compared the results in terms of the number of authors, documents, and collaborating affiliations with other universities of Indonesia, and suggested faculties' competitiveness through incentives and commitments for more collaboration with international researchers. Noruzi & Abdekhoda (2014) examined the research performance of Iraqi – Kurdistan universities by using Scopus database for the year 1970-2012 and analyzed the most productive university, number of publications with total number of citations, top highly cited papers, year-wise productivity, source-wise number of articles, highly cited papers, most prolific authors and their collaboration. Nagarkar (2014) analyzed the publications of the Department of Chemistry of the University of Pune through the WoS database for the year 1999-2012. The number of publication by faculties in different journals were identified along with the number of total citations, national and international collaboration pattern, h-index of faculties, preferred journal of publications and areas of research. Hanumappa, Desai, & Dora (2015) analyzed the publications of

Gujarat University during 2004-2013 by using the Scopus database. Types of publications are found the highest for journal articles (83%), the trend of publication is increasing from 2008 onwards, most productive author, highly cited author, collaboration trends and most preferred journals were analyzed. Pradhan (2015) studied the scholarly publication of LIS in international journals by India through Scopus, Current Awareness Abstract – Library and Information Management and Emerald Management Review databases for the period of ten years i.e. 2001-2010 using the parameters like year-wise growth of literature, forms of publication, authorship pattern, nature of collaboration, journal-wise distribution, state-wise distribution of publication etc. were identified. Bauer, Leydesdorff & Bornmann (2016) examined the top 1% highly cited papers in the field of Library and Information Science from 2002 to 2012 using the WoS database and found a total of 798 authors affiliated to 275 institutes contributed 305 top publications in 1% highly cited papers. Further, institution-wise highly cited papers, collaborating pattern of highly cited authors, collaboration among different institutions were identified by them in the study. Tripathi, Kumar, Sonker, & Babbar (2018) highlights the trends of research in Social Sciences and Humanities in India during the period 2005-2014 by analyzing occurrences of keywords in the publications. They explored the similarity in author's keyword and WoS assigned keyword plus and found that WoS is not consistent in assigning keyword plus across different areas of research while authors on an average assign 4 – 6 keywords in individual papers. Zhang et al. (2012) visualized Patient Adherence research based on co-word analysis and social network analysis by using WoS for the year 2000 to 2011 and extracted keywords with the help of Bibexcel. The frequency of keyword and their co-occurrence of frequency were counted and mapped through the keyword network. Top keywords paired with centrality keyword “adherence” are found as “care”, “disease”, “drug”, “drug adherence” etc. Jalal (2019) analyzed research collaboration between India and Bangladesh during the period 1991 to 2017 with the help of the WoS database. Bibliometrix R package was utilized for the collaboration network, the top ten keywords were extracted for analysis of subject trends, Lotka’s Law was found to be fitted for co-authorship data. Ekundayo & Okoh (2018) examined global publication trends in *Plesiomonas shigelloides* pathogens during 1990 to 2017 from WoS databases. The total number of articles, an annual growth rate of articles, top productive countries in publication, collaborating countries, top author keywords and conceptual framework of keywords were determined through the clustering of keywords. Aref, Friggens, & Hendy (2018) analyzed scientific collaborations among more than 1500 New Zealand institutions during the year 2010 – 2015 for six years in all subjects. Centrality analysis was done to identify central institutions in terms of scientific collaboration among the institutions and found that a small portion of central institutions is responsible for a large proportion of national collaborations. Hu, Hu, Deng, & Liu (2013) studied co-word analysis for Library and Information Science journals in China from 2008 – 2012. They applied multivariate statistical and social network analysis to obtain the top 50 keywords of which the highest occurring keywords are “library”, “university library”, “digital library”, “public library” etc. They also observed 13 topic clusters of keywords, in centrality & density of keywords the highest degree is found for “library service”, “information service”, and “search engine” etc. Shen, Xiong & Hu (2017) analyzed the research status, hotspots and trends of information behavior in China for 29 years by using China Academic Journal Network Publishing Database. Growth of publication, core authors, core journals, productive institutions, temporal visualization map, hierarchical cluster analysis & social network analysis of keywords were identified. Mane & Börner (2004) mapped the top 10% highest cited PNAS publications for the years 1982 – 2001. Year-wise frequency of occurrences of top 10 keywords like “human”, “animal”, “mice”, “genes” etc. was identified. Further, co-word analysis of the top 50 highly frequent and burst words were found through co-occurrence network of which core keywords like “molecular sequence data”, “gene expression”, “blotting”, and “in vitro” etc. have maximum node value and interconnected edges.

4.2.2.3.3 Scope and Limitations of the Study

LIS faculties working in the Central Universities of India have been considered as population. In India, 18 Central Universities are offering LIS courses but no permanent faculties were found for Hemvati Nandan Bahuguna Garhwal University and thus excluded from the study. Finally, the study observed 81 LIS faculties from 17 Central Universities and their information was retrieved through the concerned university website. From the Scopus database, 53 LIS faculties’ data have been retrieved and thus study is limited to 53 LIS faculties.

4.2.2.3.4 Methodology

The required data are collected from 6^{th} July – 10^{th} July 2019 through the Scopus database which is one of the largest abstract and citation databases of peer-reviewed literature provided by Elsevier. In India, there are 18 central universities offer LIS education at different program levels. At first, central university websites are accessed to determine the list of regular faculty of LIS working in the respective departments that result in 81 faculties. We retrieved data by selecting *the author search* and enter the author's last name at first, then the first name along with the affiliation of the respective faculty. The similar name occurs in the search result are refined by entering the city of institution and country of affiliation. The full-text data for 53 LIS faculties out of a total of 81 faculties have been retrieved which belongs to 15 central universities of India. The retrieved bibliographic and citation data are analyzed by using scientometric tools & techniques like R-Package, Bibexcel, VOSviewer, Pajek & MS-Excel software.

4.2.2.3.5 Results

4.2.2.3.5.1 University-wise Visibility of LIS Faculty

Table 4.39 represents the university-wise visibility of LIS faculties in the Scopus database. Out of 18 Central Universities offering LIS education in India, the study observed faculty publications from 15 Central Universities in Scopus. Further, the total number of existing faculty from observed universities is determined along with the number of faculties actively published in the Scopus database. A total of 78 faculties from 15 Central Universities are found of which 53 (68.83%) faculties have the publication in the Scopus database. The faculties belong to IGNOU & PU are fully indexed in Scopus followed by AMU & DU (each 85.71% of total), MZU (75%), BBAU, CUHP, HSGU & TU (each 66.66% of total) and BHU (62.5%). MU & CUTN have the lowest (40%) indexing of faculties in the Scopus database.

Table 4.39: Visibility of LIS Faculty

Name of University	No. of Existing LIS Faculty	No. of LIS Faculty in Scopus	% of LIS Faculty in Scopus
AMU	7	6	85.71
AU	4	2	50
BBAU	6	4	66.66
BHU	8	5	62.5
CUG	3	1	33.33
DU	7	6	85.71
CUHP	3	2	66.66
HSGU	3	2	66.66
IGNOU	5	5	100
MU	5	2	40
MZU	8	6	75
NEHU	6	3	50
PU	5	5	100
CUTN	5	2	40
TU	3	2	66.66
Total	78	53	68.83

(Source: Survey Data)

4.2.2.3.5.2 University-wise Performance of LIS Faculties

Table 4.40 represents university-wise publications & citations performance of LIS faculties. A total of 274 publications and 1091 citations have been observed with an average of 3.98 citations per publication. Among the Central Universities as shown in

Fig. 4.29, DU has the highest (65, 23.72% of total) number of publications followed by BHU (38, 13.86%), AMU (36, 13.13%) and PU (31, 11.31%). Six universities have less than 10 publications, of which AU & TU each has 5 (1.82% of total) publications followed by CUG & HSGU (3, 1.09%) and MU & CUTN (2, 0.72%).

Table 4.40: University-wise Research Performance

Name of University	Total Publications	% of Pub.	Total Citations	% of Citations	Citations per Pub.
AMU	36	13.13	219	20.07	6.08
AU	5	1.82	1	0.09	0.2
BBAU	18	6.56	20	1.83	1.11
BHU	38	13.86	181	16.59	4.76
CUG	3	1.09	0	0	0
DU	65	23.72	329	30.15	5.06
CUHP	12	4.37	51	4.67	4.25
HSGU	3	1.09	8	0.73	2.66
IGNOU	17	6.20	27	2.47	1.58
MU	2	0.72	3	0.27	1.5
MZU	27	9.85	89	8.15	3.29
NEHU	10	3.64	57	5.22	5.7
PU	31	11.31	100	9.16	3.22
CUTN	2	0.72	0	0	0
TU	5	1.82	6	0.54	1.2
Total	274	100	1091	100	

(Source: Survey Data)

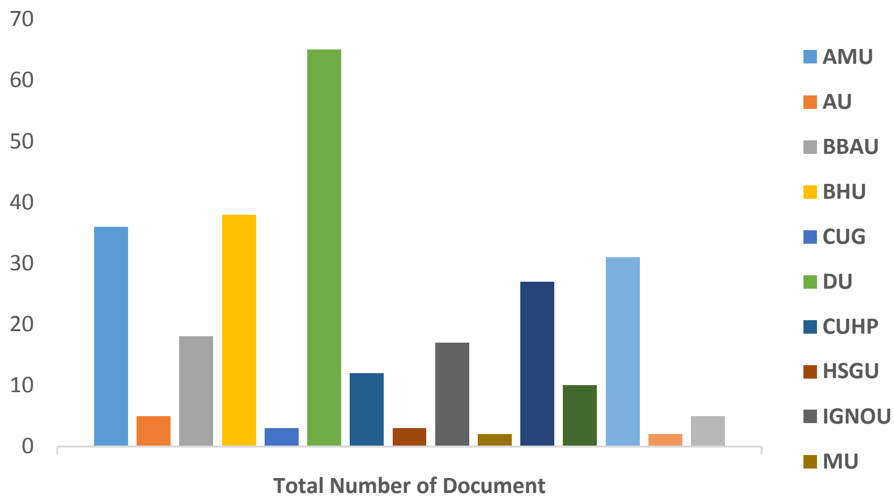


Fig. 4.29: University-wise Publications

Citations are calculated against publications from each Central University and represented in Fig. 4.30. The study found that DU has the highest (329, 30.15% of total) number of citations followed by AMU (219, 20.07%), BHU (181, 16.59%) and PU (100, 9.16%). Six universities have less than 10 citations, of which CUG & CUTN have no citations while HSGU have 8 citations (0.73%) followed by TU (6, 0.54%), MU (3, 0.27%) & AU (1, 0.09%).

Citations per publication are calculated by dividing the total number of citations by the total number of publications for each observed Central University. The citations per publication are found the highest for AMU (6.08) followed by NEHU (5.7), DU (5.06), BHU (4.76), CUHP (4.25), MZU (3.29) & PU (3.22). CUG & CUTN has not yet received any citations for their publications while AU has only (0.2) citations per publication.

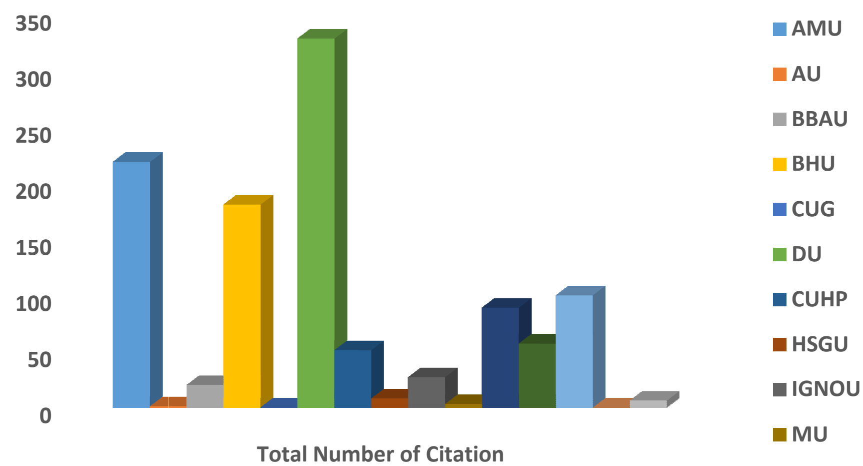


Fig. 4.30: University-wise Citations

4.2.2.3.5.3 Faculty-wise Publication Performance

Faculty-wise publication and citation performance along with their affiliating universities have been analyzed based on the Scopus database as shown in Table 4.41. Among the selected Central Universities, out of total 78 LIS faculties, 53 LIS faculties have published a total of 274 publications. Among the top three faculties, the highest publications are found for Madhusudhan M (30, 10.94% of total publications) followed by Mukherjee B (28, 10.21%) and Ramaiah CK (23, 8.39%). There are 6 LIS faculties that have 10 or more publications and contributed 42.33% of total publications while the majority of faculties (64.15%) have less than 5 publications and they contributed 26.64% of total publications. It is interesting to know that single publications have been contributed by 14 LIS faculties and altogether contributed 5.1% of total publications. Fig. 4.31 indicates the most productive LIS faculties in terms of the number of publications.

Table 4.41: Faculty-wise Publication & Citations

Name of Faculty	No. of Publications	% of Publications	No. of Citations	% of Citations	Affiliation
ALI PMN	3	1.09	33	3.02	AMU
ANSARI MA	5	1.82	16	1.46	AMU
BHATT RK	6	2.18	23	2.10	DU
FATIMA N	8	2.91	13	1.19	AMU
GALA B	3	1.09	0	0	CUG
GAYAN MA	1	0.36	0	0	TU
HANGSING P	3	1.09	5	0.45	NEHU
HARIDASAN S	2	0.72	40	3.66	AMU
KANJILAL U	7	2.55	7	0.64	IGNOU
KANUNGO NT	1	0.36	4	0.36	IGNOU
KUMAR A	4	1.45	17	1.55	MZU
KUMAR S	11	4.01	14	1.28	DU
KUMAR V	7	2.55	16	1.46	BBAU
LALOO B	1	0.36	0	0	NEHU
LEELADHARAN M	1	0.36	1	0.09	PU
MADHUSUDHAN M	30	10.94	224	20.53	DU
MAHAPATRA RK	4	1.45	6	0.54	TU
MALHAN IV	10	3.64	42	3.84	CUHP
MISHRA JK	2	0.72	8	0.73	HSGU
MISHRA R	2	0.72	3	0.27	BHU
MISHRA R N	2	0.72	0	0	MZU
MUKHERJEE B	28	10.21	170	15.58	BHU
NAZIM M	14	5.10	75	6.87	AMU
NGURTINKHUMA RK	2	0.72	0	0	MZU
PANDEY SR	2	0.72	0	0	BHU
PATEL D	2	0.72	9	0.82	CUHP
PHURITSABAM B	1	0.36	1	0.09	MU
PILLAI SKG	1	0.36	0	0	CUTN
PRASAD HN	1	0.36	5	0.45	BHU
RAMAIAH CK	23	8.39	86	7.88	PU
RAVIKUMAR S	6	2.18	52	4.76	NEHU

RAZA MM	4	1.45	42	3.84	AMU
REKHA RV	1	0.36	0	0	PU
SARMAH M	1	0.36	0	0	AU
SEVUKAN R	1	0.36	1	0.09	PU
SHARMA J	4	1.45	6	0.54	IGNOU
SHUKLA A	5	1.82	3	0.27	MZU
SHUKLA Ar	3	1.09	8	0.73	IGNOU
SINGH CI	1	0.36	2	0.18	MU
SINGH KP	9	3.28	49	4.49	DU
SINGH MP	4	1.45	1	0.09	BBAU
SINGH SN	5	1.82	58	5.31	MZU
SINGSON M	5	1.82	12	1.09	PU
SINHA MK	4	1.45	1	0.09	AU
SONKER SK	3	1.09	1	0.09	BBAU
SULOCHANA A	1	0.36	0	0	CUTN
THAPA N	1	0.36	0	0	HSGU
TRIPATHI A	5	1.82	3	0.27	BHU
VERMA MK	9	3.28	11	1.00	MZU
VERMA S	4	1.45	2	0.18	BBAU
WALIA PK	8	2.91	15	1.37	DU
YADAV M	1	0.36	4	0.36	DU
YANTHAN Z	2	0.72	2	0.18	IGNOU
Total	274	100	1091	100	

(Source: Survey Data)

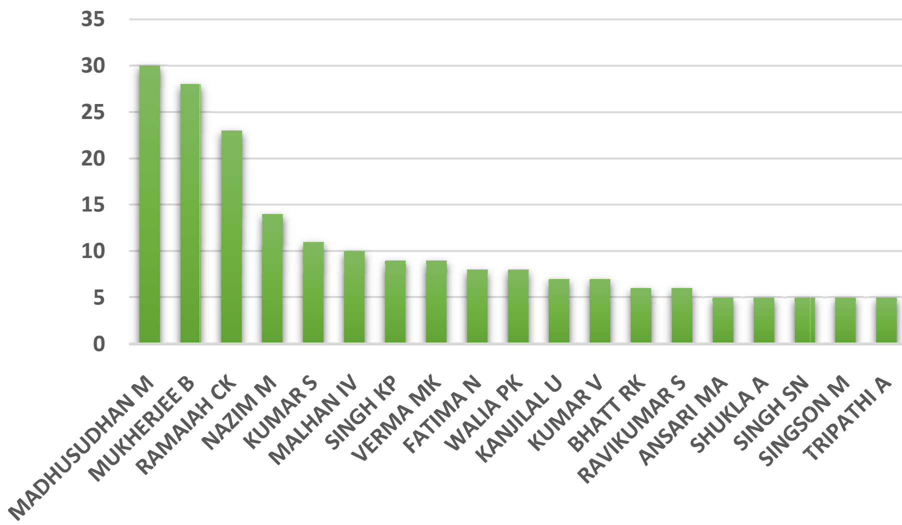


Fig. 4.31: Most Productive LIS Faculties

Further top most cited faculties, as shown in Fig. 4.32, are analyzed and among the top three cited faculties, the highest citations are found for Madhusudhan M (224, 20.53% of total citations) followed by Mukherjee B (170, 15.58%) and Ramaiah CK (86, 7.88%). There are 6 LIS faculties who have more than 50 citations and in total, they received 665 (60.95% of total) citations. The majority of faculties (62.26%) have less than 10 citations and altogether they received 83 (7.6%) citations, of which 11 LIS faculties (20.75% of total) have not received any citation to their 16 publications.

Overall, citations per publication are observed as 3.98 for total publications and among individual faculties, Haridasan S of AMU has the highest citations per publication (20) followed by Singh SN (11.6) of MZU, Ali PMN (11) of AMU and Raza MM (10.5) of AMU. The citations per publication are greater than 1 for 27 faculties, 1 for 5 faculties, lesser than 1 for 6 faculties and nil for 11 faculties.

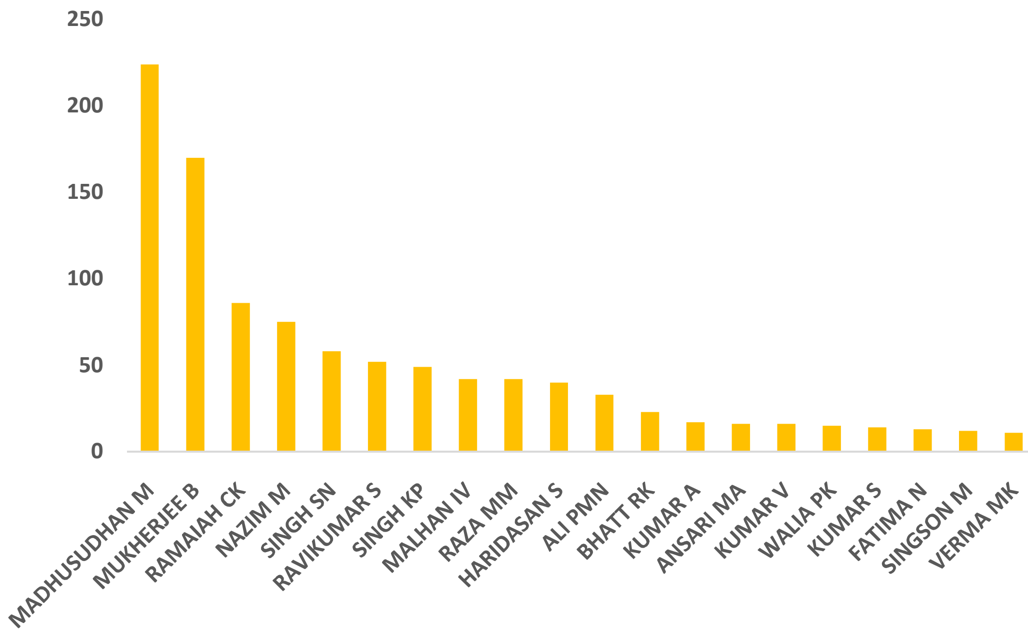


Fig. 4.32: Most Cited Faculty

4.2.2.3.5.4 Lotka's Law of Productivity

According to Lotka's Law, in the frequency distribution of scientific productivity, the number of authors making *n* contribution is about $1/n^2$ of those making one, and the proportion of all contributors that make a single contribution is about 60% (Lotka, 1926).

