SCIENTOMETRIC MAPPING OF LIBRARY AND INFORMATION SCIENCE RESEARCH IN WEB OF SCIENCE

BY

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SUBMITTED

In partial fulfillment of the requirement of the Degree of Master of Philosophy in Library and Information Science of Mizoram University, Aizawl

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CERTIFICATE

This is to certify that **Dhruba Jyoti Borgohain**, M.Phil. Scholar of the Department of Library and Information Science, Mizoram University has written his dissertation titled **"Scientometric Mapping of Library and Information Science Research in Web of Science Database"** under my supervision. To the best of my knowledge and belief, the work embodies his original investigation and findings and has not published anywhere. I consider it worthy for the Degree of **Master of Philosophy (M.Phil.)** in Library and Information Science of the Mizoram University.

(Prof. S.N. Singh)
Supervisor

FORM OF DECLARATION

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October 2020

I, **Dhruba Jyoti Borgohain**, hereby declare that the subject matter of this thesis is the record of work done by me, that the contents of this thesis did not form basis of the award of any previous degree to me or to do 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 **Master of Philosophy** in **Library and Information Science.**

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Acknowledgement

Firstly, I would like to express my sincere thanks to our Almighty God for spiritually bestowed on me and giving strength to complete my dissertation work.

I would like to express my deep sense of gratitude and heartfelt thanks to my supervisor **Prof S.N. Singh**, Professor and Head, Department of Library and Information Science, Mizoram University, for his patient guidance, encouragement and invaluable Qualitative suggestions help me do my doctoral research.

I would like to express my special thanks to **Dr. Manoj Kumar Verma,** Associate Professor of the Department of Library and Information Science, Mizoram University for his constant encouragement. A very special thanks to **Dr Akhandanand Shukla,** Associate Professor, Department of Library and Information Science, Central University of Tamil Nadu, Chennai, who was constantly guiding me starting from topic selection to data analysis when he was working as Assistant Professor at Department of Library and Information Science, Mizoram University.

I would like to extent my heartfelt gratitude to **Prof. Pravakar Rath**, **Prof. R.K. Ngurtinkhuma, Dr. Amit Kumar and Dr. Langaizuali,** of the Department of Library and Information Science, Mizoram University for their morale support and valuable guidance throughout my research work.

I am very much grateful to **Prof. S.K. Singh**, Professor and Head, Department of Library and Information Science, Gauhati University for his continuous motivation and support to complete this study.

I also acknowledge the help receive from our senior research scholars **Dr. Krishna Brahma**, **Ravi Shukla, Sunil Kr. Yadav** of the Department of Library and Information Science, Mizoram University. I am also grateful to our batchmates i.e MPhil/PhD scholars admitted in August 2018 at DLIS, MZU. I am also grateful to my junior scholars of the department.

I offered by deepest gratitude to my family for their great love, motivation and support. I am grateful to my father **Mr. Atul Chandra Borgohain** and mother **Mrs. Mira Borgohain**. My parents played an important role for the completion of my thesis. Without my parents' love and support, I would not have been come this far. I totally dedicate my research work to my Mother and Father with utmost respect and humility.

Last but not the least, I am indebted to one of my closest friend Miss Bhanushree Baishya, Lecturer of Zoology, Ramanujan Junior College, Nagaon, Assam for her affection, emotional support, moral guidance before and during my research work.

The work presented in the preparation of this thesis would not have been possible without each and every person I have mentioned here, I am thankful for their tremendous advice and support.

Aizawl, Mizoram (**DHRUBA JYOTI BORGOHAIN)**

Dated:12.10.2020

PREFACE

LIS research has been always the ultimate vision of intellectuals and academicians, as it also influences scientifically or technically research in other disciplines. With the advent of Information and Communication Technology (ICT), library professionals are also very keen to meet the emerging challenges and to explore new frontiers of LIS profession and knowledge, to show performance in disseminating knowledge as well as taking a problem in way of collaboration. In order to achieve their goal, the LIS professionals are now more competitive and update the current trends of research in the changing scenario to build a rich collection of LIS publications throughout the globe. The focus of scientometrics is the measurement of science and is therefore concerned with the growth, structure, inter-relationship, and productivity of scientific disciplines (Jeyasekar & Saravanan, 2015). There has been growing interest in mapping and visualization. Researchers began to focus on the structure of scientific literature in order to identify and visualize specialties, although they did not use the term "visualization" at that time.

Web of Science is an online citation indexing service originally produced by the Institute for Scientific Information (ISI) and later maintained by Clarivate Analytics. It gives access to multiple databases that reference cross-disciplinary research, which allows for in-depth exploration of specialized sub-fields within an academic or scientific discipline. Expanding the coverage of Web of Science, in November 2009 Thomson Reuters introduced Century of Social Sciences. This service contains files which trace social science research back to the beginning of the 20th century, and Web of Science now has indexing coverage from the year 1900 to the present. The multidisciplinary coverage of the Web of Science encompasses over 50,000 scholarly books, 12,000 journals and 160,000 conference proceedings.

There are number of scientometric studies conducted to map the research of specific field at micro-level and macro level. In the field of LIS, few studies have been found which deals with the mapping of LIS research in specific topic or country or database whereas no scientometric study conducted so far which have the coverage of global level or continental level LIS research indexed in Web of Science. So, the present study will be an attempt to fill up the gap. Therefore, the present study is an attempt to map the LIS research published and indexed in Web of Science.

This study will help LIS professionals to understand and develop an interest in such kind of metrics for LIS research and study will also provide the strengths and weaknesses of the field. The complete thesis is arranged under the following five chapters to look into the problem:

Chapter-I presents a brief introduction of the research problem, review of literature, objectives, scope of the study and research methodology.

Chapter-II gives a brief introduction to the concept of scientometrics, measurements like h-index, g-index, forms of publications, growth of publication, annual growth rate, Compound annual growth rate, doubling time.

Chapter-III gives an overview of Library and Information Science Research, history from Indian and global perspective and prominent areas of Library and Information Science Research.

Chapter-IV provides the tables and maps of the data collected and analysed considering the objectives in mind. Accordingly, data is tabulated and presented in this chapter using MS-Excel.

Chapter-V provides the findings according to the objectives formulated and further gives the conclusion and suggestions as per the work carried out in the study.

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LIST OF ABBREVIATIONS

TERM	DESCRIPTION
AHCI	Arts & Humanities Citation Index
AGR	Annual Growth Rate
AAGR	Average Annual Growth Rate
ASLIB	Association for Special Libraries and Information Bureaux
BCI	Book Citation Index
BRICS	Brazil Russia India China South Africa
	Compound Annual Growth Rate
CSV	Comma Separated Values
CSIR	Council of Scientific and Industrial Research
CPCI	Conference Proceedings Citation Index
DLSU	De La Salle University
DST	Department of Science and Technology
ESCI	Emerging Sources Citation Index
ESRI	Environmental Systems Research Institute
FAQs	Frequently Asked Questions
FLDs	Followed Linking Domains
GIF	Graphics Interchange Format
GIS	Geographic Information System
HEIs	Higher Educational Institutes

h-index	Hirsch Index
HSL	Health Science Library
HTML	Hyper Text Markup Language
ICMR	Indian Council of Medical Research
ICT	Information and Communication Technology
ICTL	Information and Communication Technology Literacy
IFLA	International Federation of Library Associations and Institutions
IIIT	International Institute of Information Technology
ILL	Inter Library Loan
ILMS	Integrated Library Management System
IISC	Indian Institute of Science
IIT	Indian Institute of Technology
IP	Internet Protocol
ISI	Institute for Scientific Information
ISICAL	Indian Statistical Institute
IWIF	Internal Web Impact Factor
JIF	Journal Impact Factor
LD	Linking Domain
LIS	Library and Information Science
MEDLINE	Medical Literature Analysis and Retrieval System Online
M.Phil.	Master of Philosophy
MS-EXCEL	Microsoft-Excel
MZU	Mizoram University
NISTADS	National Institute of Science, Technology and Development Studies

NISCAIR	National Institute of Science Communication and Information Resources
NGOs	Non-Governmental Organizations
OCR	Optical Character Recognition
OPAC	Online Public Access Catalogue
PDF	Portable Document Format
PhD	Doctor of Philosophy
R & D	Research and Development
RGR	Relative Growth Rate
RRRLF	Raja Rammohun Roy Library Foundation
RSS	Rich Site Syndication
RWIF	Revised Web Impact Factor
SAARC	South Asian Association for Regional Cooperation
SCIE	Science Citation Index Expanded
SSCI	Social Science Citation Index
SLA	Special Libraries Association
SLWIF	Self-Link Web Impact Factor
SPSS	Statistical Package for the Social Sciences
SWIF	Simple Web Impact Factor
TEBROC	Tehran Book Processing Centre
TLD	Top Level Domain

UGC	University Grants Commission
UK	United Kingdom
ULA	University Librarian Association of Sri Lanka
UPE	University with Potential for Excellence
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
WISER	Web Indicators for Science, Technology and Innovative Research
WMV	Windows Media Video
WWW	World Wide Web
WoK	Web of Knowledge

CHAPTER 1

INTRODUCTION

1.Introduction

Library and Information Science (LIS) is a discipline which deals with the management of Libraries and Information Centers in various ways. LIS research has been always the ultimate vision of intellectuals and academicians, as it also influences scientifically or technically research in other disciplines. With the advent of Information and Communication Technology (ICT), library professionals are also very keen to meet the emerging challenges and to explore new frontiers of LIS profession and knowledge, to show performance in disseminating knowledge as well as taking a problem in way of collaboration. In order to achieve their goal, the LIS professionals are now more competitive and update the current trends of research in the changing scenario to build a rich collection of LIS publications throughout the globe. According to Rashid (2001), "research is a conscious effort to collect information, to verify the information and to analyze the information". Research is an organized effort to solve the complex and teasing problems. It is generally accepted that research plays a critical role in promoting the prosperity of a nation and the well-being of its citizens in this knowledge-based era (Abbott & Doucouliagos, 2004). Creswell (2008) reported that research not only aids solving practical problems and brings about material improvements, but it also provides insight into new ideas that improve human understanding of various social, economic and cultural phenomena. In recent years, there has been increasing interest among researchers and policymakers in the notion of research output. Research output is one of the major measures of university academic performance and a core indicator for calculations of university rankings. A number of studies have tried to compare research output across nations or academic disciplines and to explore the main factors that enhance the research output of faculty members. Research plays a critical role in promoting the prosperity of a nation and the well-being of its citizens. Universities through research make important contributions to the growth and development of industries and government businesses, thereby promoting national and global development.

1.1 Research Output & Research Productivity

Research output enable academics to earn recognition in academic circle locally and internationally. In higher education, research output often served as a major role in attaining success in academics circles as it is related to promotion, tenure and salary. One of the strategies for determining research productivity is to access the quantity of publication which researcher communicated with primary or other sources. Research productivity and research activities are interrelated. Research involves collecting and analysing the data. Research productivity is the extent to which faculty engage in their own research and publish scientific articles in referred journals, conference proceedings, writing a book chapter, gathering and analysing original evidence, working with postgraduate students on dissertations and class projects, obtaining research grants, carrying out editorial duties, obtaining patents and licenses, writing monographs, developing experimental designs, producing works of an artistic or a creative nature engaging in public debates and commentaries (Creswell, 1986).