Table 4.42: Frequency Distribution of Scientific Productivity

Documents Published	No. of Authors	Proportion of Authors
1	131	0.61
2	30	0.14
3	15	0.07
4	15	0.07
5	4	0.01
7	5	0.02
8	2	0.009
9	2	0.009

10	3	0.014
11	2	0.009
19	1	0.004
23	1	0.004
30	1	0.004
33	1	0.0046

(Source: Survey Data)

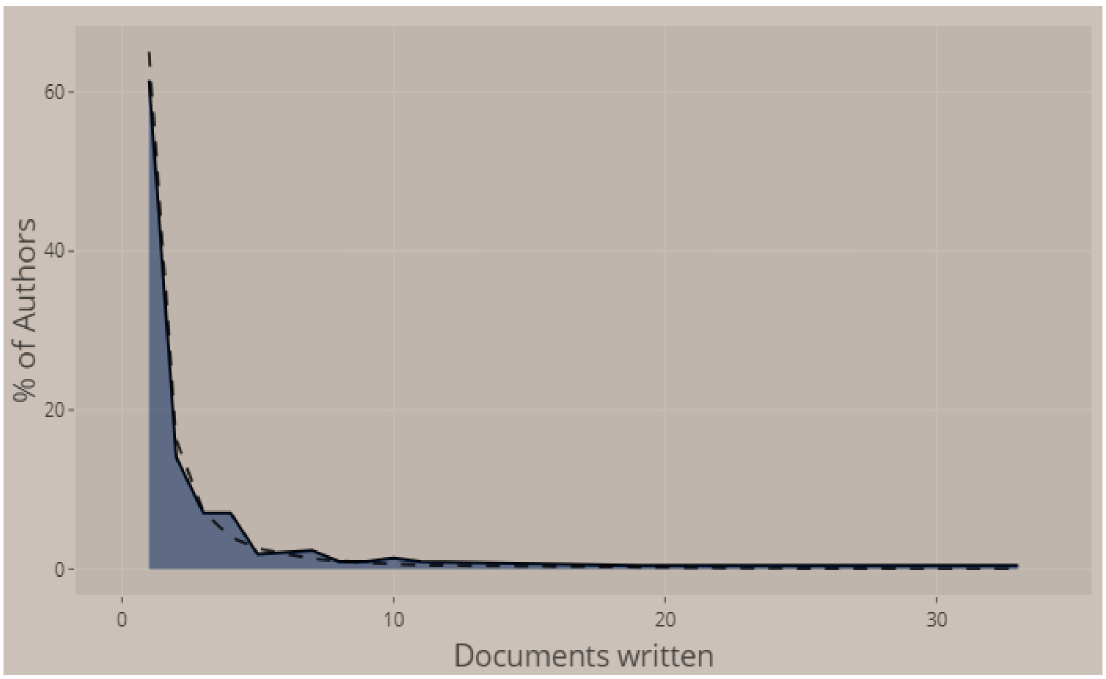


Fig. 4.33: Frequency Distribution of Scientific Productivity

If authors are arranged according to their productivity, the majority have only a few publications while only a selected portion is highly productive and the number of authors that publish a certain quantity of works is inversely proportional to the square of those works (Bailón-Moreno, Jurado-Alameda, Ruiz-Baños, & Courtial, 2005). Table 4.42 represents the frequency distribution of scientific productivity of LIS faculties in increasing order of documents written by them and the numbers of authors involved in the writing of those documents. It has been observed that about 60% of authors have contributed one publication, 14% authors have contributed two publications, and 7% authors have contributed three papers and so on. This suggests that the productivity distribution of authors in the LIS field follows Lotka's Law.

4.2.2.3.5.5 Year-wise Growth of Research Publications

Year-wise number of research publications, cumulative growth and Compound Annual Growth Rate (CAGR) were analyzed as shown in Table 4.43 that denotes there is a total of 274 publications from the year 1987 to 2019*. The highest number of publications (138, 50.36% of total) is observed during the last 5 years i.e. from 2015-2019 and year 2018 witnessed the highest number (40, 14.59% of total) of publications during last 33 years followed by year 2017 (28, 10.21%) and year 2015 (27, 9.85%). Fig. 4.34 represents a continuous increasing trend in publications from the year 2006 onwards. In the year 2019 (up to 6th July 2019), there has been 25 (10.04%) publications and chances are there to be increased till the end of the year.

Table 4.43: Year-wise Growth of Publications

Year	Publications	Cumulative Growth	% of Publications	CAGR
1987	1	1	0.36	---
1993	2	3	0.72	20.09%
1995	2	5	0.72	29.10%
1997	1	6	0.36	9.54%
2001	1	7	0.36	3.93%
2002	1	8	0.36	14.29%
2003	2	10	0.72	25%
2004	3	13	1.09	30%
2005	2	15	0.72	15.38%

2006	3	18	1.09	20%
2007	6	24	2.18	33.33%
2008	9	33	3.28	37.50%
2009	11	44	4.01	33.33%
2010	15	59	5.47	34.09%
2011	15	74	5.47	25.42%
2012	23	97	8.39	31.08%
2013	16	113	5.83	16.49%
2014	23	136	8.39	20.35%
2015	27	163	9.85	19.85%
2016	18	181	6.56	11.04%
2017	28	209	10.21	15.47%
2018	40	249	14.59	19.14%
2019*	25	274	9.12	10.04%

*Up to July 2019 (Source: Survey Data)

CAGR (https://wiki.treasurers.org/wiki/Compound_Annual_Growth_Rate) is calculated from total growth over a longer period as:

CAGR = (End Value / Starting Value) $^{(1/n)}$ - 1
Where:
n = Number of years between the two value

The average CAGR of publications over the period is 21.56% and during the decade 2000-2009, it was 22.23% as compared to 20.30% during 2010-2019. The CAGR is found maximum in the year 2008 as 37.5% followed by 34.09% in 2010, and 33.33% in 2007 & 2009.

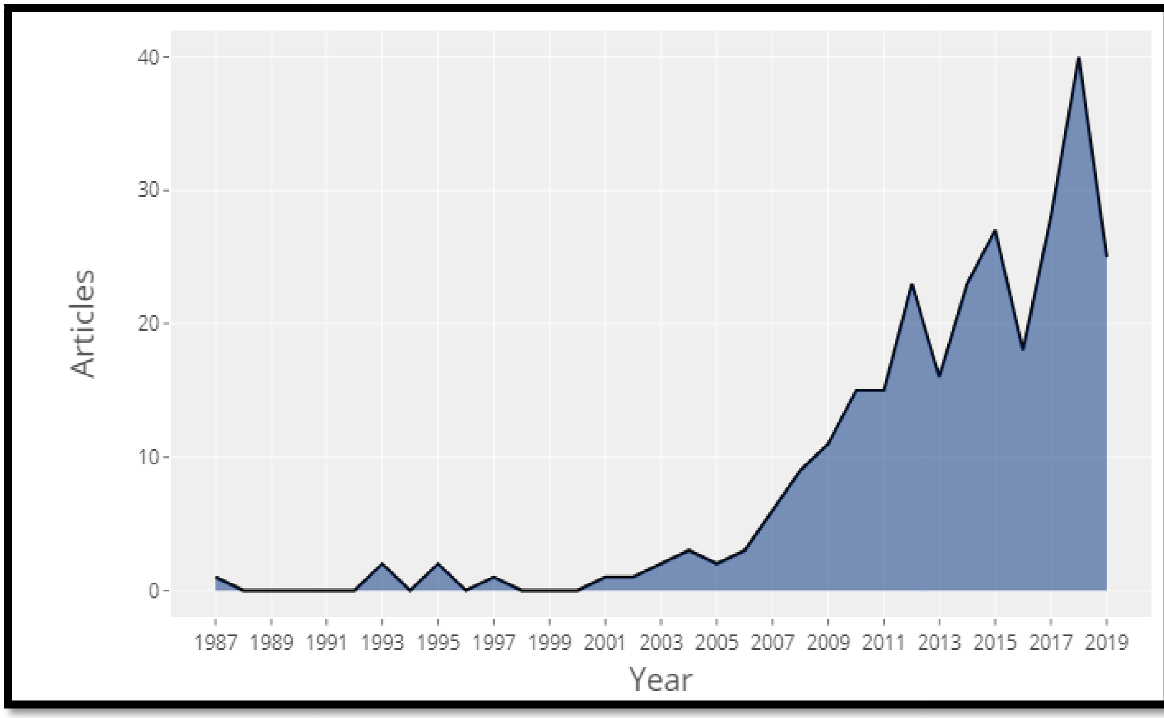


Fig. 4.34: Year-wise Scientific Productivity of LIS Faculties

4.2.2.3.5.6 Year-wise Growth of Citations

Year-wise number of citations, citations per publication, citations per year and total citable years of publications are represented in Table 4.44. During the year 1987 to 2019, a total of 1091 citations for 274 publications have been observed, and the highest number of citations (549, 50.32% of total) have been observed during the period 2011 to 2015. The number of citations is found the highest in the year 2015 (172) followed by the year 2009 (122) & year 2011 (100). Average citations per publication are calculated as 3.98 for total publications. The citations per publication are found the highest in the year 2002 (16) followed by in the year 2006 (14), in the year 2009 (11.09), in the year 2008 (10.22) & in the year 2001 (10). During the last five years i.e. from 2015 – 2019, on an average 1.88 citations per publication is found against 138 publications which are far below average citations per publication.

Table 4.44: Year-wise Growth of Citations

Year	No. of Publications	No. of Citations	Citations per Pub.	Citations per Year	Citable Years
1987	1	1	1	0.03	32
1988	0	0	0	0	0
1989	0	0	0	0	0
1990	0	0	0	0	0
1991	0	0	0	0	0
1992	0	0	0	0	0
1993	2	2	1	0.03	26
1994	0	0	0	0	0
1995	2	3	1.5	0.06	24
1996	0	0	0	0	0
1997	1	0	0	0	22
1998	0	0	0	0	0
1999	0	0	0	0	0
2000	0	0	0	0	0
2001	1	10	10	0.55	18
2002	1	16	16	0.94	17
2003	2	16	8	0.5	16
2004	3	18	6	0.4	15
2005	2	14	7	0.5	14
2006	3	42	14	1.07	13
2007	6	50	8.33	0.69	12
2008	9	92	10.22	0.92	11
2009	11	122	11.09	1.1	10
2010	15	83	5.53	0.61	9
2011	15	100	6.66	0.83	8
2012	23	98	4.26	0.6	7
2013	16	89	5.56	0.92	6
2014	23	90	3.91	0.78	5

2015	27	172	6.37	1.59	4
2016	18	27	1.5	0.5	3
2017	28	33	1.17	0.58	2
2018	40	11	0.27	0.27	1
2019	25	2	0.08		0

(Source: Survey Data)

Citable year denotes the total number of years for a document after its publication available for getting citations, and citation per year calculated based on total citable years of publications as shown in Fig. 4.35. The average citations per year are found to be 0.42 for the whole study period i.e. 33 years and citations per year are found to be highest as 1.59 with the citable year is 4 (i.e. published in 2015) followed by 1.10 (2009) and 1.07 (2006).

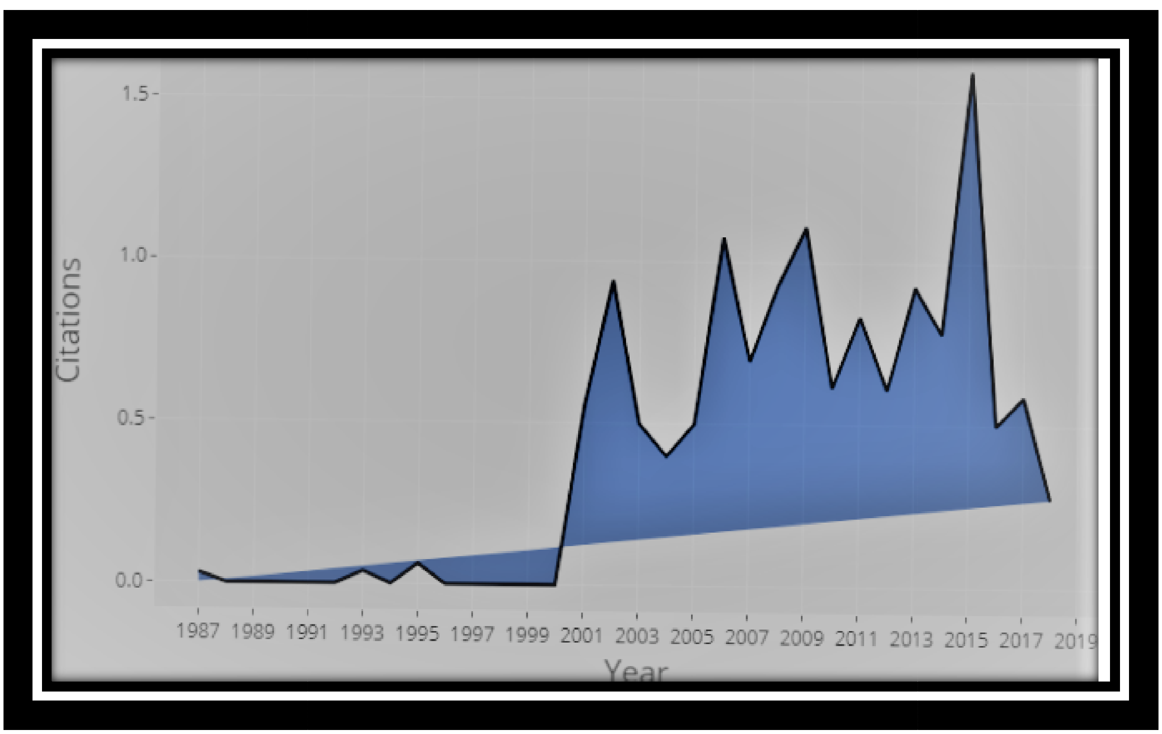


Fig. 4.35: Average Citations per Year

4.2.2.3.5.7 Publication Impact of LIS Faculties

Quantitative measurement of research publications does not support to identify the quality of the publication. Citation analysis, to an extent, helps in scientometric related studies to evaluate the research performance in terms of qualities and relevance of a publication to determine the impact (rank or position) of individual, journal, institution or country. Some of the well-known standard tools like *h*-index, *g*-index & *m*-index are available for the evaluation of the scientific impact of research scientists (Radicchi, Fortunato & Castellano, 2008). Jorge E. Hirsch (2005) devised the concept of *h*-index which is defined as the number of papers that a person has with citations equal to or greater than *h* (Roediger, 2006). The beauty of *h*-index is that it relates both publication & citation impact in a single value. The *h*-index is calculated for the observed LIS faculties and among top five, Mukherjee B of BHU has the highest h-index (9) followed by Madhusudhan M (8) of DU, Nazim M (7) of AMU, Ramaiah CK (6) of PU & Singh KP (5) of DU. The *g*-index measures the impact of the overall scientific paper of an author (De Visscher, 2011). The *g*-index is found highest for Madhusudhan M (14) of DU followed by Mukherjee B (12) of BHU, Nazim M (9) of AMU, Ramaiah CK (8) of PU, and Ravikumar S, Singh KP & Singh SN each has *g*-index 7.

Table 4.45: Impact of Faculties Publication

Author	h_index	g_index	Affiliation
ALI PMN	2	3	AMU
ANSARI MA	2	4	AMU
BHATT RK	4	5	DU
FATIMA N	2	3	AMU
GALA B	0	0	CUG

GAYAN MA	0	0	TU
HANGSING P	2	3	NEHU
HARIDASAN S	2	2	AMU
KANJILAL U	2	2	IGNOU
KANUNGO NT	1	1	IGNOU
KUMAR A	4	5	MZU
KUMAR S	3	3	DU
KUMAR V	1	4	BBAU
LALOO B	0	0	NEHU
LEELADHARAN M	1	1	PU
MADHUSUDHAN M	8	14	DU
MAHAPATRA RK	2	2	TU
MALHAN IV	4	6	CUHP
MISHRA JK	2	2	HSGU
MISHRA R	1	1	BHU
MISHRA R N	1	1	MZU
MUKHERJEE B	9	12	BHU
NAZIM M	7	9	AMU
NGURTINKHUMA RK	0	0	MZU
PANDEY SR	0	0	BHU
PATEL D	1	2	CUHP
PHURITSABAM B	1	1	MU
PILLAI SKG	0	0	CUTN
PRASAD HN	1	1	BHU
RAMAIAH CK	6	8	PU
RAVIKUMAR S	2	7	NEHU
RAZA MM	2	4	AMU
REKHA RV	0	0	PU
SARMAH M	0	0	AU
SEVUKAN R	1	1	PU
SHARMA J	2	2	IGNOU
SHUKLA A	2	2	MZU
SHUKLA Ar	2	3	IGNOU
SINGH CI	1	1	MU
SINGH KP	5	7	DU
SINGH MP	1	1	BBAU

SINGH SN	3	7	MZU
SINGSON M	3	3	PU
SINHA MK	1	1	AU
SONKER SK	1	1	BBAU
SULOCHANA A	0	0	CUTN
THAPA N	0	0	HSGU
TRIPATHI A	1	1	BHU
VERMA MK	2	3	MZU
VERMA S	1	1	BBAU
WALIA PK	2	3	DU
YADAV M	1	1	DU
YANTHAN Z	1	1	IGNOU

(Source: Survey Data)

4.2.2.3.5.8 Co-authorship Pattern

Co-authorship is a proxy of research collaboration (network) that links a set of authors based on their shared publication activity (Kumar, 2015). Co-authorship among faculties from different organizations and institutions shows the multidisciplinary and collaborative work which is a robust indicator for the value of research. The co-authorship pattern of LIS faculty is analyzed based on the number of documents shared among them as shown in Table 4.46. Among the top three collaborations, the highest number of shared publications are found between Mukherjee B & Nazim M (10) followed by Bhatt R & Kumar A (6) and Mukherjee B & Vishwakarma P (5).

Table 4.46: Co-authorship Pattern of LIS Faculties

No. of Shared Document	First Author	Second Author
10	Mukherjee B	Nazim M
6	Bhatt R	Kumar A
5	Mukherjee B	Vishwakarma P
5	Malhan I	Rao S

4	Ramaiah C	Shimray S
4	Brahma K	Verma M
4	Ngurtinkhuma R	Shukla A
4	Maurya S	Shukla A
4	Kumar S	Sanaman G
4	Maurya S	Ngurtinkhuma RK
3	Gala B	Potnis D
3	Arora M	Varshney D
3	Singson M	Thiyagarajan S
3	Foo S	Ramaiah C
3	Arora M	Kanjilal U
3	Lamba M	Madhusudhan M
3	Kanjilal U	Varshney D
3	Agrahari A	Singh S
3	Husain S	Nazim M
3	Singh S	Yadav S
3	Shukla A	Tripathi M
3	Singh S	Verma M
3	Fatima N	Hussain A
2	Leeladharan M	Thiyagarajan S
2	Madhusudhan M	Senthil V
2	Shukla R	Verma M
2	Leeladharan M	Singson M
2	Kumar A	Yusuf M
2	Verma M	Yadav S
2	Shukla A	Sonker S
2	Sevukan R	Singson M
2	Ravikumar S	Singh A
2	Ravikumar S	Singh S
2	Murugaiyan M	Singson M
2	Murugaiyan M	Sevukan R
2	Sonker S	Tripathi M
2	Tyagi U	Yanthan Z
2	Raza M	Upadhyay A
2	Moyon N	Shukla A
2	Bebi	Singh K
2	Gupta M	Walia P

2	Hazarika H	Ravikumar S
2	Hangsing P	Singson M
2	Gill M	Singh K
2	Devi K	Verma M
2	Fatima N	Kumar D
2	Bhatt R	Yusuf M
2	Dar S	Madhusudhan M
2	Hussain A	Kumar D
2	Kanjilal U	Tripathi S
2	Arya H	Mishra J
2	Ansari M	Fatima S
2	Khoon L	Ramaiah C
2	Agrahari A	Ravikumar S
2	Ali P	Nisha F
2	Kaba A	Ramaiah C
1	Bhardwaj R	Walia P
1	Tripathi A	Tripathi S
1	Bhatt R	Singh K
1	Singh M	Tripathi A
1	Singh P	Tripathi A
1	Bebi	Kumar S
1	Arora M	Verma S
1	Bhardwaj R	Madhusudhan M
1	Shukla R	Singh S
1	Kumar V	Yanthan Z
1	Kumar V	Tyagi U
1	Madalli D	Singh A
1	Madalli D	Patel D
1	Kumar A	Singh M
1	Kumar A	Singh S
1	Kumar V	Madalli D
1	Kumar S	Singh M
1	Madhusudhan M	Singh P
1	Foo S	Khoon L
1	Garg K	Sharma J
1	Fatima S	Raza M
1	Fatima S	Upadhyay A

1	Gupta V	Pandey S
1	Gupta V	Sonker S
1	Mukherjee B	Singh A
1	Mishra R	Singh P

(Source: Survey Data)

Co-authorship does not necessarily lead as an indicator of collaborations and similarly, collaboration does not indicate co-authorship (Wagner & Leydesdorff, 2005). Author network analysis is done through Pajek visualization software that helps in exploring and visualizing the intensity and dynamics of relationships among authors. The network of authors represented in Fig. 4.36 shows a set of bubbles (vertices) and a set of lines (edges). The size of bubbles indicates the number of documents produced by the authors and the thickness of lines indicates the number of co-authored documents i.e. link strength among the authors. Generally, the link strength denotes the number of documents co-authored by the authors.