There are a number of researches conducted to assess the research productivity of the researchers, authors, faculties, institutions, fields of studies, and country etc. Roleda et al. (2014) conducted a research productivity study at De La Salle University (DLSU) using Scopus database; and found that research productivity includes journal publications, conference papers, books, and monographs. Sweileh et al. (2014) assessed the scientific research productivity of the An-Najah National University, Palestine based on Scopus database and included the pattern of publication, relative growth rate, authorship pattern, collaborative measures, author's productivity, most prolific authors, and most prolific journals as productivity indicators for his research. Iqbal & Mahmood (2001) studied factors related to low research productivity at higher education level and found that extra teaching load, performance of administrative duties along with academic duties, lack of funds, non-existence of research leave, negative attitude of the faculty towards research, lack of research skills, non-availability of latest books, absence of professional journals, less number of university own journals, are the major causes of low productivity and reduced the research productivity of the university faculty members.

1.2 Scientometrics

In 1969, two Russian scientists Vassily V. Nalimov and Z. M. Mulchenko coined the Russian term “Naukometriya” equivalent to ‘scientometrics’. Tague-Sutcliffe (1992) defined “Scientometrics is

the study of the quantitative aspects of science as a discipline or economic activity. It is part of the sociology of science and has application to science policy-making. It involves quantitative studies of scientific activities including, among others, publication, and so overlaps bibliometrics to some extent". The focus of scientometrics is the measurement of science and is therefore concerned with the growth, structure, inter-relationship, and productivity of scientific disciplines (Jeyasekar & Saravanan, 2015). There has been growing interest in mapping and visualization. Researchers began to focus on the structure of scientific literature in order to identify and visualize specialties, although they did not use the term "visualization" at that time. The co-word analysis and co-citation analysis are among the most fundamental techniques for science mapping. They are the technical foundations of the contemporary quantitative studies of science. Each offers a unique perspective on the structure of scientific frontiers.

1.3 Web of Science

Web of Science is an online citation indexing service originally produced by the Institute for Scientific Information (ISI) and later maintained by Clarivate Analytics. It gives access to multiple databases that reference cross-disciplinary research, which allows for in-depth exploration of specialized sub-fields within an academic or scientific discipline. Expanding the coverage of Web of Science, in November 2009 Thomson Reuters introduced Century of Social Sciences. This service contains files which trace social science research back to the beginning of the 20th century, and Web of Science now has indexing coverage from the year 1900 to the present. The multidisciplinary coverage of the Web of Science encompasses over 50,000 scholarly books, 12,000 journals and 160,000 conference proceedings. The coverage includes sciences, social sciences, arts, and humanities. The Web of Science Core Collection consists of six online databases: Science Citation Index Expanded (SCIE) (covers more than 8,500 notable journals encompassing 150 disciplines); Social Sciences Citation Index (SSCI) (covers more than 3,000 journals in social science disciplines); Arts & Humanities Citation Index (AHCI) (covers more than 1,700 arts and humanities journals); Emerging Sources Citation Index (ESCI) (covers over 5,000 journals in the sciences, social science, and humanities); Book Citation Index (BCI) (covers more than 60,000 editorially selected books); Conference Proceedings Citation Index (CPCI) (covers more than 160,000 conference titles in the sciences).

1.4 Significance of the Study

There are number of scientometric studies conducted to map the research of specific field at micro-level and macro level. In the field of LIS, few studies have been found which deals with the mapping of LIS research in specific topic or country or database whereas no scientometric study conducted so far which have the coverage of global level or continental level LIS research indexed in Web of Science. So, the present study will be an attempt to fill up the gap. Therefore, the present study is an attempt to map the LIS research published and indexed in Web of Science. This study will help LIS professionals to understand and develop an interest in such kind of metrics for LIS research and study will also provide the strengths and weaknesses of the field. Further, prospective researchers of LIS may undertake another similar study to explore the LIS profession in a much better way.

1.5 Scope of the Study

The present study is confined to map the research publications of Library and Information Science (LIS) retrieved through Web of Science (WoS). The study will be conducted for five years (5) time duration i.e. from 2014 - 2018. The Web of Science (WoS) indexes research (publications) in the form of conference proceedings, scholarly books, journal publications etc. Research publications available in "all the document types" will be covered in the study.

1.6 Literature Review:

Jain and Garg (1992) analyzed and visualized laser research in India during 1967 to 1984 and the revealed that 785 papers, books and reports were published indicating that Indian output comprises of 1% of the international output. The total output came from 77 academic and research institutions, out of which 10 institutions contributed almost 23%, major portions of these publications appeared in foreign journals of repute, as reflected by their impact factor. Out of the 765 papers published from India 196 are in Indian journals (25.6%) and the remaining 569 are in journals published from abroad (74.4%).

Arunachalam and Doss (2000) mapped international collaboration in Science in Asia through co-authorship analysis using data from Science Citation Index indexed in its CD ROM version in 11 Asian countries with FoxPro and Visual Basic for analyzing the data. Findings reveal that Japan holds 16.4% of internationally collaborated papers, India 17.6% and Taiwan 16.3% recorded an

internationalization index less than 30 whereas China with 28.5%, South Korea with 24.6% and Hong Kong with 36.2% of internationally collaborated papers recorded an internationalization index greater than 40. India, China and South Korea collaborated more in Physics on the other hand eight other countries collaborated more in Life Science. In all fields and almost all Asian countries have preferred USA as a collaborating partner whereas all G7 countries collaborate more with China than in any country which is emerging as a leader in regional collaboration.

Chen etal. (2005) investigated an integrated approach to scientometric studies using information visualization and animation techniques like Pathfinder Network Scaling, Principal Component Analysis (PCA) and Visual Spatial models rendered in Virtual Reality Modelling Language (VRML), Multidimensional Scaling and Cluster Analysis for mapping documents published in the journal *Scientometrics* from year 1981 to 2001. Results reveal that total 403 publications received 5 citations which is a threshold value, among them earliest one published in 1917 and the most recent ones in 1999.

Sagar etal. (2007) analyzed quantitatively the growth and development of mass spectroscopy in nuclear science and technology in terms of publication output in International Nuclear Information System Database from 1970 to 2005 spreading the data downloaded into excel sheet. The findings of the study reveal that during 1970-2005, a total of 10913 papers were published in various domains: Chemistry, Materials and Earth Sciences (5286) (48.44%), Physical Sciences (2367) (21.69%), Engineering and Technology (1434) (13.14), Life and Environmental Sciences (1212) (11.11), other aspects of Nuclear & Non-Nuclear Energy (492) (4.51%) and Isotopes, Isotope and Radiation Applications (122) (1.12%).The highest number of papers (816) were published in 2004. The average number of publications published per year was 303.13. United States topped the list with 2247 publications followed by Germany with 1333 publications, Japan with 820 publications, France with 525 publications, and India with 460 publications.

Meho & Sugimoto (2007) studied mapping the intellectual impact of Library and Information Science research through citations on Scopus and Web of Science (WoS) and they examined the differences between Scopus and WoS using both databases in mapping the faculties' intellectual impact, focusing on the sources of their citations by universities, journals, and countries.

Davarpanah & Aslekia (2007) analyzed 894 contributions published in 56 LIS journals indexed in SSCI during 2000–2004. A total of 1361 authors had contributed publications during the five

years; each article received on an average 1.6 citations and the LIS researchers cite mostly latest articles; about 48% of citing authors had a tendency of self-citation.

Kedamani etal. (2007) analyzed the growth and development of science and technology activities in India as reflected in publication output covered by Science Citation Index (SCI) during 1990 to 2004. The results reveal that India achieved an average annual growth rate of 3.05 per cent of its publications output," which is much less than China (13.58 per cent), but comparable to many developed countries such as Japan (2.84 per cent), France (2.37 per cent). Indian Institute of Science, Bangalore, ranked first among academic institutes of national importance with 10247 publications, and Banaras Hindu University, Varanasi appeared on the top among universities and colleges with 4487 publications. The share of international collaborative papers in total output increased substantially rising from 12.55 per cent during 1990-94 to 21.11 per cent during 2000-2004.

Biglu (2008) studied quantitative trend of patent literature in MEDLINE during 1965 to 2005 using PubMed online database. Findings reveals that the patent literature in MEDLINE achieved an annual growth of 11.4%; 90% of all documents indexed as "patents" in MEDLINE were in English followed by Russian 4.12%, French 1.36% and German 1.20%. USA with publishing 55% of all documents indexed as patents in MEDLINE is the most prolific country in terms of patent literature and from the perspective of form 46% of publications were of the form "journal article", 22% in the form of "news", 5% letter, 5% comment, 4% review, 3% editorial, 2% newspaper article, 2% research support, 2% English abstract, and the rest were less than 2%.

Anilkumar (2010) examined doctoral thesis of physical research laboratory submitted in the period 2001 to 2005. The findings reveal that total 33 thesis submitted in the period contain 5726 citations with an average of 174 references in each bibliography. From the perspective of form journal articles are the preferred resource and comprise 84.56% (4,842 references) of the total resources (5,726) used, followed by 10.35% for books (593) and 5.08% for other documents (291).

Amongst the different areas, Theoretical Physics shows remarkable preference for electronic resources.

Chen et al. (2011) studied mapping the development of scientometrics during the year 2002-2008 and revealed the institution collaboration network which showed that 24 out of top 44 institutions

collaborated directly or indirectly to form a big collaboration cluster and Katholieke University, Leuven took up the centre of the cluster; the average number of authors per paper published in Scientometrics grew faster in 2002-2008 than in 1978-2001; the co-authorship networks illustrated one of the biggest cluster consisting of 199 codes, and some smaller clusters. In the top 50 authors, there were 28 authors appeared in the biggest collaboration cluster and all the top 10 authors appeared in the biggest collaboration cluster.

Suradkar and Kharpade (2012) examined authorship pattern of citation in journal of documentation during the year 2007 to 2011. The study reveals that overall, 5521 citations were appended to 532 articles with mean of relative growth and Doblin time for these years was 0.278 and 1.813 respectively. The value of co-efficient for citation was 0.42, Chi-square value 896.5 and the average rate of citation per article was 10.37.

Mulla (2012) mapped the Information Science and Scientometrics analysis researches in India during 2005-2009 and obtained 998 research contributions published in the field; the highest number of publications (329) was produced in 2009; the average number of publications per year was 199.6; major channel of communications used by the researchers was "Journals" during the period; observed trend for multi-authored papers was sturdily increased (59.69%) compared to single authored papers (40.31%); and the average authorship (1.86) per paper and degree of collaboration (0.78) is noted significantly.

Bhanumurthy etal. (2013) attempted to highlight through mapping and visualization of the growth and development of dark energy literature based on the literature published on Web of Science Database. The findings reveal that a total of 5858 publications were published on dark energy, which received 157,581 citations during 1999-2011. The average number of publications per year was 450.62, and the average number of citations per publication was 26.90. The publications were highest in 2011 with 934 publications, and the highest number of citations (26,404) were received in 2003. There were 3857 (65.84%) single country publications from 74 countries and 2001 (34.16%) multi-country collaborative publications. The highest number of publications were from Europe with 3723 (41.15%) publications and 126,747 (39.88%) citations followed by Asia with 2614 (28.89%) publications and 63,267 (19.90%) citations, and North America with 1980 (21.89%) publications and 105,132 (33.08%) citations. Astronomy and astrophysics accounts for the largest share 3920 publications out of total with 66.92%.

Sagar etal. (2014) mapped the agricultural research publications in India during 1993 to 2012 based on Web of Science database using parameters growth of publications and citations, domain-wise distribution of publications and citations, activity index, international collaboration, highly productive institutions, highly preferred journals, and highly cited publications. The study reveals that a total of 22615 publications were published in Agriculture during 1993-2012 and these publications received 98954 citations. The highest number of publications 1917 (8.48 %) were published in 2008. The highest number of citations 8714 (8.81 %) were received in 2007. The highest average citations per publication 8.29 were in 2002. There were 10428 (46.11 %) publications with no citations during the period under study. The highest total impact factor (1865.33) was in 2008. The highest average impact factor per publications (1.29) was in 2006. India had 1744 (7.71 %) international collaborative publications with 104 countries in Agriculture. Indian Institutions had the highest number of collaborative publications with countries like the USA, Australia, Germany, England, Philippines, Canada, Mexico, Japan, China, Netherlands, France, and South Korea.