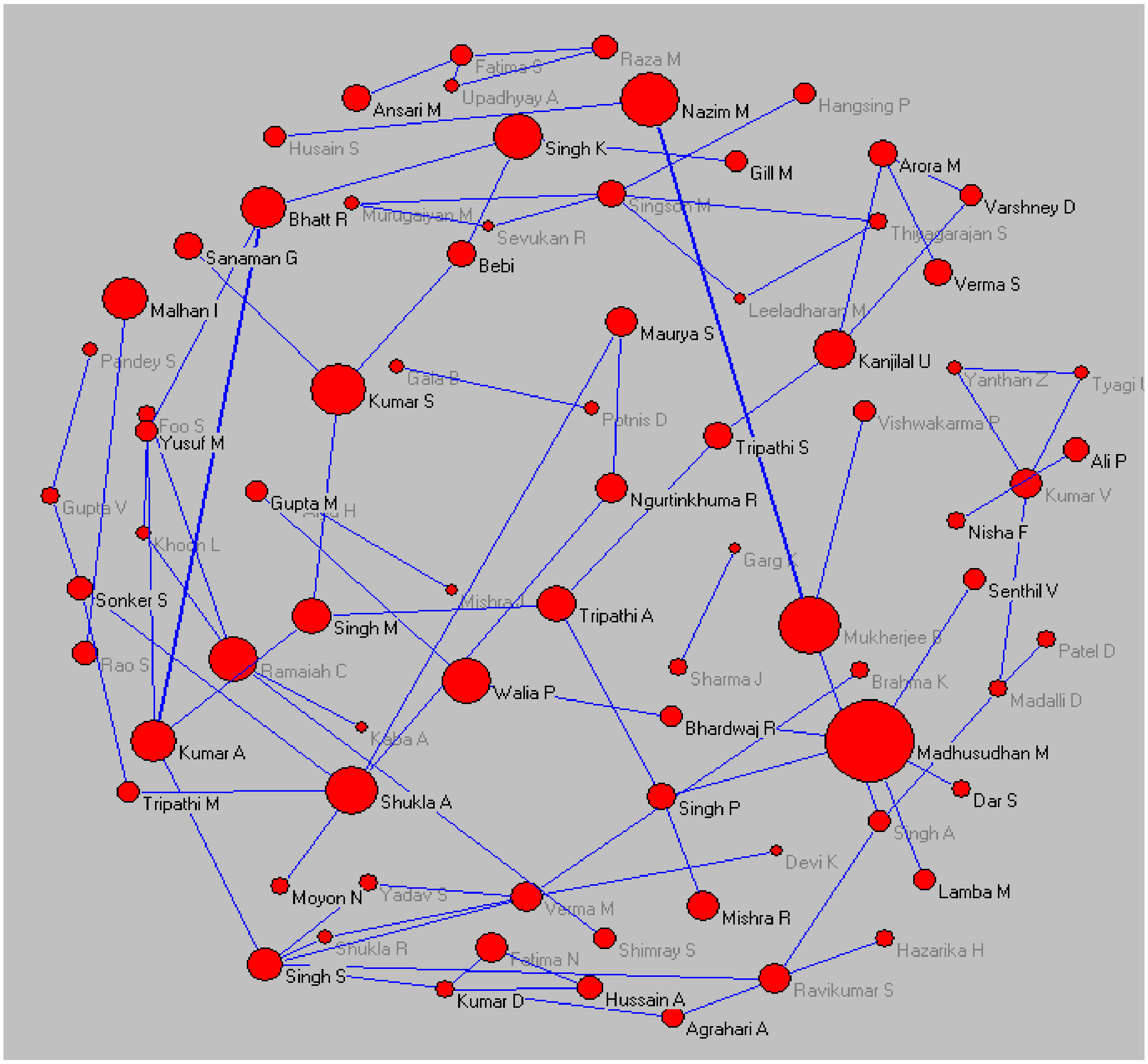


Fig. 4.36: Co-authorship Network of LIS Faculties

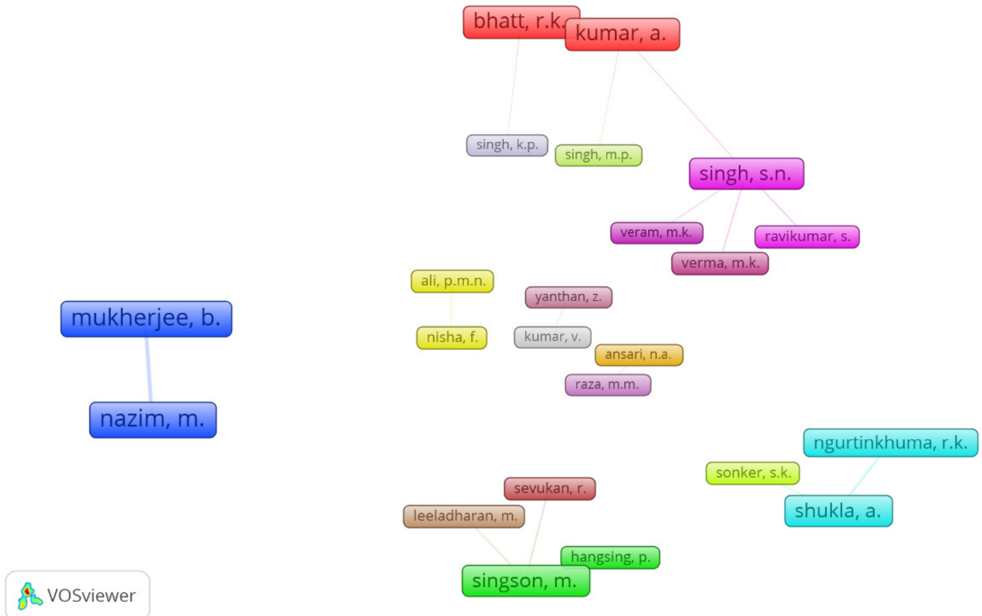


Fig. 4.37: Co-authorship Network among LIS Faculties of Central Universities

The co-authorship pattern among LIS faculty is determined by excluding the author which is not the faculty from the selected Central Universities of India. The study excluded the collaboration between LIS faculties of Central Universities and LIS faculties of other universities or non-teaching professionals of any organizations, and research scholars collaborating with selected LIS faculties. Thus, the study observed co-authorship for 54 documents authored by LIS faculties of Central Universities of India with 16 links and 40 total link strength among them as shown in Fig. 4.37. The link strength of the network shows the co-authorship pattern based on the total number of shared documents by the LIS faculties with each other. The highest total link strength (10) is found for Mukherjee B & Nazim M followed by Kumar A & Bhatt RK (6), Shukla A & Ngurtinkhuma RK (4) and so on.

4.2.2.3.5.9 Authorship Pattern & Degree of Collaboration

Authorship studies are an important bibliometric measure that helps in identifying the authors collaborating nature and contemporary communication pattern prevailing in any field of research. For the total 274 publications, the number of author's distribution for each publication has been calculated as shown in Table 4.47. Further, the study found a total of 213 individual authors, who appeared 540 times in all publications, and documents per author are calculated as 1.29. Among 274 documents, 62 documents (22.62%) are authored in single authorship, 162 documents (59.12%) are authored in two authorships, 46 documents (16.78%) are authored in three authorships, 4 documents (1.45%) authored in four authorships and no document authored in more than four authorships. The result reveals that the multi-authorship pattern is more prevalent than single authorship in publication activities among LIS faculties.

Table 4.47: Authorship Pattern of LIS Faculties

No. of Author	Single Author	Two Author	Three Author	Four Author	>Four Author	Total
No. of Publication	62 (22.62%)	162 (59.12%)	46 (16.78%)	4 (1.45%)	0	274
Total Authors	62 (11.48%)	324 (60%)	138 (25.55%)	16 (5.83%)	0	540

(Source: Survey Data)

Degree of Collaboration (C) is calculated as per formula given by (Subramanyam, 1983) which is defined as the ratio of multi-authored research paper to the total number of research papers in a discipline for a given period. It is expressed as

$$C = Nm / (Nm + Ns)$$

Where C is the Degree of Collaboration for a discipline, *Nm* is the number of multi-authored research papers, *Ns* is the number of single-authored research papers. Applying the given formula, the study found the Degree of Collaboration as 0.77 which depicts the multi-authored approach by LIS faculties.

4.2.2.3.5.10 Types of Sources

The distribution of the source is analyzed along with the number of documents per source. For a total of 274 documents, 8 types of sources have been identified as shown in Table 4.48. Journal Articles (223) are the most preferred and contributing types of source which contributed 81.38% of total documents followed by Conference Proceeding Papers (15, 5.47%), Books (4, 1.45%), Book Chapters (11, 4.01%), Editorials (3, 1.09%), Reviews (16, 5.83), Short Survey (1, 0.36%) and Notes (1, 0.36%).

Table 4.48: Sources of Publication

Source	No. of Documents	%
Journal Article	223	81.38
Conference Proceedings Paper	15	5.47
Book	4	1.45
Book Chapter	11	4.01
Editorial	3	1.09
Review	16	5.83
Short Survey	1	0.36
Note	1	0.36

(Source: Survey Data)

4.2.2.3.5.11 Productive Sources and Their Impact

Table 4.49 represents the most relevant sources of publication along with the total number of publications, the total number of citations, *the h*-index and the *g*-index of sources. A total of 72 sources are found for 274 publications from the selected LIS faculties as per the Scopus database. *Library Philosophy and Practice* is the most preferred source of publication by the faculties of LIS and they contributed the highest (61, 22.26% of total) number of articles followed by *DESIDOC Journal of Library and Information Technology* (48, 17.51%), *Annals of Library and Information Studies* (17, 6.2%), *Library Review* (14, 5.1%), *Electronic Library* (12, 4.37%) and *International Information and Library Review* (12, 4.37%). The above mentioned 6 sources of publications contributed 59.85% of total publications and each having more than 10 publications. Less than 5 publications are found for 62 sources of publications and altogether they have contributed 31.75% of total publications, and only 1 publication is found for 47 sources of publications.

Table 4.49: Productive Sources and Their Impact

Source Name	No. of Articles	Total Citations	*h*-index	*g*-index
LIBRARY PHILOSOPHY AND PRACTICE	61	86	5	7
DESIDOC JOURNAL OF LIBRARY AND INFORMATION TECHNOLOGY	48	81	4	6
ANNALS OF LIBRARY AND INFORMATION STUDIES	17	24	2	3
LIBRARY REVIEW	14	80	7	8
ELECTRONIC LIBRARY	12	117	6	10
INTERNATIONAL INFORMATION AND LIBRARY REVIEW	12	145	6	12

LIBRARY HI TECH NEWS	7	48	3	6
COLLECTION BUILDING	6	34	2	5
PROGRAM	5	46	4	5
SCIENTOMETRICS	5	128	3	5
LIBRARY MANAGEMENT	4	26	3	4
2015 4TH INTERNATIONAL SYMPOSIUM ON EMERGING TRENDS AND TECHNOLOGIES IN LIBRARIES AND INFORMATION SERVICES ETTLIS 2015 – PROCEEDINGS	3	1	1	1
IEEE 5TH INTERNATIONAL SYMPOSIUM ON EMERGING TRENDS AND TECHNOLOGIES IN LIBRARIES AND INFORMATION SERVICES ETTLIS 2018	3	1	1	1
INTERNATIONAL JOURNAL OF INFORMATION SCIENCE AND MANAGEMENT	3	0	0	0
JOURNAL OF ACADEMIC LIBRARIANSHIP	3	23	3	3
LIBRARY HI TECH	3	49	2	3
NEW LIBRARY WORLD	3	15	2	3
OPEN SOURCE TECHNOLOGY: CONCEPTS METHODOLOGIES TOOLS AND APPLICATIONS	3	0	0	0
WEBOLOGY	3	19	3	3
ACM INTERNATIONAL CONFERENCE PROCEEDING SERIES	2	0	0	0
CURRENT SCIENCE	2	5	1	2
DEVELOPING SUSTAINABLE DIGITAL LIBRARIES: SOCIO-TECHNICAL PERSPECTIVES	2	4	1	2
JOURNAL OF LIBRARY AND INFORMATION SERVICES IN DISTANCE LEARNING	2	8	2	2
KNOWLEDGE MANAGEMENT IN LIBRARIES: CONCEPTS TOOLS AND APPROACHES	2	2	1	1

LECTURE NOTES IN COMPUTER SCIENCE (INCLUDING SUBSERIES LECTURE NOTES IN ARTIFICIAL INTELLIGENCE AND LECTURE NOTES IN BIOINFORMATICS)	2	1	1	1
ASSISTIVE TECHNOLOGY	1	4	1	1
CATALOGING AND CLASSIFICATION QUARTERLY	1	1	1	1
COLLECTION MANAGEMENT	1	0	0	0
COMPUTERS IN LIBRARIES	1	0	0	0
DIGITAL INFORMATION EXCHANGE: PATHWAYS TO BUILD GLOBAL INFORMATION SOCIETY	1	0	0	0
E-AGRICULTURE AND E-GOVERNMENT FOR GLOBAL POLICY DEVELOPMENT: IMPLICATIONS AND FUTURE DIRECTIONS	1	0	0	0
EDUCATION FOR INFORMATION	1	1	1	1
GLOBAL KNOWLEDGE MEMORY AND COMMUNICATION	1	0	0	0
HUMAN RIGHTS AND ETHICS: CONCEPTS METHODOLOGIES TOOLS AND APPLICATIONS	1	0	0	0
IFLA JOURNAL	1	6	1	1
INFORMATION DEVELOPMENT	1	0	0	0
INFORMATION PROCESSING AND MANAGEMENT	1	2	1	1
INNOVATIONS IN COMPUTING SCIENCES AND SOFTWARE ENGINEERING	1	0	0	0
INTERDISCIPLINARY JOURNAL OF INFORMATION KNOWLEDGE AND MANAGEMENT	1	0	0	0
INTERNATIONAL JOURNAL OF MEDICAL TOXICOLOGY AND LEGAL MEDICINE	1	0	0	0
INTERNATIONAL JOURNAL OF WEB	1	0	0	0

BASED COMMUNITIES				
JOURNAL OF ELECTRONIC PUBLISHING	1	7	1	1
JOURNAL OF ELECTRONIC RESOURCES IN MEDICAL LIBRARIES	1	0	0	0
JOURNAL OF INFORMATION AND KNOWLEDGE MANAGEMENT	1	7	1	1
JOURNAL OF INFORMATION SCIENCE	1	25	1	1
JOURNAL OF INFORMATION SCIENCE THEORY AND PRACTICE	1	0	0	0
JOURNAL OF KNOWLEDGE MANAGEMENT	1	5	1	1
JOURNAL OF LIBRARY ADMINISTRATION	1	2	1	1
JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE AND TECHNOLOGY	1	21	1	1
JOURNAL OF WEB LIBRARIANSHIP	1	1	1	1
JURNAL KOMUNIKASI: MALAYSIAN JOURNAL OF COMMUNICATION	1	0	0	0
LEARNED PUBLISHING	1	10	1	1
LECTURE NOTES IN NETWORKS AND SYSTEMS	1	0	0	0
LIBRARY ACQUISITIONS: PRACTICE AND THEORY	1	2	1	1
LIBRARY AND INFORMATION SCIENCE IN DEVELOPING COUNTRIES: CONTEMPORARY ISSUES	1	3	1	1
LIBRARY AND INFORMATION SCIENCE RESEARCH	1	8	1	1
LIBRARY AND INFORMATION SERVICES FOR BIOINFORMATICS EDUCATION AND RESEARCH	1	1	1	1
LIBRARY COLLECTIONS ACQUISITION AND TECHNICAL SERVICES	1	1	1	1
LIBRES	1	6	1	1
LIBRI	1	3	1	1
MALAYSIAN JOURNAL OF LIBRARY	1	4	1	1

AND INFORMATION SCIENCE				
MANAGING KNOWLEDGE AND SCHOLARLY ASSETS IN ACADEMIC LIBRARIES	1	0	0	0
PROCEEDINGS - 2012 IEEE INTERNATIONAL CONFERENCE ON TECHNOLOGY ENHANCED EDUCATION ICTEE 2012	1	3	1	1
PROCEEDINGS OF THE 3RD EUROPEAN CONFERENCE ON INFORMATION MANAGEMENT AND EVALUATION ECIME 2009	1	0	0	0
PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON DUBLIN CORE AND METADATA APPLICATIONS	1	2	1	1
PROGRESSIVE TRENDS IN ELECTRONIC RESOURCE MANAGEMENT IN LIBRARIE	1	2	1	1
SCHOLARLY COMMUNICATION IN LIBRARY AND INFORMATION SERVICES: THE IMPACTS OF OPEN ACCESS JOURNALS AND E-JOURNALS ON A CHANGING SCENARIO	1	1	1	1
SERIALS REVIEW	1	0	0	0
SOCIAL NETWORK ANALYSIS AND MINING	1	0	0	0
STUDIES IN INDIAN POLITICS	1	4	1	1
THE BOTTOM LINE	1	10	1	1
THE ELECTRONIC LIBRARY	1	6	1	1

(Source: Survey Data)

The impact of sources of publication is analyzed with the help of the number of citations of each source. A total of 1091 citations from 72 sources are found as shown in Table 4.49. *International Information and Library Review* received the highest (145, 13.29% of total citations) number of citations followed by *Scientometrics* (128, 11.73%), *Electronic Library* (117, 10.72%), *Library Philosophy and Practice* (86, 7.88%), *DESIDOC Journal of Library and Information Technology* (81, 7.42%) and *Library Review* (80, 7.33).

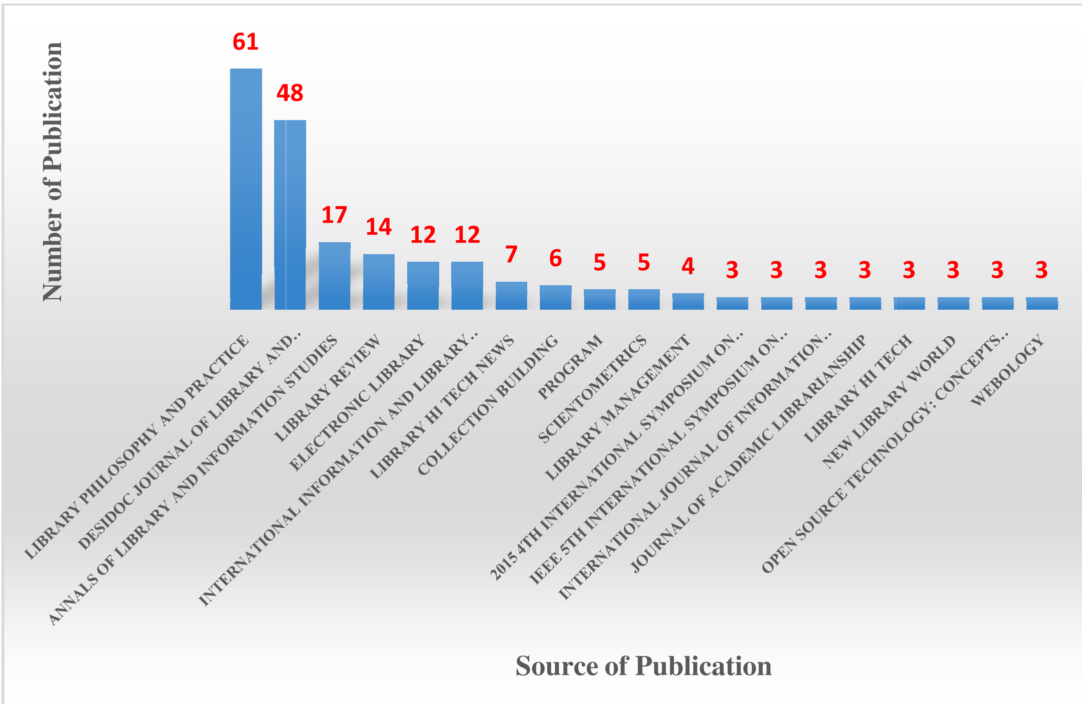


Fig. 4.38: Preferred Sources of Publication

The *h*-index is found the highest for *Library Review* (7) followed by *International Information and Library Review* (6), *Electronic Library* (6), *Library Philosophy and Practice* (5), *DESIDOC Journal of Library & Information Technology* (4) and *Program* (4). The *h*-index is found 3 for 5 sources, 2 for 5 sources, 1 for 34 sources and nil for 22 sources. The *g*-index is found the highest for *International Information and Library Review* (12) followed by *Electronic Library* (10), *Library Review* (8), *Library Philosophy and Practice* (7), *DESIDOC Journal of Library & Information Technology* (6) and *Library Hi Tech News* (6). The *g*-index is found 5 for 3 sources, 4 for 1 source, 3 for 5 sources, 2 for 3 sources, 1 for 32 sources and nil for 22 sources.

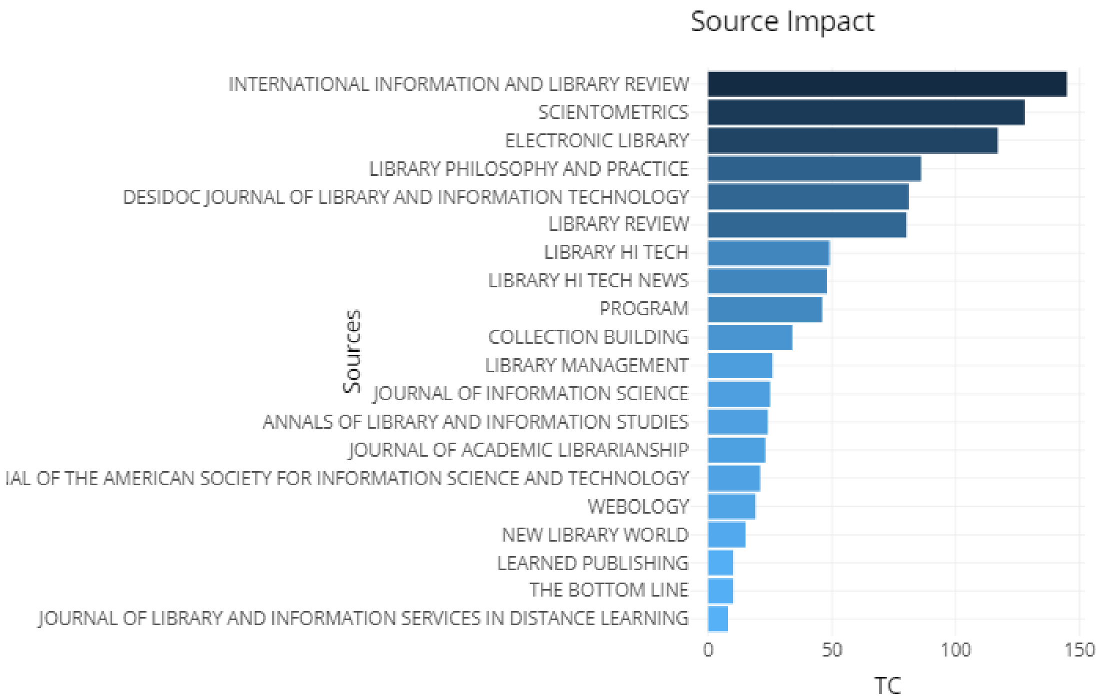


Fig. 4.39: Top 20 Most Cited Sources of Publications

4.2.2.3.5.12 Bradford's Law of Distribution

Bradford's Law states that "the articles on a given subject concentrate heavily on a relatively small core of highly productive journals. If scientific journals are arranged in a 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 of zones containing the same number of articles as the nucleus, when the number of periodicals in the nucleus and succeeding zones will be $1:n:n^2$" (Banateppanavar, Dharanikumar & Vindya, 2015). The rank of each source based on the frequency of articles published is represented in three groups of zones as shown in Table 4.50.