Barik & Jena (2014) examined 385 articles indexed by Scopus during the period of 2004-2013 to know the growth of LIS research in India, and it has been found that the highest number of (20.7%) articles published in 2013 with annual average growth rate of 16.49%; Two authors collaboration has dominated with highest (43.89%) number of articles; the degree of collaboration has ranged from 0.2 to 0.57.

Khaparde et al. (2014) investigated mapping of Library and Information Science research performance of India in national as well as global contexts and revealed that the USA was in the first position with maximum number of publications (1402) during the five years with global publication share of 9.13%; the maximum publications were published by foreign nations than compared to India; among India's major collaborative partners, the largest share (14.90%) of collaborative papers was with the United States.

Singh etal. (2015) mapped analyzed scientometrically the research on “Big Data” during 2010-2014 indexed in both the Web of Knowledge (WoK) and Scopus using parameters total output, growth of output, authorship and country-level collaboration patterns, major contributors (countries, institutions and individuals), top publication sources, thematic trends and emerging topics in the field. Findings reveals that the number of research publications in 19 different broader

disciplines along with their percentage contribution to the total research output indexed in WoK for the 5-year period depicts that Computer Science contributes a total of 708 out of 1,415 publications, which constitutes approximately 50% of the total output. Thus, in contrary about 50% of the 'Big Data' research output is from disciplines other than Computer Science. Electrical, Electronics and Telecommunication Engineering, Biological Sciences, Medical Sciences, Management and Healthcare are some of the major contributing disciplines to 'Big Data' research.

Leydesdorff and Milojević (2015) studied current trends and issues on scientometric research giving an overview of the field since 1960s till today and discuss its relationship with the sociology of scientific knowledge, the library and information sciences, and science policy issues such as indicator development. The study reveals that the modeling of knowledge exchanges in scientific discourses cannot be reduced to the exchanges of information in co-authorship, co-word, or citation relations. Models as entertained in the sciences enable researchers both to provide meaning to possible future states and to specify uncertainty. The measurement of the communication/sharing of meaning among frames of reference, the (re)constructions and their interactions update and reinforce the knowledge bases of the evolving societies and their economies. Authors in scientometrics are able to contribute to the study of science, technology, and innovation from a quantitative perspective by modeling and measuring these developments. The study also highlights the areas in which major issues or challenges are faced which includes measurement of impact, delineation of a reference set, choosing theories of citation, policy and management context.

Stojanovski et al. (2015) investigated 112 mapping science journals to determine the visibility of scientific publication using 14 bibliographic databases; the highest 94 journals were included in Google Scholar; Web of Science contains the fewest papers from mapping science journals (15,204) but it included an average of 800 papers per journals, which is more than Google Scholar and Scopus.

Jeyasekar & Saravanan (2015) studied bibliographic and citation data pertaining to global and Indian Forensic Science during 1975 to 2012 from the Scopus and found that collaborative index was at the highest of 3.46 in the year 2012; collaborative co-efficient was lowest in 1986 with 0.27 and highest in 1994 with 0.65; the international cooperation index of India in Forensic Science

research is 7.68; and India has the highest Affinity Index value of 34.16 in the Forensic Science with the USA.

Liu and Gui (2015) quantitatively visualized transport geography research from a scientometric approach based on big-data literature from the Thomson Reuters Web of Science as well as scientometric mapping analysis using C. Chen's Cite Space II, O. Person's Bib Excel and ESRI's ArcGIS, a total of 4840 articles were published from 1982 to 2014. The study reveals that since 1980s transport geography has become a fast-moving interdisciplinary field as its number of publications are increasing year by year, as is the volume of its citations, cited references have increased around 100 times, from 234 to 23,000. Accordingly, yearly average citations also have increased rapidly from less than 20 to 47 with rather large-level citations and high-speed growth. According to the chronological order, its historical changes have fluctuated and can be divided into four stages: a stagnant phase (1982–1990) where the number of and variations of documents were unstable and few; a takeoff phase (1991–2000) where figures climbed a bit more; a blooming phase (2000–2010) that presented an exponential mushroom growth and showed great scholarly concern; and finally a vibrant phase (2011–2014) showing stable and extensive development in scope.

Gupta (2016) mapped research on Library Consortia based on bibliographic records from the Web of Science on literature published during 1980 to 2015. The study reveals that out of 87 articles in the field of Library Consortia, a total number of 23 articles (26.44%) are written during 1980 to 2015 by the top ten authors. Geographical analysis indicates that the field has evolved considerably in different regions of the world. USA is found to be the highest country that contributed 30 articles. Furthermore, chronological analysis discloses that the scientific production in the field of Library Consortia shows a slow increase from 1991 to 1996. Majority of the documents are published in English. Information Technology and Libraries has the highest number of publications with 79 articles and 213 citations followed by articles on Computer Science (24.14%).

Amsaveni & Ramesh (2016) analyzed mapping of research productivity in Forensic Science and found that 10464 research were published by scientists during the study period; relative growth rates have declined from -0.482 in 1989 to 0.04 in 2010; the degree of collaboration is 0.83; Budowle, B. as the most productive author from Canada; and "Journal of Forensic Science" and

"Forensic Science International" were found as the highest research contributing and citations receiving journals.

Tripathi & Garg (2016) studied the publication output of India on cereal crops as reflected in Scopus database from 1965 to 2010 and observed that growth of publication output is highest during 2010; there were 38.93% research output in the field of rice; and the highest (33.6%) contribution by India, in domestic & foreign journals, with most of the prolific authors, were from IARI, New Delhi.

Garg & Sharma (2017) investigated the Library and Information Science research and found that the pattern of output and annual rate of growth is highly inconsistent; academic institutions have contributed approximately 86% of research; Mysore University contributed 44% research among the most prolific institutions for research contribution; and the highest citation impact per paper was made by CSIR-NISTADS and CSIR-NISCAIR.

Rathinasabapathy and Veeranjaneyulu (2017) did scientometric mapping of 50 years of global research productivity in food science and technology as reflected by CAB direct online database from 1966 to 2016 using MS-Excel to analyze the data. Findings reveals that during the year 1938 to 2016, a total of 144942 documents were published in the field of Food Science and Technology (FST) out of which 6649 were published in online mode which is about 4.59% of the total publication output. The highest number of publications is 8048 in 2015 and a total of 18 publications were indexed up to 1966. The study also reveals that about 258.30% growth was observed during the decade 1977-86 over 1967-76, 118.67% growth rate during the decade 1987-1996 over 1977-1986, 152.09% growth rate during the decade 1997-2006 over 1987-1996 and 206.70% growth rate during the decade 2007-2016 over 1997-2006.

Dziaugyte etal. (2017) mapped "interpreting" topics in Scopus database during 1990 to 2016 which gave 2931 unique records in multiple languages and documents and these data were analyzed using parameters like publication citation, word co-occurrence, and co-authorship and affiliation geo-location analysis. Findings reveals that the majority of publications are related to healthcare industry, there have not been many collaborations between authors and very little citations considering the scope of "interpreting" field. Despite increasing number of publications over the years, it still lacks significant collaboration between Institutions and authors.

Gupta etal. (2017) examined 12104 global publications on digital library research indexed in Scopus database during 2007-16 using bibliographical indicators growth rate, number of publications and international collaborative publications, citation per paper, h-index, activity index and relative citation index have been used. The results of data interpretation reveal that Digital library research registered annual average growth rate of 7.83% and averaged 4.40 citations per paper. Digital library research is dominated by top 15 most productive countries accounting for 81.61% global publications share in 10 years during 2007-16. USA accounted for the highest global publications share (26.89%), followed by China (10.42%), etc. Computer Science accounts for the largest publication share (62.48%) in global digital library research, followed by Social Sciences and Engineering (30.86% and 19.75%), Mathematics (15.74%), etc. The top 20 most productive research organizations and productive authors contributed 13.64% and 6.90% global publication share respectively and 15.98% and 10.05% global citation share respectively during 2007-16. The top 30 journals contributed 35.15% share to the global journal output during 2007-16.

Kim and Zhu (2018) mapped thematic patterns and emerging trends of the published literature in scientometrics during 1990 to 2017 using a variety of tools and techniques, including CiteSpace, VOSviewer, and dynamic topic modeling. A total of 8098 bibliographic records were published and domain-level citation paths, subject category assignment, keyword co-occurrence, topic models, and document co-citation network were examined in these articles. Findings reveal that the domain is multidisciplinary in that a wide range of disciplines contribute to the growth of literature, but only partially interdisciplinary as some works heavily cites from similar domains. Early literature was interested in measuring the impact of a science and evaluating research performance and productivity. Total number of articles published in bibliometrics is 6352, in scientometrics it's is 1779, infometrics, webometric, altmetric, cybermetric and entitymetric are 382, 288, 261, 28, 3 respectively.

Shukla etal. (2018) made a scientometric assessment of scholarly communication of Mizoram University based on Web of Science in Global perspective from 2007 to 2017 using MS-Excel for processing and analyzing data. The findings reveal that total of 404 scholarly communications have been retrieved with the highest share in 2016 (28.21 %), analyzing the forms of scholarly communications it has been found that "Article" is the most prevalent form (93.56%) followed by

"Review" (3.46%) and "Proceedings Paper" (2.22%) with "Physics" and "Chemistry" being the top area of communication. 58% scholarly communications have been published with the support of funding agencies and out of total scholarly communications DST, India funded projects have produced more than 14% scholarly communications followed by UGC, New Delhi (12.87%). Korea Government funded projects have produced 8.16% scholarly communications out of total scholarly communications.

Velmurugan (2019) mapped research productivity on Nanotechnology in Canada by examining annual growth rate of publications, collaborative countries and territories, preferred subject areas and research work, prolific organizations and institutions and top ranked journals and highly productive papers based on Web of Science database using Excel spreadsheet for further statistical analysis and also used the VOS viewer visualization software to screenshot the publication. The study reveals that during the period between 1994 and 2014, a total 576 scientific research papers along with cited references are 34955 were published in the field in Canada average number of literature output were published per year was 33.88 and the greatest number of publications were published in 2013 and 2014 respectively a total number of authors 2213 were identified and the maximum number of authors i.e. 364 and the mean value of 4.77 were in the year 2014. Out of 15804 citations, the greatest number of 2791 citations in the year 2008 (52 papers, 23 h-index) and highest average citation per paper were 60.74 in the year 2007.

B.S. etal. (2019) mapped scientific articles on Leukemia research in India during 2009 to 2018 based on the Web of Science database using MS Excel, Histcite software package examining growth of publications, document-wise distribution of records, country-wise distribution of publications, identification of most prolific authors, highly preferred journals and highly productive institutions. Findings reveals that 16794 of records were published in 2016 and 575 of records were published in India. Analysis of forms reveals that they were "articles", "meeting abstracts", "review" and "letter". Geographic analysis reveals that USA was the most productive country on Leukemia. The study also found that only 4 authors were contributed above 100 numbers of articles and the author Bakhshi a with 121 publication has occupied the first position. The All India Institute of Medical Sciences was top most contributed institution on Leukemia research with 349 records.