Table 4.50: Frequency Distribution of Articles in Sources

Source Name	Rank	Frequency	Cumulative Frequency	Zones
LIBRARY PHILOSOPHY AND PRACTICE	1	61	61	Zone 1
DESIDOC JOURNAL OF LIBRARY AND INFORMATION TECHNOLOGY	2	48	109	Zone 1
ANNALS OF LIBRARY AND INFORMATION STUDIES	3	17	126	Zone 2
LIBRARY REVIEW	4	14	140	Zone 2
ELECTRONIC LIBRARY	5	12	152	Zone 2
INTERNATIONAL INFORMATION AND LIBRARY REVIEW	6	12	164	Zone 2
LIBRARY HI TECH NEWS	7	7	171	Zone 2
COLLECTION BUILDING	8	6	177	Zone 2
PROGRAM	9	5	182	Zone 2
SCIENTOMETRICS	10	5	187	Zone 2
LIBRARY MANAGEMENT	11	4	191	Zone 3
2015 4TH INTERNATIONAL SYMPOSIUM ON EMERGING TRENDS AND TECHNOLOGIES IN LIBRARIES AND INFORMATION SERVICES, ETTLIS 2015 – PROCEEDINGS	12	3	194	Zone 3
IEEE 5TH INTERNATIONAL SYMPOSIUM ON EMERGING TRENDS AND TECHNOLOGIES IN LIBRARIES AND INFORMATION SERVICES, ETTLIS 2018	13	3	197	Zone 3
INTERNATIONAL JOURNAL OF INFORMATION SCIENCE AND MANAGEMENT	14	3	200	Zone 3
JOURNAL OF ACADEMIC LIBRARIANSHIP	15	3	203	Zone 3
LIBRARY HI TECH	16	3	206	Zone 3
NEW LIBRARY WORLD	17	3	209	Zone 3
OPEN SOURCE TECHNOLOGY: CONCEPTS, METHODOLOGIES, TOOLS, AND APPLICATIONS	18	3	212	Zone 3

WEBOLOGY	19	3	215	Zone 3
ACM INTERNATIONAL CONFERENCE PROCEEDING SERIES	20	2	217	Zone 3
CURRENT SCIENCE	21	2	219	Zone 3
DEVELOPING SUSTAINABLE DIGITAL LIBRARIES: SOCIO-TECHNICAL PERSPECTIVES	22	2	221	Zone 3
JOURNAL OF LIBRARY AND INFORMATION SERVICES IN DISTANCE LEARNING	23	2	223	Zone 3
KNOWLEDGE MANAGEMENT IN LIBRARIES: CONCEPTS, TOOLS AND APPROACHES	24	2	225	Zone 3
LECTURE NOTES IN COMPUTER SCIENCE (INCLUDING SUBSERIES LECTURE NOTES IN ARTIFICIAL INTELLIGENCE AND LECTURE NOTES IN BIOINFORMATICS)	25	2	227	Zone 3
ASSISTIVE TECHNOLOGY	26	1	228	Zone 3
CATALOGING AND CLASSIFICATION QUARTERLY	27	1	229	Zone 3
COLLECTION MANAGEMENT	28	1	230	Zone 3
COMPUTERS IN LIBRARIES	29	1	231	Zone 3
DIGITAL INFORMATION EXCHANGE: PATHWAYS TO BUILD GLOBAL INFORMATION SOCIETY	30	1	232	Zone 3
E-AGRICULTURE AND E-GOVERNMENT FOR GLOBAL POLICY DEVELOPMENT: IMPLICATIONS AND FUTURE DIRECTIONS	31	1	233	Zone 3
EDUCATION FOR INFORMATION	32	1	234	Zone 3
GLOBAL KNOWLEDGE, MEMORY AND COMMUNICATION	33	1	235	Zone 3
HUMAN RIGHTS AND ETHICS: CONCEPTS, METHODOLOGIES, TOOLS, AND APPLICATIONS	34	1	236	Zone 3
IFLA JOURNAL	35	1	237	Zone 3

INFORMATION DEVELOPMENT	36	1	238	Zone 3
INFORMATION PROCESSING AND MANAGEMENT	37	1	239	Zone 3
INNOVATIONS IN COMPUTING SCIENCES AND SOFTWARE ENGINEERING	38	1	240	Zone 3
INTERDISCIPLINARY JOURNAL OF INFORMATION, KNOWLEDGE, AND MANAGEMENT	39	1	241	Zone 3
INTERNATIONAL JOURNAL OF MEDICAL TOXICOLOGY AND LEGAL MEDICINE	40	1	242	Zone 3
INTERNATIONAL JOURNAL OF WEB BASED COMMUNITIES	41	1	243	Zone 3
JOURNAL OF ELECTRONIC PUBLISHING	42	1	244	Zone 3
JOURNAL OF ELECTRONIC RESOURCES IN MEDICAL LIBRARIES	43	1	245	Zone 3
JOURNAL OF INFORMATION AND KNOWLEDGE MANAGEMENT	44	1	246	Zone 3
JOURNAL OF INFORMATION SCIENCE	45	1	247	Zone 3
JOURNAL OF INFORMATION SCIENCE THEORY AND PRACTICE	46	1	248	Zone 3
JOURNAL OF KNOWLEDGE MANAGEMENT	47	1	249	Zone 3
JOURNAL OF LIBRARY ADMINISTRATION	48	1	250	Zone 3
JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE AND TECHNOLOGY	49	1	251	Zone 3
JOURNAL OF WEB LIBRARIANSHIP	50	1	252	Zone 3
JURNAL KOMUNIKASI: MALAYSIAN JOURNAL OF COMMUNICATION	51	1	253	Zone 3
LEARNED PUBLISHING	52	1	254	Zone 3
LECTURE NOTES IN NETWORKS AND SYSTEMS	53	1	255	Zone 3
LIBRARY ACQUISITIONS: PRACTICE	54	1	256	Zone 3

AND THEORY				
LIBRARY AND INFORMATION SCIENCE IN DEVELOPING COUNTRIES: CONTEMPORARY ISSUES	55	1	257	Zone 3
LIBRARY AND INFORMATION SCIENCE RESEARCH	56	1	258	Zone 3
LIBRARY AND INFORMATION SERVICES FOR BIOINFORMATICS EDUCATION AND RESEARCH	57	1	259	Zone 3
LIBRARY COLLECTIONS, ACQUISITION AND TECHNICAL SERVICES	58	1	260	Zone 3
LIBRES	59	1	261	Zone 3
LIBRI	60	1	262	Zone 3
MALAYSIAN JOURNAL OF LIBRARY AND INFORMATION SCIENCE	61	1	263	Zone 3
MANAGING KNOWLEDGE AND SCHOLARLY ASSETS IN ACADEMIC LIBRARIES	62	1	264	Zone 3
PROCEEDINGS - 2012 IEEE INTERNATIONAL CONFERENCE ON TECHNOLOGY ENHANCED EDUCATION, ICTEE 2012	63	1	265	Zone 3
PROCEEDINGS OF THE 3RD EUROPEAN CONFERENCE ON INFORMATION MANAGEMENT AND EVALUATION, ECIME 2009	64	1	266	Zone 3
PROCEEDINGS OF THE INTERNATIONAL CONFERENCE ON DUBLIN CORE AND METADATA APPLICATIONS	65	1	267	Zone 3
PROGRESSIVE TRENDS IN ELECTRONIC RESOURCE MANAGEMENT IN LIBRARIE	66	1	268	Zone 3
SCHOLARLY COMMUNICATION IN LIBRARY AND INFORMATION SERVICES: THE IMPACTS OF OPEN ACCESS JOURNALS AND E-JOURNALS	67	1	269	Zone 3

ON A CHANGING SCENARIO				
SERIALS REVIEW	68	1	270	Zone 3
SOCIAL NETWORK ANALYSIS AND MINING	69	1	271	Zone 3
STUDIES IN INDIAN POLITICS	70	1	272	Zone 3
THE BOTTOM LINE	71	1	273	Zone 3
THE ELECTRONIC LIBRARY	72	1	274	Zone 3

(Source: Survey Data)

For the 72 sources of publications, three zones based on the frequency of publications have been identified. The first zone consists of 2 sources and contributed 109 articles, the second zone consists of 8 sources that contributed 78 articles and the third zone consists of 62 sources that contributed 87 articles. Hence, the source distribution as per Bradford's Law reveals in ratio as 2:8:62 that fits well with Bradford Law of distribution. Fig. 4.40 shows that *Library Philosophy and Practice* & *DESIDOC Journal of Library and Information Technology* are the two core sources of publications as per Bradford's Law.

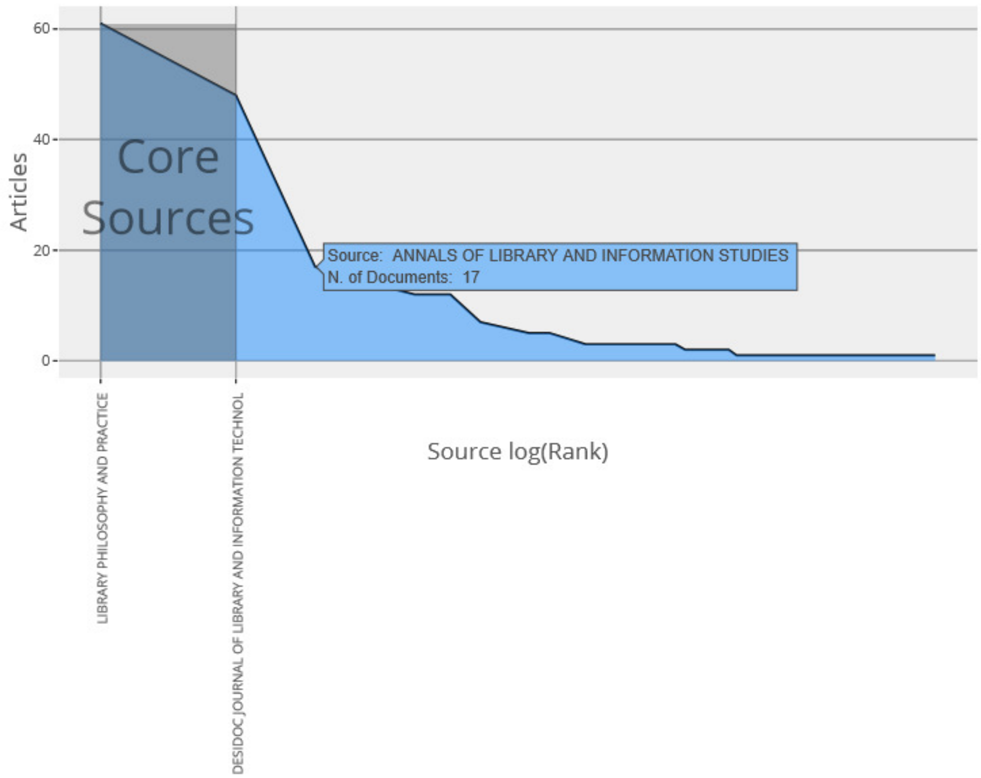


Fig. 4.40: Bradford's Law of Scattering

4.2.2.3.5.13 Top Cited Documents

Table 4.51 and Fig. 4.41 represent the top 20 cited documents of LIS faculties as per the Scopus database. Publication in *International Information and Library Review* by M Madhushudhan has received the highest 55 citations with an average of 7.85 citations per year. S Ravikumar & S N Singh both have received 52 citations from publication in *Scientometrics* with an average of 13 citations per year. Similarly again M Madhusudhan has received 34 citations in *Library Hi Tech* with an average of 3.09 citations per year.

Table 4.51: Top Cited Documents

Document	Total Citations	TC per Year
MADHUSUDHAN M, 2012, INT INF LIBR REV	55	7.85
RAVIKUMAR S & S N SINGH, 2015, SCIENTOMETRICS	52	13
RAVIKUMAR S & S.N. SINGH 2015, SCIENTOMETRICS-a	52	13
SEADLE M & MADHUSUDHAN M, 2008, LIBR HI TECH	34	3.09
HARIDASAN S, 2009, ELECTRON LIBR	32	3.2
MADHUSUDHAN M, 2010, ELECTRON LIBR	29	3.22
CHIRRA R & MADHUSUDHAN M, 2009, LIBR HI TECH NEWS	28	2.8
RAZA MM, 2006, INT INF LIBR REV	28	2.15
SUBOTIC S & MUKHERJEE B, 2014, J INF SCI	25	5
MUKHERJEE B, 2009, SCIENTOMETRICS	23	2.3
MUKHERJEE B, 2009, J AM SOC INF SCI TECHNOL	21	2.1
NAZIM M, 2008, INT INF LIBR REV	21	1.9
ALI PMN & N. FATIMA, 2011, COLLECT BUILD	18	2.25
SINGH KP, 2015, ELECTRON LIBR	17	4.25
RAMAIAH CK, 2002, LIBR REV	16	0.94
MADHUSUDHAN M, 2007, LIBR HI TECH NEWS	16	1.33
PENG LK & RAMAIAH CK, 2004, PROGRAM	15	1
NISHA F & ALI PMN, 2013, COLLECT BUILD	15	2.5
MADHUSUDHAN M, 2011, PROGRAM	14	1.75
PRADEEP BALAJI B & KUMAR V, 2011, LIBR HI TECH	14	1.75

(Source: Survey Data)

Among top-20 cited documents, M Madhusudhan has contributed 6 documents, B Mukherjee contributed 3 documents, N Fatima & PMN Ali both have contributed 2 documents. Among sources, the highest citations per year received by *Scientometrics* followed by *International Information and Library Review*, *Journal of Information Science* and *Electronic Library*.

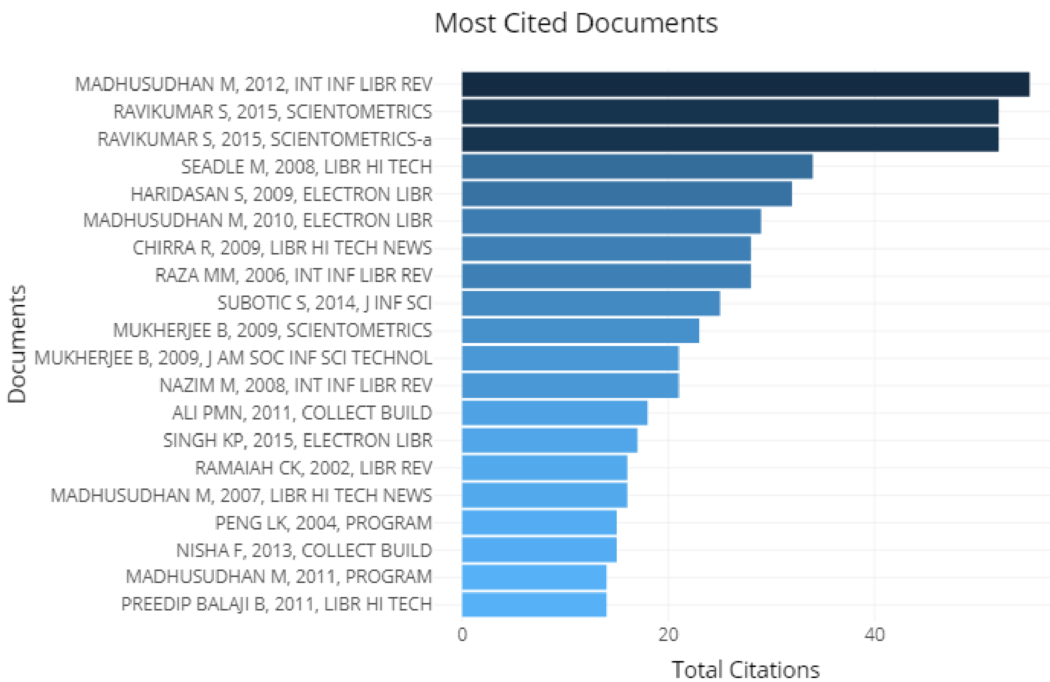


Fig. 4.41: Top-20 Cited Documents

4.2.2.3.5.14 Author's Keyword

Keywords are used in indexing or cataloguing that provides a concise and precise high-level summarization of documents. Keywords help in retrieval of a document, search of the topic, classification, and acts as a tool for finding a summary of any full-text document. Extracting keywords manually is an extremely difficult and time-consuming process. Therefore need for an automated process is required that extracts keywords from documents (Madane & Thakore, 2012). Author keywords have advantages over the title or abstract keywords as they do not contain any irrelevant information and do not allow manipulation of information by the researchers (González, García-Massó, Pardo-Ibañez, Peset, & Devís-Devís, 2018).

Table 4.52: Top-50 Most Occurred Author Keywords

Author Keywords	Occurrence
India	47
Academic Libraries	12
Bibliometrics	11
Information Retrieval	11
Citation Analysis	9
Knowledge Management	8
Libraries	8
University Libraries	8
Open Access	7
Social Networking Sites	7
Web 2.0	7
H-index	6
Research	6
Scientometrics	6
Universities	6
Collection Development	5
ICT	5
Internet	5
Library Automation	5
Social Media	5
Social Networking	5
Students	5
Web of Science	5
Websites	5
Authorship Pattern	4
Citation	4
Citations	4
Content Analysis	4
Degree of Collaboration	4
Information Management	4

Open Access Journals	4
Research Performance	4
Scholarly Communication	4
UGC INFONET	4
Web Impact Factor	4
Webometrics	4
World Wide Web	4
Activity Index	3
Assistive Technology	3
Bibliometric	3
Blogs	3
Collaboration Coefficient	3
Data Repositories	3
Delhi	3
Digital Libraries	3
DOAJ	3
DRDO	3
E-Journals	3
Electronic Media	3
Evaluation	3

(Source: Survey Data)

Table 4.52 represents the top 50 most frequently occurred keywords used by LIS faculty along with the number of times its occurrence. For the 274 documents, a total of 1130 keywords have been found and the total number of unique keywords obtained as 726. The occurrence of keywords is shown in Fig. 4.42 based on word cloud and it represents highly occurring keywords used by faculties in their publications. Among the highly occurring keywords, keywords like “India” (47 times), “Academic Libraries” (12), “Information Retrieval” (11), “Bibliometrics” (11) and “Citation Analysis” (9) are prevalent. Out of total keywords, 543 keywords (48.05%) occurred one time, 113 keywords (10%) occurred two times, 36 keywords (3.18%) occurred three times, 13 keywords (1.15%) occurred four times, 9 keywords (0.79%) occurred five times, and 15 keywords (1.32%) occurred more than five times.

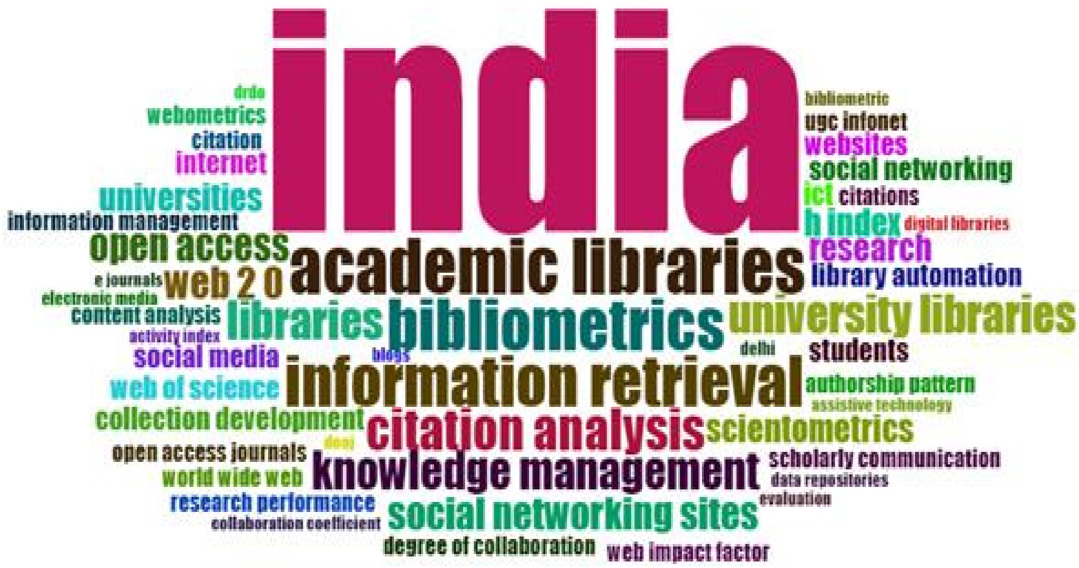


Fig. 4.42: Occurrence of Author's Keyword

4.2.2.3.5.15 Co-occurrence Network of Keywords

Co-occurrence refers to the appearance of two keywords together in a document. Table 4.53 represents the internal structure of keywords in terms of cluster and centrality analysis. Cluster analysis identified the grouping of terms or other items based on criteria of similarity, and similarity of terms is identified based on the distance between the distribution of terms by counting occurrences in documents (Wartena & Brussee, 2008). Centrality analysis is conducted to determine nodes in the network, to determine which keyword is at the center among the various keywords.

Table 4.53: Centrality of Keywords

Keywords	Cluster	Betweenness Centrality
India	3	45.97
Libraries	3	0.18
Information Retrieval	3	7.16
Academic Libraries	3	0.58
Students	3	0
Knowledge Management	3	14.04
Universities	3	0.63
University Libraries	3	1.4
Library Automation	3	0.03
Citation Analysis	2	28
H-index	2	0
Scientometrics	2	0
Bibliometrics	1	40.55
Social Networking	1	0.36
Social Networking Sites	1	6.12
Blogs	1	5.54
Web 2.0	1	19.37

(Source: Survey Data)

Degree Centrality, Betweenness Centrality, and Close Centrality are the three types of centrality analysis of which Betweenness Centrality is measured in terms of the role of a keyword as the mediator and intermediator in the entire network (Kim, Jang, & Lee, 2018). The keyword with the highest level of Betweenness Centrality is “India” (45.97), “Bibliometrics” (40.55), “Citation Analysis” (28), “Web 2.0” (19.70) and so on as shown in Table 4.53.