Research Gap

On the analysis of above literature review, it has been observed that there are sufficient numbers of research conducted on the scientometric aspects of journals articles, fields of studies, and individual institutions on various levels. Besides these, a number of scientometric studies have been conducted on some specific country also but none of the studies found till today that deals with the wider mapping (assessment) of Library and Information Science research based on Web of Science during the proposed period. So, the present study will be an attempt to fill up the gap in the proposed area.

1.8 Research Design

1.8.1 Statement of the Problem

Scientometric mapping is a process to identify the growth and development of published literature in a specific field with the help of various scientometric indicators. There is a number of studies have been observed on the mapping of research in some specific field of the study at micro-level or specific country level or particular database level. Still, there is lack of such research that covers wider perspective of LIS subject from Web of Science. Library and Information Science researchers have conducted numbers of micro-level studies in certain fields of specific subject domains but observed rare studies in the field of Library and Information Science at wider level during the proposed study period. Due to lack of such research in the field of Library and Information Science, need arises to investigate the mapping of Library and Information Science research indexed in Web of Science database and it would thus be interesting to conduct the study.

1.8.2 Objectives of the Study

The objectives of the study are to:

- Assess the extent of published research in the field of LIS.
- Identify most productive nation and journal in the field of LIS.
- Identify the most productive authors and organizations in the field of LIS.
- Find out the prevalent research areas in LIS

1.8.3 Research Methodology

The study is designed to investigate the scientometric mapping (assessment) of LIS research indexed in Web of Science database.

1.8.3.1 Parameters of Study

The scientometric mapping (assessment) includes various indicators to measure the research. The study covers author-wise research productivity, organizational research productivity, countrywide research productivity, document type research productivity, total research documents, funding agencies productivity, and source journals etc. as research productivity indicators.

1.8.3.2 Time Frame of Study

The study is conducted for five (5) years' time frame from 2014-2018.

1.8.3.3 Limitations of Study

The study limits to the "English" language publications and "all document types" from Web of Science database for all countries of the world.

1.8.3.4 Method of Data Collection and Analysis

The research method applied here is observation method. The raw data is collected from Web of Science database and is tabulated in MS-Excel file. Web of Science is one of the leading scholarly databases which have the collection of many databases in different fields. It covers more than 90 million records from 256 academic disciplines. Its temporal coverage starts from 1900 to date and provides the scholarly resources from more than 12000 journals, 160,000 conference proceedings as well as 50000 scholarly books. Due to wider coverage of research in various disciplines, Web of Science database has been chosen for data collection to display broader perspectives of LIS research.

The following search expression was used to gather data.

TOPIC: Information Science and Library Science Research and LANGUAGE: (English) AND DOCUMENT TYPES: (Article) Timespan=2014-2018. Indexes=SCI-EXPANDED, SSCI, A&HCI, ESCI.

For the analysis of collected data, MS-Excel and VoSViewer are used for statistical data analysis and presentation of results also other suitable statistical and bibliometric/scientometric tools are used.

1.9. Chapterization

The present study has been tentatively divided into the following chapters:

Chapter 1: Introduction

Chapter 2: Scientometrics: Concept

Chapter 3: Library and Information Science Research

Chapter 4: Data analysis and Interpretation

Chapter 5: Findings, Suggestions and Conclusion

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CHAPTER 2

SCIENTOMETRICS: CONCEPT

2.1 Introduction

In the today's era of "White Plague" many issues and challenges are standing in front of Library and Information Science professionals. These issues and challenges can be minimized to some extent using metrics sciences which have achieved enormous growth in the twentieth century. In 1948, Dr. S.R. Ranganathan used the term "Librametry" in an ASLIB conference calling it as a quantitative analysis technique of various facets of Library activities and documents by application of mathematical and statistical calculus to seek solution to library problems. In 1969, the term "Bibliometrics" has been first used by Alan Pritchard in place of an existing terminology "Statistical Bibliography", defining it as a quantitative analysis of research literature based upon citations, and can be used to evaluate the impact on the academic community of a research paper, an individual researcher, a research group or institution or a journal. In 1977, T Braunin published a journal named "Scientometrics" from Hungary, meaning of scientometrics being communication process in science including socio-cultural aspects and appears to be almost synonymous with science of science with more stress on quantitative aspects. It is a scientific discipline which performs reproducible measurement of scientific activity, and reveals its objectives in quantitative regularities. In 1979 Otto Nacke of West Germany first proposed the term "Informetrics", which focuses on information productivity. Bjoreborn and Ingwersen in 2001 proposed the term "Webometrics", to study content, structure, usage and terminology in web sites. In 1990s the concept "cybermetrics" also emerged which is a science of measurement involving cyber objects. This term was first used by Norbert Weiner in his book published in 1948.

Scientometrics is having concern with quantitative features and characteristics of science and scientific research. It is called as sociology of science. It is one of the vital measures for estimation of scientific productivity. Scientometric studies focuses on investigation in which development, productivity and collaboration in Science are examined by statistical and mathematical methods. The terms bibliometrics, scientometrics and informetrics studies component fields and parameters associated with different disciplines as reflected in the production of literature. Scientometrics

pertains to the quantitative aspects of scientific endeavors including publication, journal, scatter of scientific literature, citation process and patents etc. According to Nalimov and Mulchenko scientometrics is "a quantitative method of investigating the development of science as an information process" (Nalimov and Mulchenko, 1969). This depicts an information model in which the research articles are carriers of information, journals are the channels of communication and bibliographical references shows the effect of prior research on the development of information flow.