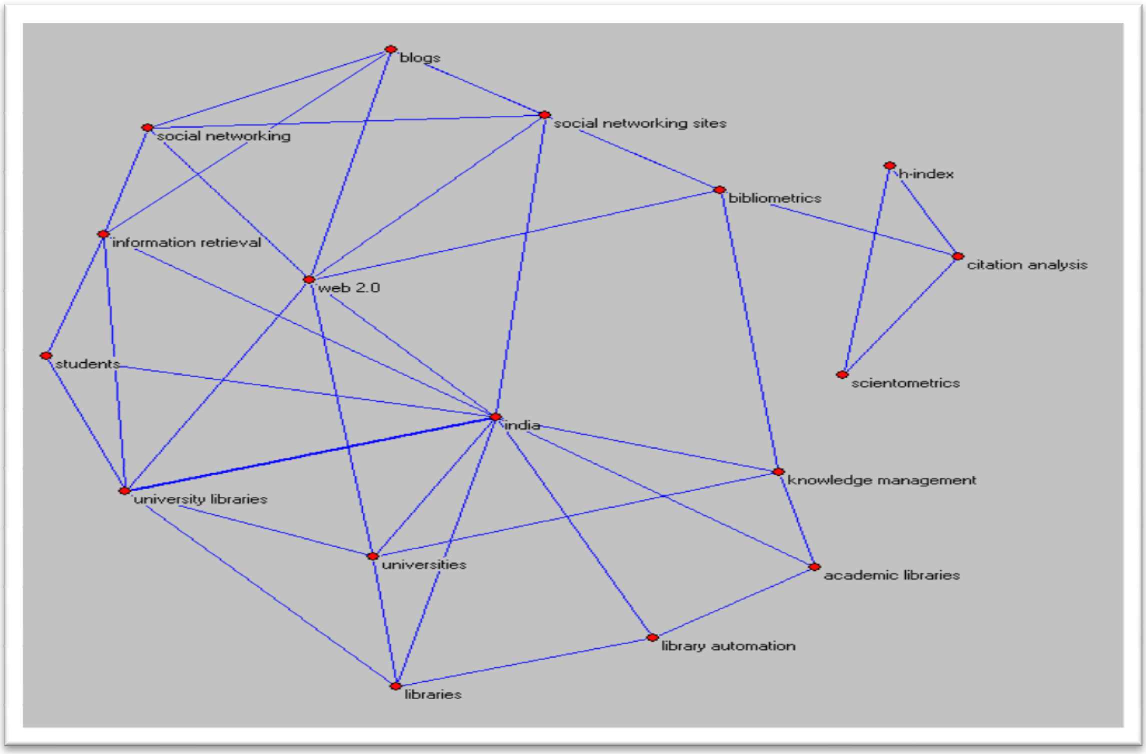


Fig. 4.43: Co-occurrence Network of Keywords

4.2.2.3.5.16 Thematic Map of Cluster Keywords

The analysis of clusters of highly occurred 50 keywords is taken by considering the minimum number of labels for each cluster as five as shown in Table 4.54. The analysis of high frequency keywords indicates presence of seven clusters, of which first label of cluster (Bibliometrics) contains 18 keywords, second label cluster (Information Retrieval) contains 8 keywords, third label cluster (Students) contains 3 keywords, fourth label cluster (India) contains 14 keywords, fifth label cluster (Web 2.0) contain one keyword, sixth label cluster (Websites) contains five keywords and seventh label cluster (Library Automation) contains one keyword. Keyword occurrences are calculated for each cluster, the selected keywords occurred overall 293 times.

Table 4.54: Clustering of Author Keywords

Keyword Occurrences	Keywords	Cluster	Label of Cluster
47	India	4	India
12	Academic Libraries	4	India
11	Bibliometrics	1	Bibliometrics
11	Information Retrieval	2	Information Retrieval
9	Citation Analysis	1	Bibliometrics
8	Libraries	4	India
8	Knowledge Management	4	India
8	University Libraries	4	India
7	Social Networking Sites	2	Information Retrieval
7	Web 2.0	5	Web 2.0
6	H-index	1	Bibliometrics
6	Scientometrics	1	Bibliometrics
6	Universities	4	India
6	Research	4	India
5	Open Access	1	Bibliometrics
5	Web of Science	1	Bibliometrics
5	ICT	2	Information Retrieval
5	Social Networking	2	Information Retrieval
5	Social Media	2	Information Retrieval
5	Students	3	Students
5	Internet	4	India
5	Websites	6	Websites
5	Collection Development	6	Websites
5	Library Automation	7	Library Automation
4	Degree of Collaboration	1	Bibliometrics
4	Authorship Pattern	1	Bibliometrics
4	Research Performance	1	Bibliometrics
4	Citations	1	Bibliometrics
4	Content Analysis	1	Bibliometrics

4	Open Access Journals	1	Bibliometrics
4	Information Management	4	India
4	Citation	4	India
4	UGC-INFONET	4	India
4	Scholarly Communication	4	India
4	Webometrics	6	Websites
4	Web Impact Factor	6	Websites
4	World Wide Web	6	Websites
3	Activity Index	1	Bibliometrics
3	Collaboration Coefficient	1	Bibliometrics
3	DOAJ	1	Bibliometrics
3	Research Productivity	1	Bibliometrics
3	Scientometric Assessment	1	Bibliometrics
3	University of Delhi	1	Bibliometrics
3	Bibliometric	1	Bibliometrics
3	Social Networking Tools	2	Information Retrieval
3	Facebook	2	Information Retrieval
3	Twitter	2	Information Retrieval
3	Mobile Devices	3	Students
3	University	3	Students
3	Library Management	4	India

(Source: Survey Data)

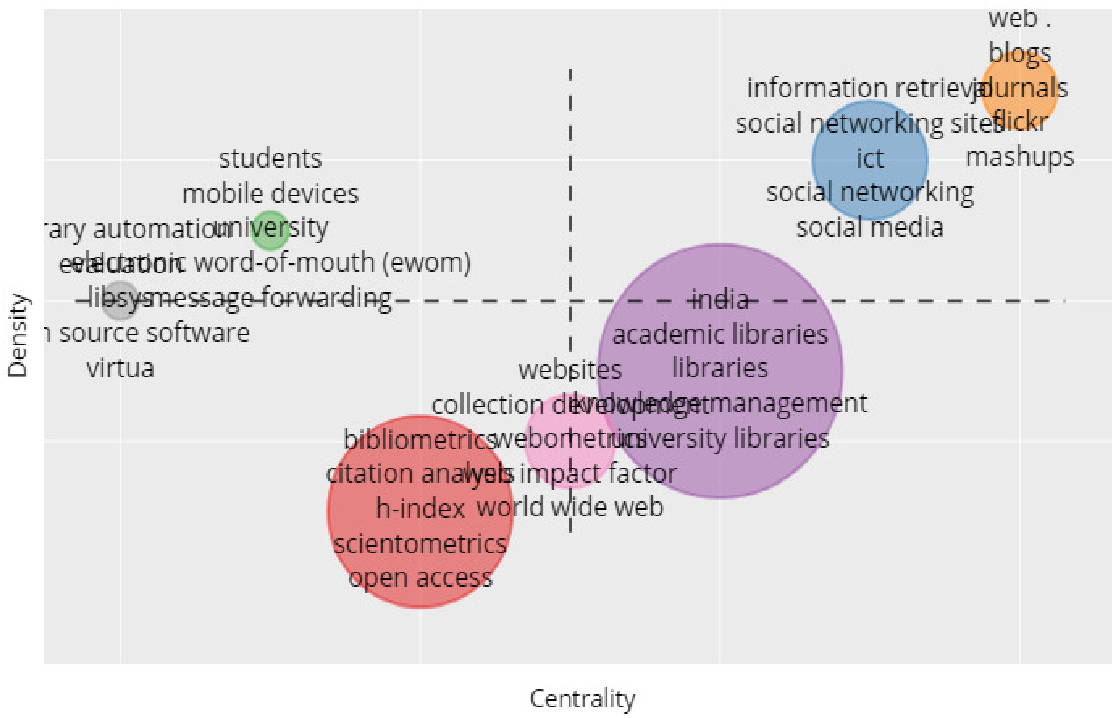


Fig. 4.44: Clustering Network of Keywords

The highest occurrence of keywords is found in the cluster four (122 times) followed by cluster one (84 times), cluster two (42 times), cluster six (22 times), cluster three (11 times), cluster five (7 times) and cluster seven (5 times). The first label of cluster "Bibliometrics" contains mainly the concept of "Scientometrics", "Research Productivity", "H-index", "Web of Science" etc. Second label of cluster "Information Retrieval" contains concepts like "Social Networking Sites", "Social Media", "Facebook", "Twitter" etc. Third label of cluster "Students" contains "Mobile Device" & "University", Fourth label of cluster "India" contains "Academic Libraries", "Knowledge Management", "UGC – INFONET", "Universities", "Internet" etc. The fifth label of cluster "Web 2.0" contains "Web 2.0", Sixth label of cluster "Websites" contains “Webometrics”, “Web Impact Factor”, “World Wide Web” etc. The seventh label of the cluster “Library Automation” contains the single keyword “Library Automation”. A dendrogram (Fig. 4.45) represents the hierarchical clustering of keywords that simply display the relationship between objects allocated in the clusters.

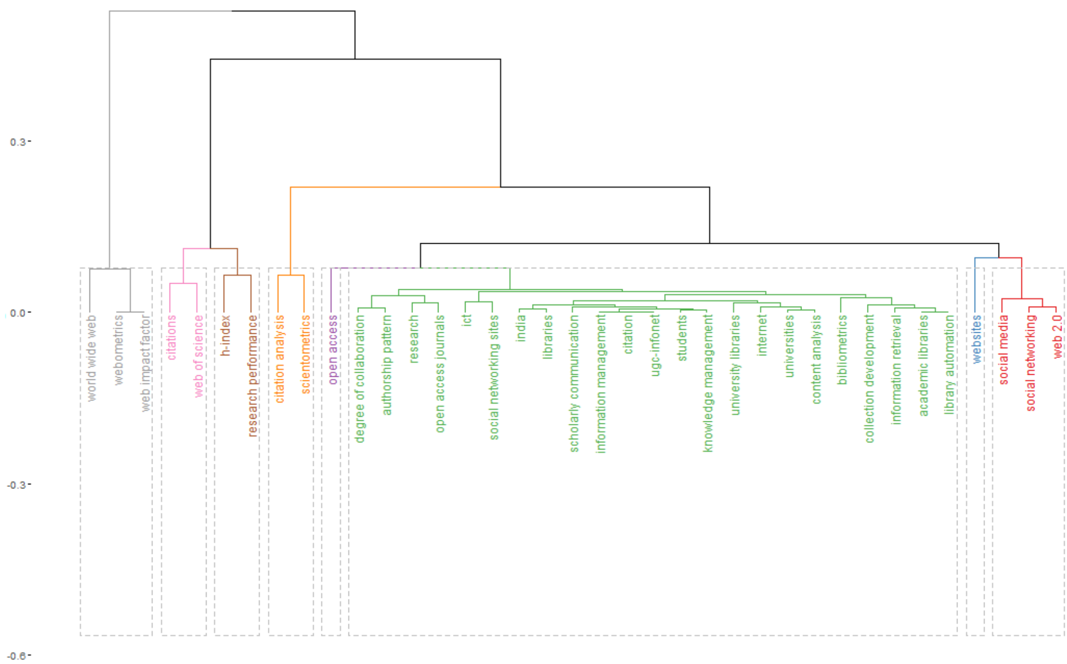


Fig. 4.45: Dendrogram of Author’s Keyword

4.2.2.3.6 Major Findings

a) From the Scopus database, research productivity for 53 LIS faculties (68.83% of total faculties) has been retrieved which belongs to 15 Central Universities of India. Web visibility in the Scopus database has been found the highest (100%) for IGNOU and PU.

b) A total of 274 publications and 1091 citations to publications have been found with an average of 5.16 publications per faculty & 3.98 citations per publication.

The highest publication was observed for DU (65, 23.72% of total) while the lowest publication found for MU (2, 0.72%) and CUTN (2, 0.72%).

c) The highest citation was found for DU (329, 30.15% of total citations) while no citation has been found for CUG and CUTN. Citations per publication have been calculated and found highest for AMU (6.08).

d) In publications, among the top three faculties, the highest number of publications found for Madhusudhan M (30, 10.94% of total publications) followed by Mukherjee B (28, 10.21%) and Ramaiah CK (23, 8.39%). The majority (64.15%) of faculties have less than 5 publications while 14 faculties have a single publication in the Scopus database.

e) In the citation, the highest number of citations found for Madhusudhan M (224, 20.53% of total citations) followed by Mukherjee B (170, 15.58%) and Ramaiah CK (86, 7.88%). There were 11 faculties (20.75%) who have not received any citation to their publications.

f) Citations per publication have been found the highest for Haridasan S (20) followed by Singh SN (11.6) and Ali PMN (11). Citations per publication have been found >1 for 27 faculties, 1 for 5 faculties, and <1 for 6 faculties.

g) Productivity distribution of LIS faculties found fit to the Lotka's Law.

h) Growth of research publications found maximum during 2015-2019 (138, 50.36% of total publications) and the year 2018 witnessed the highest number (40, 14.59%) of publications. CAGR has been found maximum in the year 2008 (37.5%).

i) The highest citation (549, 50.32% of total citations) found during the year 2011 to 2015 and the number of citations found the highest in the year 2015 (172).

j) The h-index is found the highest for Mukherjee B (9) followed by Madhusudhan M (8) and Nazim M (7). The g-index is found the highest for Madhusudhan M (14) followed by Mukherjee B (12) and Nazim M (9).

k) Co-authorship pattern of LIS faculties is found highest for B Mukherjee & M Nazim (10) followed by R Bhatt & A Kumar (6) and B Mukherjee & P Vishwakarma (5); the co-authorship pattern found highest only among LIS faculties for B Mukherjee & M Nazim (10) followed by A Kumar & R K Bhatt (6), and A Shukla & R K Ngurtinkhuma (4).

l) Multiple authorship patterns have been found prevalent among LIS faculties for 274 documents as 62 documents (22.62%) were authored by single authors, 162 documents (59.12%) were authored by two authors, and 46 documents (16.78%) authored by three authors. The Degree of Collaboration is found 0.77 among authors.

m) Journal Articles (223, 81.38%) have been found as the most preferred source type followed by Review (16, 5.83), and Conference Proceedings (15, 5.47%).

n) The total publications have been published in 72 different sources. Among 72 sources, *Library Philosophy and Practice* (61, 22.26%) found as the most preferred source of publication followed by *the DESIDOC Journal of Library and Information Technology* (48, 17.51%) and *Annals of Library and Information Studies* (17, 6.2%).

o) Among 72 sources, *International Information and Library Review* (145, 13.29% of total citations) received the highest number of citations followed by *Scientometrics* (128, 11.73%) and *Electronic Library* (117, 10.72%). The h-index is found highest for *Library Review* (7) followed by *International Information and Library Review* (6) and *Electronic Library* (6) while g-index is found highest for *International Information and Library Review* (12) followed by *Electronic Library* (10) and *Library Review* (8).

p) Journals *Library Philosophy and Practice* and *DESIDOC Journal of Library and Information Technology* are the two core sources of publication as per the application of Bradford's Law. Out of three zones based on the frequency distribution of the publication, the first zone consists of 2 sources with 109 articles, the second zone consists of 8 sources with 78 articles and the third zone consists of 62 sources with 87 articles. It resulted in the ratio of 2:8:62 which is approximately similar to $1:n:n^2$.

q) The top-cited document is found for M Madhushudhan for publication in *International Information and Library Review* (55 citations with an average of 7.85 citations per year) followed by S. Ravikumar & S. N. Singh for publication in *Scientometrics* (52) and M Madhusudhan in *Library Hi Tech* (34). Among the top 20 cited documents, M Madhusudhan has contributed 6 documents followed by B Mukherjee (3), N Fatima (2) and PMN Ali (2). Among the sources, the highest citations per year received by *Scientometrics* followed by *International*

Information and Library Review, *Journal of Information Science* and *Electronic Library*.

r) For 274 documents, a total of 1130 keywords were found and the unique number of keywords obtained as 726. The highly occurred keywords were "India" (47 times), "Academic Libraries" (12 times), "Information Retrieval" (11 times), "Bibliometrics" (11 times) and "Citation Analysis" (9 times).

s) The co-occurrence of keywords was represented in clusters of which the first label of cluster "Bibliometrics" mainly network with keywords like "Scientometrics", "Research productivity", "H-index", "Web of Science" etc. Similarly second label cluster "Information Retrieval" mainly network with keywords like "Social Networking Sites", "Social Media", "Facebook", "Twitter" etc.

t) Clustering network of keywords have been framed with 7 clusters; the highest occurrence of keywords is found in the cluster 4 (122 times) followed by cluster 1 (84 times) and cluster 2 (42 times). The hierarchical clustering of keywords has been represented by the dendrogram in the study.

4.2.2.3.7 Conclusion

The study presents the Web-based scholarly communications of LIS faculties indexed in Scopus and found 53 LIS faculties indexed in Scopus with 274 total LIS publications. Few Central Universities have been indexed fully in the Scopus database. The individual publication is found to be 274 with an average of 5.16 publications per author. The total number of publications for every single faculty is counted and ranked according to the individual and affiliating institutional level. Publication impact of faculties is observed based on total citations and *h*-index while *the g*-index score is determined based on citations of publications. Co-authorship pattern is found maximum for multiple authors than solo authors. Co-authorship collaboration among faculties belongs to the same or different institution is analyzed and the highest collaborated publications (10) are found between faculties.

Implications of Lotka's Law has been calculated and found fit with the data. CAGR has been calculated and found positive over the period. Citations growth has been analyzed and found that more than 50% citations to the publications have been received recently. Average citations per year have shown tremendous growth in the 21^{st} century. B Mukherjee, M Madhusudhan, M Nazim, CK Ramaiah have higher h-index and g-index based on their research performance as indexed in Scopus. The co-authorship network of LIS faculties has been showing the linkage of publications among faculties as well as scholars. M Madhusudhan has the strongest co-authorship network among LIS faculties. The most productive publication sources have been evaluated and 72 sources of publications have been identified from 274 publications. Based on the number of publications, *Library Philosophy and Practice* has been found as the most preferred source of publication followed by *the DESIDOC Journal of Library & Information Technology* and *Annals of Library and Information Studies*. The journal *International Information and Library Review* has received the highest citations followed by

Scientometrics and *Electronic Library*. The implication of Bradford's Law has been calculated for the 72 sources and found fir with the data. As per Bradford's Law, *Library Philosophy and Practice* and *DESIDOC Journal of Library & Information Technology* are the two core sources of publications.

Faculty member M. Madhusudhan has published a paper in *International Information and Library Review* which is the top-cited document while journal *Scientometrics* received the highest citations per year. Year-wise growth of publications was found maximum during the year 2015 to 2019 and within this duration, 50.36% of total publications were published while 14.59% publications have been witnessed during the year 2018. Almost 81% of the total source documents are available in the form of a *journal article* that represents that a journal article is the most preferred type of communication channel by the LIS faculties. The occurrence of keyword, keyword cloud, and clustering of keywords are analyzed from the total 1130 author keywords. The co-occurrence network of keywords is observed in the form of clusters and analyzed in terms of Betweenness centrality to determine the central keyword among various keywords. The highest level of Betweenness centrality found for "India", "Bibliometrics', and "Citation Analysis". Top 50 keywords based clusters have been analyzed and found 7 clusters. The highest occurrence of keywords found in cluster 4 followed by cluster 1, cluster 2, etc. The first label of cluster "Bibliometrics" contains mainly "Scientometrics", "Research Productivity", "H-index", "Web of Science" etc. which shows conceptual relativity among author keywords.

4.3 Suggestions given by LIS Faculties

LIS faculties have been asked to suggest for improvement upon the scholarly communications of LIS academia and received some genuine suggestions given by faculty members which are hereunder:

a) The impact of research publications should be evaluated based on quality rather than quantity.

b) Every faculty should have an online research profile in Google Scholar, ResearchGate, etc to increase the research visibility.

c) For research publication, the qualitative and subject-oriented journals should be selected for research communication.

d) Faculty should interact more with colleagues and fellow researchers towards increasing research quality and disseminate their findings through attending conferences, seminars, and workshops, etc.

e) Higher authorities and educational bodies of the country should make stringent criteria for filtering the faculty at the selection level and further during the research production level.

f) Authority should recognize the quality work of faculty by well-framed research evaluation parameters and non-performers should be restrained by stopping other promotional benefits.

g) Production of quality journals by research institutions should be encouraged as well as number of research projects should be initiated in the field.

h) LIS teachers should attract research minded scholars rather than select someone who applied for research admission.

i) The Higher Education sector is facing a problem with the lack of staff. The government should initiate and fill up all the vacancies of teachers so that work overload may be distributed equally among LIS teachers and they can concentrate on research activities also.

4.4 Testing of Hypotheses

4.4.1 Hypothesis 1

H_0: There is no significant relationship between research productivity and academic position of the faculties.

H_1: There is a significant relationship between research productivity and academic position of the faculties.

Table 4.55 displays the research productivity of faculty members as per their academic position from 1978 to 2018. The research productivity of faculty members has been categorized into their respective academic position and covered the whole publications.

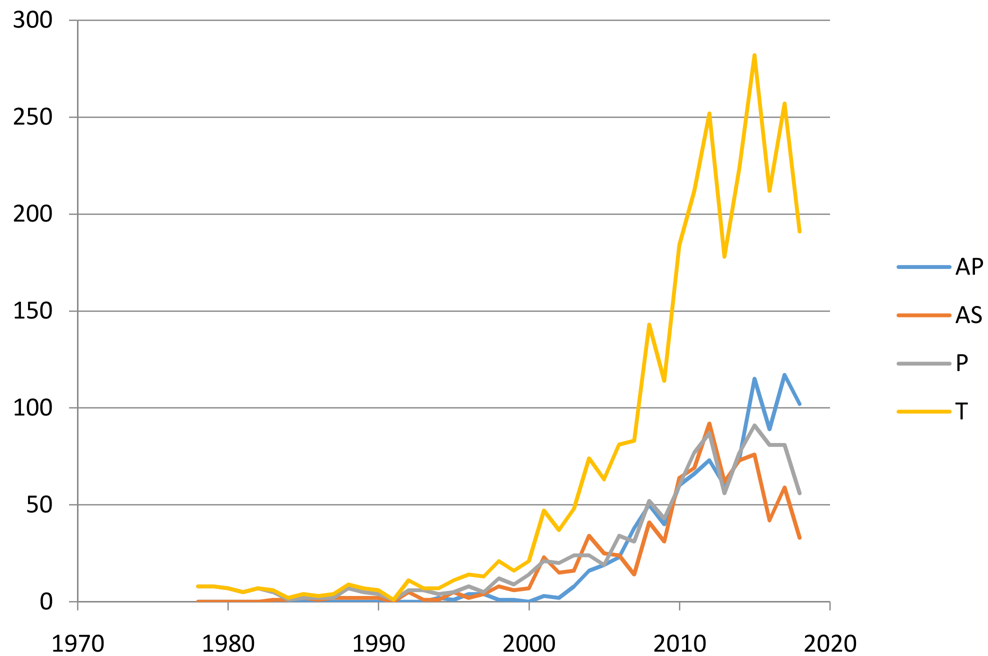
Table 4.55: Research Productivity as per Academic Position

Year	Assistant Professor (30)	Associate Professor (15)	Professor (18)	Total (63)
1978	0	0	8	8
1979	0	0	8	8
1980	0	0	7	7
1981	0	0	5	5
1982	0	0	7	7
1983	0	1	5	6
1984	0	1	1	2
1985	0	2	2	4

1986	0	1	2	3
1987	0	2	2	4
1988	0	2	7	9
1989	0	2	5	7
1990	0	2	4	6
1991	0	0	1	1
1992	0	5	6	11
1993	0	1	6	7
1994	2	1	4	7
1995	1	5	5	11
1996	4	2	8	14
1997	4	4	5	13
1998	1	8	12	21
1999	1	6	9	16
2000	0	7	14	21
2001	3	23	21	47
2002	2	15	20	37
2003	8	16	24	48
2004	16	34	24	74
2005	19	25	19	63
2006	23	24	34	81
2007	38	14	31	83
2008	50	41	52	143
2009	40	31	43	114
2010	60	64	60	184
2011	66	69	77	212
2012	73	92	87	252
2013	60	62	56	178
2014	74	73	77	224
2015	115	76	91	282
2016	89	42	81	212
2017	117	59	81	257
2018	102	33	56	191

From the observation and analysis of Fig. 4.46, it has been found that the research productivity of the Assistant Professor category is more than Professor and Associate

Professor categories. Though, the increase in research productivity has been observed for all categories of faculty members. Professor and Associate Professor categories have more teaching and research experience but showed less research productivity than the Assistant Professor category. This proves that research productivity does not have any relationship with the academic position of faculty and thus the null hypothesis is failed to reject.



Legends: AP=Assistant Professor, AS=Associate Professor, P=Professor, T=Total

Fig. 4.46: Academic Position-wise Research Productivity

4.4.2 Hypothesis 2

H_0: There is no significant relationship in the preference order of scholarly communications and the academic position of faculty.

H_1: There is a significant relationship in the preference order of scholarly communications and the academic position of faculty.

Table 4.56 displays the frequency of preference order for scholarly communication as per academic position. Further, Table 4.57 displays the rank of preference order among academic positions.

Table 4.56: Frequency of Preference Order for Scholarly Communications

SN	Forms of Publication	Academic Positions						Total	
		Assistant Professor		Associate Professor		Professor			
		Frequency	%	Frequency	%	Frequency	%	Frequency	%
1	Journal Articles	204	18.2	56	20.4	131	16.4	391	17.8
2	Conference/ Seminar Papers	151	13.4	33	12.0	116	14.6	300	13.6
3	Book Chapters	141	12.6	41	14.9	99	12.4	281	12.8
4	Authored Books	133	11.8	32	11.6	86	10.8	251	11.4
5	Edited Books	118	10.5	31	11.3	74	9.3	223	10.1
6	Co-authored Books	113	10.1	22	8.0	71	8.9	206	9.3
7	Reviews	71	6.3	12	4.4	53	6.6	136	6.1
8	Technical Reports	60	5.3	17	6.2	42	5.3	119	5.4
9	News Items	48	4.3	13	4.7	42	5.3	103	4.6
10	Editorials	47	4.2	8	2.9	45	5.6	100	4.5
11	Abstract	25	2.2	7	2.5	25	3.1	57	2.5
12	Other	12	1.1	3	1.1	13	1.6	28	1.2
	Total	1123	100	275	100	797	100	2195	100

(Source: Survey Data)

Table 4.57: Rank of Preference Order among Academic Positions

SN	Forms of Publication	Rank of Preference Order			Total Rank
		Assistant Professor Rank	Associate Professor Rank	Professor Rank	
1	Journal Articles	1	1	1	1
2	Conference/ Seminar Papers	2	3	2	2
3	Book Chapters	3	2	3	3
4	Authored Books	4	4	4	4
5	Edited Books	5	5	5	5
6	Co-authored Books	6	6	6	6
7	Reviews	7	9	7	7
8	Technical Reports	8	7	9	8
9	News Items	9	8	10	9
10	Editorials	10	10	8	10
11	Abstract	11	11	11	11
12	Other	12	12	12	12

Table 4.58: Spearman's Rank Correlation (Spearman's rho)

	Assistant Professor Rank	Associate Professor Rank	Professor Rank	Total Rank
Assistant Professor Rank	1.000	.972**	.979**	1.000**
Associate Professor Rank	.972**	1.000	.937**	.972**
Professor Rank	.979**	.937**	1.000	.979**
Total Rank	1.000**	.972**	.979**	1.000

**. Correlation is significant at the 0.01 level (2-tailed).

Spearman's rank correlation has been calculated (Table 4.58) and observed a significant correlation between academic position and preference order for scholarly communications, and thus the null hypothesis is rejected and the alternative hypothesis is accepted.

4.4.3 Hypothesis 3

H_0: There is no significant relationship in the preference order of scholarly communications among central universities.

H_1: There is a significant relationship in the preference order of scholarly communications among central universities.

Table 4.59: Preference Order of Scholarly Communications of Central Universities

SN	Publication Media	AMU	AU	BBAU	BHU	CUG	CUTN	MU	MZU	NEHU	PU	TU
1	Authored Books	19	21	22	51	5	7	8	49	29	9	21
2	Co-authored Books	20	21	12	42	6	0	5	36	27	10	18
3	Book Chapters	30	17	21	54	6	10	10	62	19	25	18
4	Edited Books	27	15	31	29	7	6	9	47	32	9	14
5	Journal Articles	35	32	24	63	4	12	12	83	51	27	24
6	Conference/ Seminar Papers	16	16	23	59	5	11	11	67	41	26	13
7	Technical Reports	0	18	12	24	5	0	7	24	8	4	14
8	News Items	0	13	12	19	5	3	4	11	9	10	11
9	Reviews	0	19	12	32	7	9	6	22	5	8	9
10	Editorials	0	14	12	15	0	8	3	26	2	8	7
11	Abstract	0	10	12	4	0	5	2	4	12	0	5
12	Other	0	3	10	1	0	9	1	1	0	0	1
Total		147	199	203	393	50	80	78	432	235	136	155

Table 4.60: Rank of Preference Order of Central Universities

Publication Media	AMU	AU	BBAU	BHU	CUG	CUTN	MU	MZU	NEHU	PU	TU
Journal Articles	1	1	2	1	9	1	1	1	1	1	1
Authored Books	5	3	4	4	6	7	5	4	4	7	2
Book Chapters	2	6	5	3	3	3	3	3	6	3	3
Co-authored Books	4	2	6	5	4	11	8	6	5	4	4
Edited Books	3	8	1	7	2	8	4	5	3	6	5
Technical Reports	7	5	8	8	7	12	6	8	9	10	6
Conference/ Seminar Papers	6	7	3	2	5	2	2	2	2	2	7
News Items	8	10	10	9	8	10	9	10	8	5	8
Reviews	9	4	7	6	1	4	7	9	10	8	9
Editorials	10	9	9	10	10	6	10	7	11	9	10

Abstract	11	11	11	11	11	9	11	11	7	11	11
Other	12	12	12	12	12	5	12	12	12	12	12

Table 4.61: Spearman’s Rank Correlation (Spearman’s rho)

SN	Univ.	AMU	AU	BBAU	BHU	MU	MZU	NEHU	PU	TU	CUG	CUTN
1	AMU	1.000	.706*	.867**	.839**	.860**	.860**	.804**	.825**	.944**	**.538**	**.238**
2	AU	.706*	1.000	.643*	.790**	.643*	.657*	**.524**	**.566**	.811**	**.497**	**.154**
3	BBAU	.867**	.643*	1.000	.839**	.909**	.895**	.853**	.741**	.797**	.622*	**.385**
4	BHU	.839**	.790**	.839**	1.000	.916**	.916**	.790**	.874**	.832**	**.545**	**.524**
5	MU	.860**	.643*	.909**	.916**	1.000	.916**	.804**	.797**	.804**	**.538**	**.497**
6	MZU	.860**	.657*	.895**	.916**	.916**	1.000	.818**	.832**	.825**	**.413**	**.517**
7	NEHU	.804**	**.524**	.853**	.790**	.804**	.818**	1.000	.783**	.755**	**.336**	**.280**
8	PU	.825**	**.566**	.741**	.874**	.797**	.832**	.783**	1.000	.727**	**.448**	**.441**
9	TU	.944**	.811**	.797**	.832**	.804**	.825**	.755**	.727**	1.000	**.448**	**.154**
10	CUG	**.538**	**.497**	**.622***	**.545**	**.538**	**.413**	**.336**	**.448**	**.448**	1.000	**.070**
11	CUTN	**.238**	**.154**	**.385**	**.524**	**.497**	**.517**	**.280**	**.441**	**.154**	**.070**	1.000

**. Correlation is significant at the 0.01 level (2-tailed).

Table 4.59 displays the frequency of preference order for scholarly communications in central universities. Further, Table 4.60 displays the rank of preference order of scholarly communications in central universities. Spearman’s rank correlation has been calculated (Table 4.61) for Central Universities and observed significant correlation among Central Universities and preference order for scholarly communications for older universities and found an insignificant relationship for CUG and CUTN. There are some exceptions observed for NEHU and PU while the majority of the Central Universities have a significant relationship, and thus the null hypothesis is rejected and the alternative hypothesis is accepted.

4.4.4 Hypothesis 4

H_0: There is no significant increase observed in online scholarly communications over the period.

H_1: There is a significant increase observed in online scholarly communications over the period.

Online scholarly communications have been communicated by the faculties over various online platforms viz. Google Scholar, Scopus, Web of Science, ResearchGate, Academia.edu and many more. The Scopus and Web of Science databases found useful for hypothesis testing due to its journal coverage and natural indexing of scholarly communications. The hypothesis testing has been done separately for Web of Science and Scopus databases to check the online visibility of LIS academia over the period.

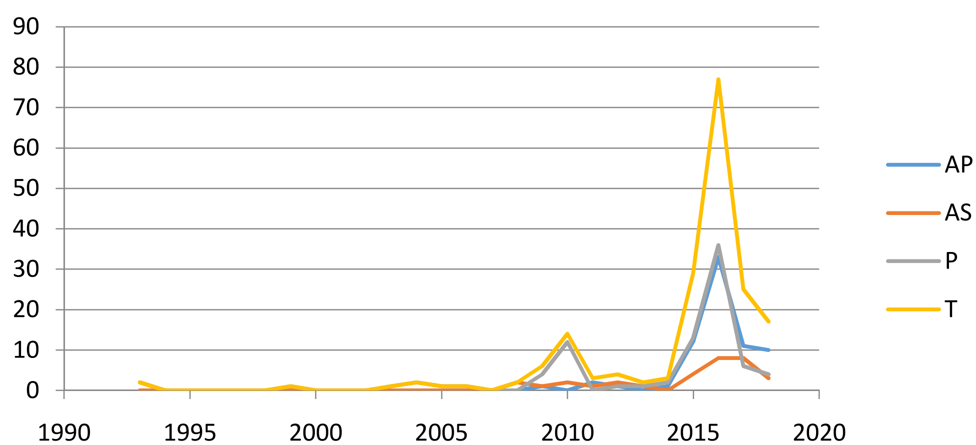
Table 4.62 displays the scholarly communications over the Web of Science and graphical representation has been displayed by Fig. 4.47. On the observation of Fig. 4.47, it has been found that the increase in online scholarly communications observed over the period. Simultaneously, the increase of online scholarly communications found for all the categories of academic positions over the period in the Web of Science database. Thus the null hypothesis is rejected and accepted alternative hypothesis for Web of Science database.

Table 4.62: Scholarly Communications over Web of Science

Year	Assistant Professor	Associate Professor	Professor	Total
1993	0	0	2	2
1994	0	0	0	0
1995	0	0	0	0
1996	0	0	0	0
1997	0	0	0	0
1998	0	0	0	0

1999	0	0	1	1
2000	0	0	0	0
2001	0	0	0	0
2002	0	0	0	0
2003	0	0	1	1
2004	0	0	2	2
2005	0	0	1	1
2006	0	0	1	1
2007	0	0	0	0
2008	0	2	0	2
2009	1	1	4	6
2010	0	2	12	14
2011	2	1	0	3
2012	1	2	1	4
2013	0	1	1	2
2014	1	0	2	3
2015	12	4	13	29
2016	33	8	36	77
2017	11	8	6	25
2018	10	3	4	17

(Source: Survey Data)



Legends: AP=Assistant Professor, AS=Associate Professor, P=Professor, T=Total

Fig. 4.47: Scholarly Communication over Web of Science

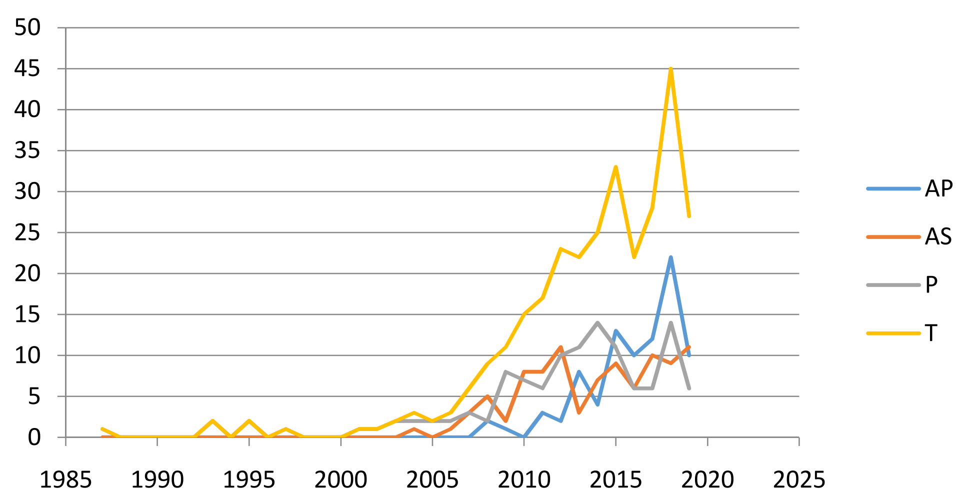
Table 4.63 displays the scholarly communications over the Scopus database and graphical representation has been displayed by Fig. 4.48. On the observation of Fig. 4.48, it has been found that the increase of online scholarly communications observed over the period. Similarly, the increase of online scholarly communications found for all the categories of academic positions over the period in the Scopus database. Thus the null hypothesis is rejected and accepted alternative hypothesis for the Scopus database.

Table 4.63: Scholarly Communications over Scopus

Year	Assistant Professor	Associate Professor	Professor	Total
1987	0	0	1	1
1988	0	0	0	0
1989	0	0	0	0
1990	0	0	0	0
1991	0	0	0	0
1992	0	0	0	0
1993	0	0	2	2
1994	0	0	0	0
1995	0	0	2	2
1996	0	0	0	0
1997	0	0	1	1
1998	0	0	0	0
1999	0	0	0	0
2000	0	0	0	0
2001	0	0	1	1
2002	0	0	1	1
2003	0	0	2	2
2004	0	1	2	3
2005	0	0	2	2
2006	0	1	2	3
2007	0	3	3	6
2008	2	5	2	9

2009	1	2	8	11
2010	0	8	7	15
2011	3	8	6	17
2012	2	11	10	23
2013	8	3	11	22
2014	4	7	14	25
2015	13	9	11	33
2016	10	6	6	22
2017	12	10	6	28
2018	22	9	14	45
2019	10	11	6	27

(Source: Survey Data)



Legends: AP=Assistant Professor, AS=Associate Professor, P=Professor, T=Total

Fig. 4.48: Scholarly Communication over Scopus

4.4.5 Hypothesis 5

H_0: There is no significant relationship between academic position and their visibility in online scholarly communication.

H_1: There is a significant relationship between academic position and their visibility in online scholarly communication.

Online scholarly communications have been communicated by the faculties over various online platforms viz. Google Scholar, Scopus, Web of Science, ResearchGate, Academia.edu and many more. The academic position of the faculty member denotes their teaching and research experience and thus relates to their research productivity. Higher the academic position tends to higher the research productivity and the same has been framed as a hypothesis in online research visibility of the faculty members. In this case, hypothesis testing has been done for Web of Science and Scopus databases separately.

Table 4.62 and Fig. 4.47 display the online scholarly communications for faculty members over the Web of Science. On the observation of Fig. 4.47, it has been found that visibility of online scholarly communications found more for Assistant Professor followed by Professor and Associate Professor. Similarly Table 4.63 and Fig. 4.48 display the online scholarly communications for faculty members over the Scopus database; and on the observation of Fig. 4.48, it has been found that visibility of online scholarly communications found highest for Assistant Professor followed by Professor and Associate Professor. From the observation of the results of both the databases, it has been an inference that academic positions do not have any relation with their research visibility in online platforms. Thus the null hypothesis is failed to reject and proved that there is no significant relationship between academic position and their visibility in online scholarly communication.

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Chapter 5: Conclusion and Suggestions

Chapter Plan

5.1 Introduction

Scholarly communication is the process of sharing, dissemination, and publishing research findings by academics and researchers with an objective to generate academic content by using research methods, tools, and techniques for the global academic community. Most important and known scholarly communication channels include journal articles, conference proceedings, books, book chapters, monographs, reports, reviews, and dissertations, etc. An academician or researcher prepares a manuscript for submission in any of the above-mentioned channels of communication, where they eloquently narrate about their scientific experiment, methodologies, key findings and conclusions to communicate their significant contribution in the universe of knowledge. In the modern era, research activities continuously increase in every branch of knowledge, as a result, numerous global and specialized sub-discipline areas of research are emerging. To cope up with the structure of discipline or knowledge and the quantitative and qualitative characterization of scientific scholarly communications, bibliometric & scientometric related studies are done to measure the research output and productivity of sources, individuals, institutions, nations or worldwide. This type of study provides a tool for understanding and identifying the trends & growth of a subject, forms and pattern of publication, collaboration, core areas of research, most influential contributors, etc. at the micro and macro level.

The study made an attempt to measure the scholarly communications of academia of Library and Information Science (LIS) in Central Universities of India. The objectives laid down for the present study were as follows:

a) To examine the trends and growth of research output of academia of Library & Information Science in Central Universities of India.

b) To examine the forms and extent of research output of academia of Library & Information Science in Central Universities of India.

c) To find out the authorship pattern and degree of collaboration of academia of Library & Information Science in Central Universities of India.

d) To study the implications of Lotka's Law and Bradford's Law over the scholarly communications of academia of Library & Information Science.

e) To measure the Web visibility of online scholarly communications of academia of Library & Information Science in Central Universities of India.

On the basis of the above objectives of the study, the following hypotheses were drawn to assess the research objectives:

Hypothesis 1:

H_0: There is no significant relationship between research productivity and academic position of the faculties.

H_1: There is a significant relationship between research productivity and academic position of the faculties.

Hypothesis 2:

H_0: There is no significant relationship in the preference order of scholarly communications and the academic position of faculty.

H_1: There is a significant relationship in the preference order of scholarly communications and academic position of faculty.

Hypothesis 3:

H_0: There is no significant relationship in the preference order of scholarly communications among central universities.

H_1: There is a significant relationship in the preference order of scholarly communications among central universities.

Hypothesis 4:

H_0: There is no significant increase observed in online scholarly communications over the period.

H_1: There is a significant increase observed in online scholarly communications over the period.

Hypothesis 5:

H_0: There is no significant relationship between academic position and their visibility in online scholarly communication.

H_1: There is a significant relationship between academic position and their visibility in online scholarly communication.

The descriptive study designed to measure the performance of the academia of Library and Information Science in Central Universities of India. A survey and observation methods of research have been used for conducting the study. The faculty member's publications and other demographic details were collected by the questionnaire method and an online survey was conducted for each faculty member to gather the required data. The collected data were cross-verified from the bio-data of faculty members available on their university website. The total population of the study was 81 LIS faculty members from 18 Central Universities of India and no LIS faculty is found from Hemvati Nandan Bahuguna Garhwal University. Further, Google Scholar, Web of Science and Scopus databases were used for measuring the Web visibility of online scholarly communications of LIS faculty members. The collected data were scrutinized, tabulated and analyzed for the inference. Statistical inference was drawn by using appropriate data analysis tools, statistical tools, and software.

5.2 Research Objectives

The following section presents a discussion on the laid objectives:

5.2.1 Objective 1

Trends and Growth of Research Output of Academia of Library & Information Science in Central Universities of India

One of the objectives of the study was to examine the trend and growth of the research output of academia of the Library and Information Science in Central Universities of India. For the purpose, trend analysis has been done based on scholarly communications. The cumulative and categorical trend and growth of scholarly communications have been analyzed through both primary and secondary data. The scholarly communications related primary data (Table 4.15, Fig. 4.10) represents growth in scholarly communications but observed intermittent growth of scholarly communications. The scholarly communications growth has been increased significantly since 2010 onwards and similar results obtained in the case of Google Scholar (Fig. 4.13) also. In Web of Science (Fig. 4.22) and Scopus (Fig. 4.34) databases, the continuous growth in the number of scholarly communications has been observed and the significant growth (increase) in scholarly communications was observed from 2005 onwards in both the databases. The growth of scholarly communications in Web of Science database is comparatively less than the Scopus database while the overall growth of scholarly communications has been found less in these databases as compared to Google Scholar database as well as with primary data. The faculty may have less opportunity to publish in Scopus and Web of Science based journals due to that observed weaker growth of scholarly communications than Google Scholar.

5.2.2 Objective 2

Examine the Forms and Extent of Research Output of Academia of Library & Information Science in Central Universities of India

One of the objectives of the study was to examine the forms and extent of research output of academia of Library and Information Science in Central Universities of India. For this purpose, a study has been done on published scholarly communications through primary and secondary data. The study observed *Journal Articles* as the most prevalent form of publication and more than 40% of publications (Table 4.16) were *Journal Articles* followed by *Conference Proceedings*, *Book Chapters*, and *Books*. Further *Journal Articles* were found as the most preferred medium of publication (Fig. 4.4) followed by *Conference Proceedings*, *Book Chapters*, and *Books*. The *Journal Articles* has been found as the most preferred form of publication in the case of Web of Science (Fig. 4.23) and Scopus (Table 4.48) databases. Google Scholar (Fig. 4.14) database has been found inappropriate for analysis as this database failed to categorize the forms of published documents and most of the scholarly communications do not have any forms of the document which were represented as “blank”.

5.2.3 Objective 3

Find Out the Authorship Pattern and Degree of Collaboration of Academia of Library & Information Science in Central Universities of India

One of the objectives of the study was to find out the authorship pattern and degree of collaboration of academia of the Library and Information Science in Central Universities of India. From the findings of the study, the authorship pattern has been found more for multi-authored publications as compared to single-authored publications (Table 4.19, Table 4.47). Among the multi-authored publications, the maximum collaboration found for two authored publications. The Degree of Collaboration has been found as 0.67 as per primary data (cf. section 4.2.1.22) and 0.77 as per the Scopus database (cf. section 4.2.2.3.5.9). There is strong collaboration found among LIS faculties in scholarly communications and thus support multi-authorship pattern.

5.2.4 Objective 4

Study the Implications of Lotka's Law and Bradford's Law over the Scholarly Communication of Academia of Library & Information Science

One of the objectives of the study was to study the implications of Lotka's Law and Bradford's Law over the scholarly communications of academia of Library and Information Science in Central Universities of India. To study the implications of Lotka's Law over published scholarly communications through primary data, the distribution of faculty productivity has been observed (Table 4.20, Table 4.21). Further, by using Lotka's Inverse Power Law & Kolmogorov Smirnov (K-S test), the dataset found to be fit with modified Lotka's Law with the value $n = 0.893$. Implications of Lotka's Law of author's productivity has been done for the Scopus database and frequency distribution of scientific productivity (Table 4.42, Fig. 4.33) suggests that productivity distribution of LIS academia follows Lotka's Law.

To study the implications of Bradford's Law over published scholarly communications, the rank of journal productivity in descending order has been observed (Table 4.22). Further, distribution of data in Bradford Zones (Table 4.23) and distribution of paper in each zones (Table 4.24) was suggested that the dataset does not follow Bradford's Law due to deviation in expected and observed number of papers in first and second zone respectively.

5.2.5 Objective 5

Measure the Web Visibility of Online Scholarly Communications of Academia of Library & Information Science in Central Universities of India

One of the objectives of the study was to measure the Web visibility of online scholarly communications of academia of Library and Information Science in Central Universities of India. For the purpose, the study has been done based on Google Scholar, Web of Science & Scopus databases. It has been found that a total of 1186 publications by 75 LIS faculties with 4684 citations in Google Scholar (cf. section 4.2.2.1.5.4 & Fig. 4.13). Among the LIS faculties, the study concluded that faculties like M Madhusudhan, B Mukherjee, CK Ramaiah, R Sevukan and HN Prasad have performed a remarkable contribution in terms of scholarly communications and citations while among Central Universities, fewer contributions were seen for TU, GGU and CUH.

In Web of Science database, a total of 157 scholarly communications with 435 citations was observed for 42 LIS faculties (Table 4.32); and among LIS faculties, B Mukherjee, M Nazim & M Madhusudhan have performed a remarkable contribution in terms of scholarly communications and citations; in case of universities performance, from among 14 central universities, fewer contributions were seen for

HSGU, MU, CUTN & TU (Table 4.33). The strongest bibliographic coupling link strength is found for BHU, AMU & DU while weak link strength is found for CUG and MU (Fig. 4.27). In terms of source journals, *DESIDOC Journal of Library & Information Technology*, *Annals of Library and Information Studies*, *COLLNET Journal of Scientometrics & Information Management* have been found as the most productive journals (Table 4.36).

In Scopus database, a total of 273 scholarly communications with 1091 citations was observed for 53 LIS faculties (Table 4.40); and among LIS faculties, M Madhusudhan, B Mukherjee & CK Ramaiah (Table 4.41, Fig. 4.32) have performed a remarkable contribution in terms of scholarly communications and citations; and among 15 contributing Central Universities, fewer contributions were seen for CUG, CUTN, HSGU & MU. The faculty M Madhusudhan has the strongest co-authorship network among LIS faculties (Fig. 4.36). Among the source journals, *Library Philosophy and Practice*, *DESIDOC Journal of Library & Information Technology* and *Annals of Library and Information Studies* have been found as the most productive journals in the Scopus database (Table 4.49).

5.3 Research Hypotheses

The following section presents a discussion on the laid hypotheses:

5.3.1 Hypothesis 1

H_0: There is no significant relationship between research productivity and academic position of the faculties.

H_1: There is a significant relationship between research productivity and academic position of the faculties.

At the beginning of this study, it was conceived that research productivity will not vary in relation to the academic position of faculties and after testing of the hypothesis (Table 4.55 & Fig. 4.46) it has been found that research productivity of Assistant Professor category is more than Professor and Associate Professor categories. Though, the increase in research productivity has been observed for all categories of faculty members during the period. Professor and Associate Professor categories have more teaching and research experience but showed less research productivity in comparison to the Assistant Professor category. This proves that research productivity does not have any relationship with the academic position of faculty and thus the null hypothesis is failed to reject.

5.3.2 Hypothesis 2

H_0: There is no significant relationship in the preference order of scholarly communications and the academic position of faculty.

H_1: There is a significant relationship in the preference order of scholarly communications and the academic position of faculty.

The preference order of scholarly communications has been correlated with the academic position of faculties. The assumption has been made that there will be no variation in the preference order of scholarly communications with the academic position. In this regard, the hypothesis was tested using Spearman's rank correlation (Table 4.56, Table 4.57 & Table 4.58) and observed a significant correlation between academic positions and their preference orders and thus null hypothesis is rejected.

5.3.3 Hypothesis 3

H_0: There is no significant relationship in the preference order of scholarly communications among central universities.

H_1: There is a significant relationship in the preference order of scholarly communications among central universities.

Preference order of scholarly communications has been correlated among Central Universities and assumption has been made that there will be no variation in the preference order of scholarly communications in different Central Universities. In this regard, the hypothesis was tested using Spearman's rank correlation (Table 4.59, Table 4.60 & Table 4.61) and observed significant correlation among Central Universities with regard to preference order of scholarly communications for older universities and found an insignificant relationship for CUG and CUTN while some exceptions observed for NEHU and PU. The overall majority of the Central Universities have found significant relationships, and thus the null hypothesis is rejected.

5.3.4 Hypothesis 4

H_0: There is no significant increase observed in online scholarly communications over the period.

H_1: There is a significant increase observed in online scholarly communications over the period.

At the beginning of the study, it was assumed that over the period there will be no increase in the number of online scholarly communications. In this regard, the hypothesis was tested using Scopus and Web of Science databases. Table 4.62 & Fig. 4.47 clearly depicts the increase of online scholarly communications over the period in the Web of Science database while Table 4.63 & Fig. 4.48 clearly indicates the increase of online scholarly communications over the period in the Scopus database. Thus, the null hypothesis is rejected and accepted alternative hypothesis for both the Web of Science & the Scopus databases.

5.3.5 Hypothesis 5

H_0: There is no significant relationship between academic position and their visibility in online scholarly communication.

H_1: There is a significant relationship between academic position and their visibility in online scholarly communication.

It has been assumed that academic positions do not have any relation with their research visibility in the online platform. Table 4.62 and Fig. 4.47 for Web of Science database and Table 4.63 and Fig. 4.48 for the Scopus database clearly indicates that no relationship between academic position and their visibility in online scholarly communication, and thus null hypothesis is failed to reject and proved that there is no significant relationship found between academic position and their visibility in online scholarly communications.

5.5 Suggestions

Based on the analysis, observation and responded suggestions related to study, the following are some important suggestions to improve upon scholarly communications of LIS academia:

a) University authority may motivate faculties for research and give targets for research publications and provides facilities to reach the targets.

b) The university may make provision of institutional research funds for younger faculty members to undertake research projects.

c) There may be a provision of incentives or awards for the best research performers who considerably involved in the creation of new knowledge through quality research.

d) Organizing national/international conferences in the departments per year and set the targets for every faculty member to submit and present a paper on the concerned theme.

e) To publish papers in international open access journals to increase the citation of published papers.

f) The faculty may focus on team-based research so that participating faculty should be able to develop a better research mindset with other researchers.

g) Faculties' focus should be to publish scholarly communications in impact factor journals that are indexed in global academic databases or linked with internationally reputed publishers.

h) Faculties' focus should be based on quality rather than quantity as the aim of research should be the creation of *innovative knowledge* rather than *knowledge repetition.*

5.6 Scope of Further Research

The scientometric study is an open area of research that is applicable for mapping and analyzing any subject field by author, publisher, institution & country using numbers of scientometric indicators. The present study was an attempt to measure the scholarly communications of academia of Library and Information Science in Central Universities of India. However, a study is warranted to look into the different aspects of study such as comparative analysis of academic and non- academic professionals of LIS, comparative study of Central and State Universities LIS faculty. Similar studies based on the scholarly communications, publication performance of most productive LIS authors, topmost LIS institutions, highly contributed Indian states, Indian journals, and many others may be conducted which has the potential for further research. The study found online visibility in three databases which have a lot of potentials to carry out a similar study with many other academic databases.

APPENDICES

Appendix-I

List of Central Universities with No. of LIS Faculty

Name of Central University (Abbr.)	No. of LIS Faculty
Aligarh Muslim University (AMU)	7
Assam University (AU)	4
Babasaheb Bhimrao Ambedkar University (BBAU)	6
Banaras Hindu University (BHU)	8
Central University of Gujarat (CUG)	3
Central University of Haryana (CUH)	2
Central University of Himachal Pradesh (CUHP)	3
Central University of Tamil Nadu (CUTN)	5
Dr. Hari Singh Gour University (HSGU)	3
Guru Ghasidas University (GGU)	1
Indira Gandhi National Open University (IGNOU)	5
Manipur University (MU)	5
Mizoram University (MZU)	8
North-Eastern Hill University (NEHU)	6
Pondicherry University (PU)	5
Tripura University (TU)	3
University of Delhi (DU)	7
Total	**81**

Appendix-II

List of Faculties in LIS Departments of Central Universities

SN	Name of Faculty	Affiliating University	Gender	Designation
1.	Aditya Tripathi	BHU	Male	Professor
2.	Ajay Pratap Singh	BHU	Male	Professor
3.	Akhandanand Shukla	MZU	Male	Assistant Professor
4.	Amit Kumar	MZU	Male	Assistant Professor
5.	Anila Sulochana	CUTN	Female	Assistant Professor
6.	Archana Shukla	IGNOU	Female	Assistant Professor
7.	Ashwini Singh	BHU	Male	Assistant Professor
8.	Augustine Zimik	TU	Male	Assistant Professor
9.	Bhakti Gala	CUG	Female	Assistant Professor
10.	Bhaskar Mukherjee	BHU	Male	Professor
11.	Bikika Laloo	NEHU	Female	Professor
12.	Bobby Phuritsabam	MU	Male	Assistant Professor
13.	Brajesh Tiwari	GGU	Male	Associate Professor
14.	C K Ramaiah	PU	Male	Professor
15.	Ch Ibohal Singh	MU	Male	Assistant Professor
16.	Dimple Patel	CUHP	Female	Assistant Professor
17.	H N Prasad	BHU	Male	Professor
18.	Inder Vir Malhan	CUHP	Male	Professor
19.	J J Thabah	NEHU	Female	Assistant Professor
20.	J K Mishra	HSGU	Male	Associate Professor
21.	Jaideep Sharma	IGNOU	Male	Professor
22.	Jiarlimon Khongtim	NEHU	Female	Assistant Professor
23.	K L Mahawar	BBAU	Male	Professor
24.	Keisham Sangeeta Devi	MU	Female	Assistant Professor
25.	K P Singh	DU	Male	Associate Professor
26.	Kunwar Singh Rawat	BHU	Male	Associate Professor
27.	Lalngaizuali	MZU	Female	Assistant Professor

28.	M Leeladharan	PU	Male	Assistant Professor
29.	M P Singh	BBAU	Male	Professor
30.	Mahendra Kumar	HSGU	Male	Assistant Professor
31.	Mangkhollen Singson	PU	Male	Assistant Professor
32.	Manish Kumar	DU	Male	Assistant Professor
33.	Manoj Kumar Sinha	AU	Male	Professor
34.	Manoj Kumar Verma	MZU	Male	Assistant Professor
35.	Margam Madhusudhan	DU	Male	Associate Professor
36.	Masoom Raza	AMU	Male	Associate Professor
37.	Meera Yadav	DU	Female	Associate Professor
38.	Mehtab Alam Ansari	AMU	Male	Associate Professor
39.	Minaxi Parmar	CUG	Female	Assistant Professor
40.	Mithu Anjali Gayan	TU	Female	Assistant Professor
41.	Mohammad Nazim	AMU	Male	Assistant Professor
42.	Moses M. Naga	NEHU	Male	Professor
43.	Mukut Sarmah	AU	Male	Associate Professor
44.	Muzamil Mushtaq	AMU	Male	Assistant Professor
45.	Nabin Chandra Dey	AU	Male	Assistant Professor
46.	Naushad Ali PM	AMU	Male	Professor
47.	Neelam Thapa	HSGU	Female	Assistant Professor
48.	Neena Talwar Kanungo	IGNOU	Female	Professor
49.	Nimmala Karunakar	CUHP	Male	Assistant Professor
50.	Nishat Fatima	AMU	Female	Associate Professor
51.	P Hangsing	NEHU	Male	Associate Professor
52.	Paramjeet Kaur Walia	DU	Female	Professor
53.	Pawan Kumar Saini	CUH	Male	Assistant Professor
54.	Pravakar Rath	MZU	Male	Professor
55.	R Sevukan	PU	Male	Associate Professor
56.	Rabinarayan Mishra	MZU	Male	Professor
57.	R K Mahapatra	TU	Male	Associate Professor
58.	Rajani Mishra	BHU	Female	Associate Professor

59.	Rajesh Rangappa Aldarthi	AU	Male	Assistant Professor
60.	Rakesh Kumar Bhatt	DU	Male	Associate Professor
61.	Ranjeet Kumar Choudhary	BBAU	Male	Assistant Professor
62.	Rashmi T Kumbar	CUG	Female	Assistant Professor
63.	Rekha RV	PU	Female	Assistant Professor
64.	R K Ngurtinkhuma	MZU	Male	Professor
65.	S Ravi	CUTN	Male	Professor
66.	S Ravikumar	NEHU	Male	Assistant Professor
67.	Sapna Devi N	CUH	Female	Assistant Professor
68.	Shailendra Kumar	DU	Male	Associate Professor
69.	Sharad Kumar Sonker	BBAU	Male	Assistant Professor
70.	Shilpi Verma	BBAU	Male	Professor
71.	Shri Ram Pandey	BHU	Male	Assistant Professor
72.	S N Singh	MZU	Male	Professor
73.	Sudharma Haridasan	AMU	Female	Associate Professor
74.	Sudhier K. G. Pillai	CUTN	Male	Assistant Professor
75.	Taddi Murali	CUTN	Male	Assistant Professor
76.	Th Madhuri Devi	MU	Female	Professor
77.	Th Purnima Devi	MU	Female	Professor
78.	Uma Kanjilal	IGNOU	Female	Professor
79.	V K Dhanyasree	CUTN	Female	Assistant Professor
80.	Vinit Kumar	BBAU	Male	Assistant Professor
81.	Zuchamo Yanthan	IGNOU	Male	Assistant Professor

Appendix-III

Research Questionnaire

Measuring Scholarly Communications of Academia of Library and Information Science in Central Universities of India

Dear Sir/Madam,

I am pursuing Ph.D. in the Department of Library and Information Science, Mizoram University, Aizawl. As a component of the work, I have to submit dissertation on the above mentioned topic under the guidance of Prof. R. K. Ngurtinkhuma. In this regard, you are requested to kindly fill up the questionnaire which comprises your all scholarly activities since the date of joining to the teaching profession till 31st December, 2018. I assure you that data provided in this questionnaire will be kept confidential and will be used for academic and research purposes only.

Sanjay Kumar Maurya, Ph.D. Scholar,
Department of Library and Information Science
Mizoram University, Aizawl
Email: **sanjay2015maurya@gmail.com**

Part A.
General Information

Name of the Respondent	Gender (M/F)	Age of Respondent

Name of the Department & Name of University	Establishment year of the Department

Part B.
Professional Information

1. Current Academic Position/ Designation (**Make Bold/color of your answer**):
   (a) Assistant Professor (b) Associate Professor (c) Professor

2. Highest academic qualification (**Make Bold/color of your answer**):

(a) Ph.D. (b) Pursuing Ph.D. (c) M. Phil. (d) Pursuing M. Phil. (e) MLIS/M. Lib. Degree

(f) If others (please specify): …………

3. Teaching Experience (since date of joining in teaching profession): ……………yrs.

4. Research Experience (in years):…………yrs.

5. Areas of Research
Interest:………………………………………………………………

6. Kindly give the most preferred languages used by you in scholarly communications. Put tick (✓) mark in the appropriate box.(Tick mark can be copied/pasted in the appropriate box.)

SL. No.	Publication Media	Language Used for Publication		
		English	Hindi	Any other
1.	Authored Books			
2.	Co-authored Books			
3.	Book Chapters			
4.	Edited Books			
5.	Journal Articles			
6.	Conference/Seminar Papers			
7.	Technical Reports			
8.	News Items			
9.	Reviews			
10.	Editorials			
11.	Abstracts			
12.	Others			

7. What is your preferred medium of research publications?* (Please give/type the preference order for below mentioned medium of publications in numerical values like 1, 2, 3, 4, 5, 6, 7, 8).

SN	Medium of Research Publication	Preference Order*
1.	Authored Books	
2.	Co-authored Books	
3.	Book Chapters	
4.	Edited Books	
5.	Journal Articles	
6.	Conference/Seminar Papers	
7.	Technical Reports	
8.	News Items	
9.	Reviews	

10.	Editorials	
11.	Abstracts	
12.	Others	

Note: For question 8(a) to 8(d)
Please provide either the latest publication link or attach latest full bio-data including publication details or fill the table 8(a) to 8(d) given below:

8. (a) Please provide the details of Journal Publications published up to 31st December, 2018.

Author(s)	Article Title	Journal Name	Year

If require, more rows can be created by using **Tab** key in the last row of the table.

8. (b) Please provide the details of Conference /Seminar Proceedings published up to 31st December, 2018.

Author(s)	Article Title	Conference/Seminar Name	Year

If require, more rows can be created by using **Tab** key in the last row of the table.

8. (c) Please provide the details of Books (Authored/Edited/Festschrift Volumes) published up to 31st December, 2018.

Author(s)	Book Title	Publisher & Place	Year	Authored/ Edited Vol.

If require, more rows can be created by using **Tab** key in the last row of the table.

8. (d) Please provide the details of Book Chapters (Edited/Festschrift Volumes) published up to 31st December, 2018.

Author(s)	Article Title	Book Title	Year	Publisher & Place

If require, more rows can be created by using **Tab** key in the last row of the table.

9. Do you have an Identity (id) in Google Scholar? Please put tick (✓) mark in appropriate box.

Yes	No

If yes;
Kindly give your name as registered in Google Scholar (Google Scholar id.)

10. Kindly give the basic details of research projects undertaken by you up to 31st December, 2018.

Title of the Project	Nature of the Project		Funding/ Sponsoring Agency	Completed/ Ongoing	Individual/ Collaborative
	Major	Minor			

If require, more rows can be created by using **Tab** key in the last row of the table.

11. Kindly give the number of research scholars' status enrolled (M. Phil. /Ph.D.) under your supervision.

Year	No. of M. Phil. Scholars	No. of Ph.D. Scholars
	Awarded	Awarded
Before 1990		
1991-2000		
2001-2010		
2011-2017		

12. Please suggest if any, for improvement of scholarly communication in Library and Information Science:
……………………………………………………………………………………………
……………………………………………………………………………………………
……………………………………………………………………………………………

(Please return completed questionnaire to: sanjay2015maurya@gmail.com)

Thank You Very Much (Signature of Respondent)

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BRIEF BIO-DATA OF THE CANDIDATE

Mr. Sanjay Kumar Maurya
Department of Library and Information Science
School of Economics, Management and Information Science
Mizoram University, Aizawl - 796004, India
Phone: +91 80113 22020
Email: sanjay2015maurya@gmail.com

EDUCATIONAL QUALIFICATIONS

UGC NET - JRF: January, 2018	UGC, New Delhi
Masters in Library and Information Science: 2013	Dibrugarh University, Dibrugarh
B.Sc. (Hons.): 2009	Dibrugarh University, Dibrugarh
Intermediate: 2005	Asaam Higher Secondary Education Council, Guwahati
High School: 2003	Board of Secondary Education, Assam

RESEARCH INTEREST:

- Bibliometrics, Scientometrics, Citation Analysis, Library Cataloguing & Classification

(Sanjay Kumar Maurya)

LIST OF PUBLICATIONS

Journal Publications

1. OPEC countries: research performance across nations in Library and Information Science. *International Journal of Information Science and Management*, *16*(2), 101-110. (Scopus Indexed)

2. Research performance of South Asian Association for Regional Cooperation (SAARC) countries in Library and Information Science: A scientometric analysis. *COLLNET Journal of Scientometrics and Information Management*, *12*(1), 73- 81. (WoS Indexed)

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Conference Publications

7. Scientometric sketch of faculty's research performance of Library and Information Science: A study of Mizoram University, Aizawl. *In* International Conference on "*Exploring the Horizons of Library & Information Sciences: From Libraries to Knowledge Hubs*", 7th - 9th August, 2018, DRTC, ISI, Bengaluru.

8. Evaluating online visibility of Library and Information Science academia in central universities of North-East India: A scientometric study based on Google Scholar. *In* 11th Convention PLANNER-2018 on "*Rejuvenate Academic Library as a Social Hub*", 15th -17th November, 2018, organized by INFLIBNET Centre, Gandhinagar Gujarat and held at Tripura University, Agartala, Tripura.

STATISTICAL INDIAN INSTITUTE

UNITY IN DIVERSITY

Indian Statistical Institute

Documentation Research and Training Centre

Bengaluru, India

Certificate

This is to certify that Mr. Sanjay Kumar Maurya participated and presented a paper in the International Conference on "Exploring the Horizons of Library and Information Sciences: From Libraries to Knowledge Hubs" organised by the Documentation Research and Training Centre (DRTC), Indian Statistical Institute (ISI), Bengaluru, from 7th to 9th August 2018.

(A.R.D. Prasad)

Convener, SRR125 2018

Date : 09-08-2018

Bengaluru - 560059

11th Convention

PLANNER 2018

(Promotion of Library Automation and Networking in North Eastern Region)

CERTIFICATE

THIS CERTIFICATE IS PRESENTED TO

Sanjay Kumar Maurya

for Participation or Paper / Abstract Presentation in the 11th Convention PLANNER 2018 on

"Rejuvenate Academic Library as a Social Hub"

organized by INFLIBNET Centre, Gandhinagar, Gujarat in collaboration with Tripura University, Agartala, Tripura during November 15- 17, 2018

B. Sanjay

(Dr. B Sanjay)
Organizing Secretary, PLANNER 2018

(Dr. Jagdish Arora)
Director, INFLIBNET Centre

PARTICULARS OF THE CANDIDATE

NAME OF THE CANDIDATE	: SANJAY KUMAR MAURYA
DEGREE	: Ph.D
DEPARTMENT	: LIBRARY AND INFORMATION SCIENCE
TITLE OF THE THESIS	: MEASURING SCHOLARLY COMMUNICATIONS OF ACADEMIA OF LIBRARY AND INFORMATION SCIENCE IN CENTRAL UNIVERSITIES OF INDIA
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1. BOS	: 01.05.2017
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EXTENSION (IF ANY)	: NO

(HEAD)
DEPARTMENT OF LIBRARY AND INFORMATION SCIENCE
MIZORAM UNIVERSITY, AIZAWL

ABSTRACT

MEASURING SCHOLARLY COMMUNICATIONS OF ACADEMIA OF LIBRARY AND INFORMATION SCIENCE IN CENTRAL UNIVERSITIES OF INDIA

SANJAY KUMAR MAURYA

DEPARTMENT OF LIBRARY AND INFORMATION SCIENCE

MIZORAM UNIVERSITY, AIZAWL

1. Introduction

The discipline of Library and Information Science (LIS) has existed in India for more than a century. After its inception, tremendous growth and development have been taken place in the area of library services as well as the organization of documents. The rapid growth in information technology, computer networks, electronic publishing, and digital libraries has contributed to the restructuring of scholarly publishing, its methods of access, copyright policies, and the relationships among the author, publisher & libraries. The study of scholarly communication involves the trend and growth of communications, core areas of research for the discipline, information needs and users of information as well as the relationship in both formal and informal methods of communication. Bibliometrics studies have a set of pre-defined methods to study scholarly research output. Citation analysis, considered as one of the best-known bibliometric studies, is the measurement of scholarly communication of documents; Web citation analysis is the measurement of citations of scholarly communications of documents over the Web and citation databases are used in the extraction of Web citation from scholarly resources. The interconnection between documents and citations through hyperlink mechanism in databases allows an information seeker to move between related documents. These citations on the Web are produced from the research publications which are generated from different sources such as articles, proceedings, journals and so on. Nowadays, dissemination of scientific publications via Web becomes very common, and various discussions have already done for the possibility of Web mention being a citation for evaluating the impact of any academic activity. Scientometrics is a quantitative method of measuring scientific information based on the number of scientific articles published during a given period and their citation impact will be used for the present study. Bibliometrics and scientometrics related research includes various studies in relation to scientific publications through scattering & growth of literature, obsolescence of literature, distribution of productivity by author, journal, institution & country which helps to analyze the growth & pattern of publications.

2. Statement of the Problem

Scholarly communications of academia in contributing in any discipline are an essential source for their professional development in the concerned area as well as for the research output of an institution or country. From the LIS perspective especially in India, there are inadequate scientometric researches conducted to measure the scholarly communication of academia of Library & Information Science in comparison to the USA and Europe. Scientific visibility of scholarly communication (research output) of LIS academia in India is properly not measured in any research conducted which displays poor visibility of scholarly communications to indicate their contribution to knowledge generation, be accountable for funding, and reap rewards in terms of personal and international recognition. Therefore, need arises to study the knowledge and information generated by LIS academia through their scholarly communication as well as to assess the current status of Web visibility and research performance by analyzing the scholarly communications of the academia in terms of growth rate, areas of research concentration, author productivity, and authorship pattern. From the LIS perspective, there have been few pieces of research so far, based on the scientometric analysis of the Library and Information Science academia and it would thus be interesting to conduct the study.

3. Significance of the Study

There are several scientometric studies conducted in the Library and Information Science (LIS) perspective in India as well as in the world also but studies related to LIS faculties of Central Universities from the Indian perspective, there is a lack of adequate scientometric studies so far. Thus, the present study is an attempt to fill up the gap created in the field. The study assessed scholarly communications of academia of Library and Information Science by using scientometric techniques, a valuable method for the identification of new scientific and technological knowledge. The increase of literature has to turn out to be a key concern for the intellectuals and library and information science professionals as they have to keep themselves updated, aware of the recent development & changes, in their subject. The publication profile acts as an indicator of the scholarly (scientific) activity of an author, institution, and country. Many important observations have been derived by analyzing scholarly communications in sense of scientific publication through their bibliographical features such as type, language, forms & medium of communication channels, journal name, year of publication, the name and affiliation of authors, authorship pattern and research collaboration, co-authorship pattern, keyword analysis, etc. In this way, the present study helped to show the current status of the scholarly performances of the academia of Library and Information Science (LIS) in India by analyzing their works where growth, stagnation, and decline have been presented according to scientometric methods.

4. Scope of the Study

The study belongs to the scientometric analysis of academia of Library and Information Science and confined to the scholarly communications of academia of Library and Information Science in Central Universities of India. The Central Universities in India are established by the Act of Parliament and recognized by the University Grants Commission (UGC). There are 46 Central Universities in India (as on May 2017), out of that 18 Central Universities have Library and Information Science (LIS) department with 81 faculty members that are given in Table.

Table: Central Universities with LIS Department & Faculty Members

SN	Central University (Code Name)	No of Faculty Members			Total
		Professor	Associate Professor	Assistant Professor	
1	Aligarh Muslim University (AMU)	2	3	2	7
2	Assam University (AU)	1	1	2	4
3	Babasaheb Bhimrao Ambedkar University (BBAU)	3	0	3	6
4	Banaras Hindu University (BHU)	4	1	3	8
5	Central University of Gujarat (CUG)	0	0	3	3
6	Central University of Haryana (CUH)	0	0	2	2
7	Central University of Himachal Pradesh (CUHP)	1	0	2	3
8	Dr. Hari Singh Gour University (HSGU)	1	0	2	3
9	Guru Ghasidas University (GGU)	0	1	0	1
10	Hemvati Nandan Bahuguna Garhwal University (HNBGU)	0	0	0	0
11	Indira Gandhi National Open University (IGNOU)	3	0	2	5
12	Manipur University (MU)	2	0	3	5
13	Mizoram University (MZU)	4	0	4	8
14	North-Eastern Hill University (NEHU)	2	0	4	6
15	Pondicherry University (PU)	1	1	3	5

16	Tripura University (TU)	0	1	2	3
17	University of Delhi (DU)	1	5	1	7
18	Central University of Tamil Nadu (CUTN)	1	0	4	5
	Total	26	13	42	81

(Source: Central University's websites)

5. Objectives of the Study

The purpose of the study is to measure the scholarly communication of academia of Library and Information Science in Central Universities of India. The objectives of the study are to:

a) Examine the trends and growth of research output of academia of Library & Information Science in Central Universities of India.

b) Examine the forms and extent of research output of academia of Library & Information Science in Central Universities of India.

c) Find out the authorship pattern and degree of collaboration of academia of Library & Information Science in Central Universities of India.

d) Study the implications of Lotka's Law and Bradford's Law over the scholarly communication of academia of Library & Information Science.

e) Measure the Web visibility of online scholarly communications of academia of Library & Information Science in Central Universities of India.

6. Hypotheses

The hypotheses of the study are:

Hypothesis 1:

H_0: There is no significant relationship between research productivity and academic position of the faculties.

H_1: There is a significant relationship between research productivity and academic position of the faculties.

Hypothesis 2:

H_0: There is no significant relationship in the preference order of scholarly communications and the academic position of faculty.

H_1: There is a significant relationship in the preference order of scholarly communications and the academic position of faculty.

Hypothesis 3:

H_0: There is no significant relationship in the preference order of scholarly communications among central universities.

H_1: There is a significant relationship in the preference order of scholarly communications among central universities.

Hypothesis 4:

H_0: There is no significant increase observed in online scholarly communication over the period.

H_1: There is a significant increase observed in online scholarly communication over the period.

Hypothesis 5:

H_0: There is no significant relationship between academic position and their visibility in online scholarly communication.

H_1: There is a significant relationship between academic position and their visibility in online scholarly communication.

7. Research Methodology

This is the descriptive study designed to measure the scholarly communications of academia of Library and Information Science in Central Universities of India. The survey (through a questionnaire) and observation methods of research have been found appropriate for conducting the study. The faculty member's publications and other demographic details have been collected by routing printed questionnaire as well as an online survey conducted for each faculty member also. The collected data were cross-verified from the bio-data of faculty members available on their respective universities' websites. The population of the study was 81 faculty members of Library and Information Science from 18 Central Universities of India, and no LIS faculty has been found in Hemvati Nandan Bahuguna Garhwal University. Further, Google Scholar (GS), Web of Science (WoS) and Scopus databases have been used for measuring the Web visibility of online scholarly communications of faculty members. The methodology related to Google Scholar, Web of Science and Scopus databases has been given separately at the place of analysis & discussion of data (cf. section 4.2.2.1, section 4.2.2.2, & section 4.2.2.3). The collected data were scrutinized, tabulated and analyzed for inference. Statistical inferences were drawn by using appropriate data analysis tools i.e. Bibliometrix R; statistical tool i.e. SPSS were used for testing of hypotheses.

8. Findings of the Study

Findings of study divided into four sections dealing different set of data analysis and its result.

a) Findings based on Primary Data

The study conducted on faculty members of 18 Central Universities having Library and Information Science (LIS) departments using scientometric indicators. The study found 81 LIS faculties in 18 Central Universities of India, out of which 63 LIS faculties responded to the questionnaire. Hemvati Nandan Bahuguna Garhwal University does not have any faculty in the LIS department. Faculties of some Central Universities were interested to share their academic and research related data for the study while some were not interested. LIS departments have more male faculty than females. The numbers of Assistant Professors are more than Associate Professors and Professors. About half of the faculty members belong to Assistant Professor. The gender perspective of LIS faculties biased towards the male in the case of Assistant Professor (70% male), Associate Professor (73.3% male), and Professor (77.7% male) also.

The age factor of LIS faculties has been studied to know their level of experience in the field and to ascertain the professional experience and found that 40 LIS faculties have shared their age-related information. All the LIS faculties belong to more than 30 years of age while the majority of them belonged to the age group 41-50 years followed by age group 31-40 years. In a categorical study, it has been found that all Assistant Professor belongs to the age group 31-40 years while among the age group of 41-50 years, 60% faculties were Assistant Professor. The study observed that faculties related to the Assistant Professor category have the age range of 30-50 years while Associate Professor and Professor have a higher age range as per their designation. LIS faculties have a tendency to achieve higher academic as well as professional qualifications while some new entrants in the profession are pursuing higher degrees.

Working experience and designation of the faculty have a direct relationship as observed from the study. The period of academic and research experience fully depends upon the faculty's designation, and experience increases with the change of designation. Language is the medium of communication and thus scholarly communication also needs some language to disseminate research findings and *the English* language has been found as the most preferred language for research publications. Simultaneously, scholarly communication needs some medium to publish the research finding besides language requirements and observed *journal articles* as the most preferred medium of research publication followed by *conference/ seminar proceedings* and *book chapters*.

Google Scholar (GS) has provided the facility to everyone to showcase his/her research achievement in the online domain using Google Scholar profile. In the case of LIS faculties of Central Universities of India, the majority of the faculties have a GS profile but still, there is a significant number of faculties who do not have a GS profile. The younger faculties have a tendency to showcase their research achievement through GS profile than senior faculties. Funded research projects have been found for more than 50% faculties (amongst responded). Senior LIS faculties have more research projects and others. Faculties have a tendency to get major research projects rather than minor research projects from funding agencies. UGC, DRDO, and ICSSR were the main funding agencies for research projects in the field. Research supervision is one of the important research activities of faculties, and LIS faculties have produced significant number of research degree in terms of M. Phil. and Ph.D. Study observed more production of M. Phil. than Ph.D.; and found that designation has the direct impact in research supervision and research production especially in the case of M. Phil. and Ph.D.

Research activities are one of the core areas of faculties for subject development and bringing innovation in the field. Research activities depend upon the capability of the individual faculty as well as his/her interest in research. There are some faculties who are producing more research while others are far from that. The LIS faculties also have the same pattern where some faculties and universities are more productive while other faculties and universities are dull in the whole research landscape. In terms of research supervision, Shailendra Kumar, Mahender Pratap Singh, Margam Madhusudhan, R. K. Mahapatra, H. N. Prasad, and Brajesh Tiwari are some more productive faculties. In terms of research papers published in journals, conference proceedings, book chapters, books etc., M. K. Sinha, C. I. Singh, M. K. Verma, S. K. Sonker, Shilpi Verma, C. K. Ramaiah, I. V. Malhan, R. K. Bhatt, M. P. Singh and K. P. Singh are more productive LIS faculties.

The department-wise research performance has been analyzed based on total faculties' performance and found that DU, MZU, BBAU, AMU, and AU are the top performers among LIS departments of Central Universities of India. Nowadays, there is a tendency to share research activities among many researchers and the same has been observed for the LIS field also. LIS faculties have strong authorship collaboration for research publications. Lotka's Law displays the trends of the author's research productivity and found fit for the present study also while dataset found unfit for Bradford's Law with a significant deviation of values in first, second and third zones. The source items, where scholarly communication published, have been analyzed using Bradford's Law and found some highly productive LIS journals of the filed like *DESIDOC Journal of Library and Information Technology*, *Library Philosophy and Practice* and *Journal of Library and Information Science*.

b) Findings based on Google Scholar

The efforts have been put to draw a portrait of LIS faculty's performance based on GS which is one of the most used, popular and powerful scholarly search tools. Various studies confirmed that the number of citations in GS is found higher than WoS or Scopus as GS includes various forms of literature like journal papers, conference papers, books, book chapters, reports, theses, patents, publications from repositories and websites, etc. A total of 75 LIS faculties have produced 1186 publications and received 4684 citations. The variation in citations and publications is measured university-wise that indirectly reflects the quality of research work done at the university; and at the same time, very fewer contributions are seen for three central universities like TU, GGU and CUH. The year-wise growth rate of publications and citations is analyzed up to October 2018 which shows the continuous growth in terms of publications and fluctuations in terms of citations. Over the years, citations have shown growth but CPP reduced after 2008 (see Fig. 4.13) due to the downfall of citations in comparison to the number of publications. There may be several reasons for the downfall of citations but it simply implies the possibility of the low quality of research during the period, if we consider the CPP. This downfall of citations leaves a gap to find out all the possible reasons behind it. It is quite unclear about the types of document retrieved through GS as it categorized documents into link, citation, pdf and other formats like PS, DOC, RTF which can be considered as the limitations of GS; and has to be categorized in proper forms of document like journal article, conference proceedings, reports, book, book chapters, patents, etc.

Based on the publications of top highly productive authors, top-cited authors, and top-cited journal articles, it can be the inference that faculties like M Madhusudhan, B Mukherjee, CK Ramaiah, R Sevukan and HN Prasad have performed a remarkable contribution in terms of publications and citations also. The preferred areas of research by LIS faculties are proposed through the co-occurrence of keywords extracted from the title of the publications. It is found that the proposed areas of research cover the core areas of LIS research. Finally, through the co-authorship network, the study identified highly linked LIS faculties in terms of sharing of publication; and reached to the conclusion that both inter-& intra-departmental collaboration is weak among LIS faculties.

c) Findings based on Web of Science database

The study presents the publication productivity and its result based on scientometric indicators for LIS faculties belongs to Central Universities of India based on the WoS database. A total of 157 publications were observed from 47 different sources during the year 1993 to 2019 by the 42 LIS faculties out of 81 LIS faculties. The individual publication is found to be 191 with an average of 4.54 publications per author. The total number of publications for every single faculty is counted and ranked according to the individual and affiliating institutional level. Publication impact of faculties is observed based on total citations and *h*-index while *the g*-index score is determined based on citations of publications. Co-authorship pattern is found maximum for multiple authors (76.43%) than single authors. Collaboration among faculties belongs to the same or different institution is analyzed and the highest collaborated publications (24, 15.28%) are found between faculties.

Most productive sources are evaluated based on the number of publications, *DESIDOC Journal of Library & Information Technology* contributed the highest (17.19%) publication. Year-wise growth of publications was found maximum during the year 2015 to 2018 and within this duration, 72.59% of total publications were published and of which 30.57% publications have been witnessed during the year 2016. Positive growth trend is observed for the sources like *DESIDOC Journal of Library and Information Technology*, *Knowledge Management in Libraries: Concepts, Tools and Management*, *Annals of Library and Information Studies*, *COLLNET Journal of Scientometrics and Information Management* while negative growth trend is found for the journals like *Library Review*, *Electronic Library*, *Scientometrics*, and *Program: Electronic Library and Information Systems*. Almost 68% of the total source documents are available in the form of a *journal article* that represents that a journal article is the most preferred type of communication channel by the LIS faculties.

The occurrence of keyword, conceptual structure map of keywords and clustering of keywords are analyzed from the total 390 author keywords. The high frequency of keywords implies the core areas of research preferred by the LIS faculties in their publications. Grouping of keywords is observed in the form of clusters, the number of the link between keywords & link strength between keywords which are determined based on criteria of similarity. The similarity denotes the distance between distributions associated to keywords by counting co-occurrences in author keywords. Keywords like “India”, “Academic Libraries”, “Information Retrieval”, “Libraries” etc. are the most co-occurred keywords. Closeness relation of core keywords with each related keywords is mapped based on the *conceptual structure of keywords* and observed that core keywords like “Academic Libraries”, “Knowledge Management”, and “Link Analysis” are closely related while “Citation Analysis” is less related with other keywords. The “citation analysis”, “information science”, “libraries”, “knowledge management”, “impact factor”, “university libraries”, “neural network research”, “academic libraries” are the most popular keywords that are basically clustered with the keywords like “impact”, “citation analysis”, “usage”, “bibliometric analysis”, “ICT”, and “Internet” etc.

Bibliographic coupling of sources and institutions were analyzed based on the link strength of the same. Among sources, the strongest link strength is observed for the journals like “*Library Review*”, “*DESIDOC Journal of Library & Information Technology*” and “*Scientometrics*” while weak link strength is found for the journal “*Program: Electronic Library and Information System*s” and “*Library Hi Tech*.” Under institutions, the strongest link strength is found for BHU, AMU & DU while weak link strength is found for CUG and MU. Co-citation of cited reference was analyzed along with the number of times the references were cited by the faculties. For total 1786 cited sources, co-citation of cited sources is observed maximum for the journal “*Scientometrics*”, “*Journal of the Association for Information Science* *and Technology*", "*Electronic Library*", "*Knowledge Management*", "*Journal of Academic Librarianship*", "*Journal of the American Society for Information Science*", "*DESIDOC Journal of Library & Information Technology*", "*Library Review*", "*Program: Electronic Library and Information Systems*" and "*Information Research*".

d) Findings based on Scopus database

The study presents the Web-based scholarly communications of LIS faculties indexed in Scopus and found 53 LIS faculties indexed in Scopus with 274 total LIS publications. Few Central Universities have been indexed fully in the Scopus database. The individual publication is found to be 274 with an average of 5.16 publications per author. The total number of publications for every single faculty is counted and ranked according to the individual and affiliating institutional level. Publication impact of faculties is observed based on total citations and *h*-index while *the g*-index score is determined based on citations of publications. Co-authorship pattern is found maximum for multiple authors than solo authors. Co-authorship collaboration among faculties belongs to the same or different institution is analyzed and the highest collaborated publications (10) are found between faculties.

Implications of Lotka's Law has been calculated and found fit with the data. CAGR has been calculated and found positive over the period. Citations growth has been analyzed and found that more than 50% citations to the publications have been received recently. Average citations per year have shown tremendous growth in the 21st century. B Mukherjee, M Madhusudhan, M Nazim, CK Ramaiah have higher h-index and g-index based on their research performance as indexed in Scopus. The co-authorship network of LIS faculties has been showing the linkage of publications among faculties as well as scholars. M Madhusudhan has the strongest co-authorship network among LIS faculties. The most productive publication sources have been evaluated and 72 sources of publications have been identified from 274 publications. Based on the number of publications, *Library Philosophy and Practice* has been found as the most preferred source of publication followed by *the DESIDOC Journal of Library & Information Technology* and *Annals of Library and Information Studies*. The journal *International Information and Library Review* has received the highest citations followed by *Scientometrics* and *Electronic Library*. The implication of Bradford's Law has been calculated for the 72 sources and found fir with the data. As per Bradford's Law, *Library Philosophy and Practice* and *DESIDOC Journal of Library & Information Technology* are the two core sources of publications.

Faculty member M. Madhusudhan has published a paper in *International Information and Library Review* which is the top-cited document while journal *Scientometrics* received the highest citations per year. Year-wise growth of publications was found maximum during the year 2015 to 2019 and within this duration, 50.36% of total publications were published while 14.59% publications have been witnessed during the year 2018. Almost 81% of the total source documents are available in the form of a *journal article* that represents that a journal article is the most preferred type of communication channel by the LIS faculties. The occurrence of keyword, keyword cloud, and clustering of keywords are analyzed from the total 1130 author keywords. The co-occurrence network of keywords is observed in the form of clusters and analyzed in terms of Betweenness centrality to determine the central keyword among various keywords. The highest level of Betweenness centrality found for “India”, “Bibliometrics’, and “Citation Analysis”. Top 50 keywords based clusters have been analyzed and found 7 clusters. The highest occurrence of keywords found in cluster 4 followed by cluster 1, cluster 2, etc. The first label of cluster “Bibliometrics” contains mainly “Scientometrics”, “Research Productivity”, “H-index”, “Web of Science” etc. which shows conceptual relativity among author keywords.

9. Organization of the Study

The present study has been divided into the following chapters:

Chapter 1: Introduction

Introduces the overview of the entire research work and discusses the significance, scope of the study, literature review, and research design of the study.

Chapter 2: Metrics: Conceptual Approach

It highlights about the concept of bibliometrics, bibliometric laws, the concept of scientometrics, and various indicators of scientometric study.

Chapter 3: Scholarly Communications and Web Visibility in LIS

It briefly elaborates on the channels of scholarly communication, citation databases for scholarly communication, and various tools for mapping scholarly communications.

Chapter 4: Scholarly Communications of LIS Academia – An Analysis

It highlights the collected data and its descriptions in the form of tables, figures, and graphs as well as findings of the study.

Chapter 5: Conclusion & Suggestions

It presents a summary of the entire study and suggestions for improvement of scholarly communications in the field of Library and Information Science.

The appendices and bibliography are given at the end. Publication Manual of the American Psychological Association (6th ed.) is used for recording the references.