Tijessen & van Rann, (1994), said scientometric techniques can be classified into scalar and relational. The one-dimensional techniques or scalar techniques include direct counts, graphical representations, bibliometric entities like publications and patents, keywords, address or citations. They are used to monitor state of the art science and technology system. These indicators have found tremendous use in science policy making both as descriptive and diagnostic tools. On the other hand, relational techniques are based on co-occurrence of specific data elements like citations of two papers or frequency of keywords mentioned by a third paper. Structural features of the data in the form of maps are analyzed with the help of multidimensional statistical techniques. This type of cartographical visualization of massive data offers comprehensive outlook of the data in a very less time. These analysis and visualization can be drawn at different levels of organizations initiating from Research and Development units to institutions to countries and to entire domain of science and technology. Scientometric techniques are supporting a lot for decision making to the policy makers. In 1979 discipline got recognized with the publication of journals like Scientometrics, which is being the first periodical with specialization in bibliometrics and subsequently another journal named "Research Evaluation" emerged. Scientometric studies targets to understand the behavior of scientific citation as a medium of scholarly communication and map intellectual portrait of any discipline of science and also focuses on the production of indicators for use in the evaluation of performance and productivity. In each domain of research, the volume of published literature has exponentially grown, and the evaluation of the quality of these research items from the perspective of impact of authors, publications, journals, institutes and countries as referenced to publications such as articles and patents. Thus, scientometrics studying mainly the quantitative aspects of science has strengthened its position as an important component of the scientific study and it is evolving as a complete disciplinary field with clear outline of subject of research, with particular research methods, tools and techniques and numerous conferences,

seminars, workshops organized on it by different institutions and standardized with the journal of reputation purely devoted to this discipline namely "Scientometrics".

2.2 Bibliometrics

This term first appeared as "Statistical Bibliography" in 1969 in the *Journal of Documentation* and it is defined as *"application of mathematical and statistical methods in books and other media of communication"* used by Alan Pritchard. This word is derived from two words "Biblio" and "metrics", the word "biblio" comes from a Greek word "Biblion" meaning book and "metrics" from "metricus" meaning measurement or scale. Bibliometrics basically studies the growth of literature, productivity count, literature usage, citations and extent of divergent existence from geographical and language perspective. This is a branch of information theory that analyses quantitatively the properties and behaviour of recorded knowledge. Bibliometric studies are trending to be an important aspect of interdisciplinary research contributing effectively to promote research productivity in any discipline of knowledge as these studies give quantitative data on the quantity and quality of research in any discipline through analysis of different parameters mentioned above.

2.3 Areas of Bibliometric Research

Bibliometric research can be broadly divided into two areas:

a) Productivity count (descriptive)

The main objective of this method is to study the degree of productivity in scientific communications. Productivity count aims to identify the growth of subject as a whole or particular area within a discipline. The first trace of Bibliometric study was confined to productivity count of literature and it was seen in the field of anatomy which was performed by Cole and Eales. Research production is counted on the basis of three main heads:

- **Geographical (Countries):** The research productivity of a particular geographic area is counted. It can also be extended to institution of several kinds. Identifying the rate of productivity at institution level or country and region wise is an important measure to highlight the research environment prevailing in the particular institution.
- **Time Period (Era):** Under this category research publications are counted corresponding to their time period. The time period with maximum and minimum research publications are counted. Counting of publications according to the time period can be used to determine the obsolescence of literature in a specific topic or discipline.

- **Disciplines (Subjects):** The main purpose is to identify the growth and decline of a particular subject area. Every subject has the possibility of growth and declining and doesn't have same share on research productivity. The citations and study of bibliographic references shows the growth and decline of a discipline.

b) Literature Usage count (Evaluative)

Evaluative study through literature usage counting is an integral part of bibliometric studies. It deals with citations with published works, circulation and frequency of browsing different library materials, failure and success in such strategies, search option etc. Evaluative count of references is also intended to identify the frequency of used journals which will identify a list of core journals used for reference and the same method can be applied for other information sources, the result of which can be a base for a library to enhance their collection accordingly.

2.4 Laws of Bibliometrics

Three fundamental laws are governing the discipline Bibliometrics. These laws provide a scientific basis for evaluating a research problem. The bibliometrics is conducted applying three laws which are discussed in brief below:

2.4.1 Lotka's Law of Author Productivity:

Alfred James Lotka (1880-1949) proposed this law correlating contributors of scientific papers to their number of contributions. It states that "the number of authors making n contributions is about 1/n*n of those making one and the proportion of all contributors, that make a single contribution is about 60%". Lotka stated that ones the number of authors contributing a single publication is known then the number of authors contributing two or more publication can be predicted.

2.4.2 Bradford's Law of Scattering:

Samuel Clement Bradford formulated this law in 1934. The statement of this law is "if scientific journals are arranged in order of decreasing productivity of articles on a given subject, they may be divided into a nucleus of periodicals more particularly devoted to the study and several groups of zones containing the same number of articles as the nucleus and succeeding zones will be 1: $n:n^2$ …." (Hertzel, 2003). It serves as a general guideline to researchers in determining the number of core journals in any given field.

2.4.3 Zipf's Law of Word Occurrence

This law was formulated by George Kingsley Zipf formulated his law to predict the frequency of words within a text. This law states that "in a relatively lengthy text, if the words occurring within

the text are arranged in order of decreasing frequency, the rank of word on the list multiplied by its frequency will be a constant." The equation for this relationship is

r* f = k where r is the rank of the word, f is the frequency, and k is the constant. This law has great significance in developing indexes.

2.5 Techniques of Bibliometrics

The techniques studied in Bibliometric research is described in brief below:

2.5.1 Citation Analysis:

This is the major applied area in bibliometric research. It is the activity of analyzing the citations or references. Citation analysis studies the references given by an author to the previous work. It is a useful technique for studying the trends in scientific research. There are mainly three main applications areas in citation analysis:

a) Qualitative and quantitative evaluation of scientists, publication and publication institutions.

b) Modelling of the historical development of science and technology.

c) Information Search and retrieval

2.5.2 Bibliographic Coupling:

Bibliographic coupling was introduced by M.M. Kessler. Bibliographic coupling occurs when two works give reference to a common third work in their bibliographies. The bibliographically coupled documents are presumed to have a relationship in one way or the other. In this regard, citation can serve as a nodal point thus creating a network of interrelated knowledge.

2.5.3 Co-citation

Co-citation is the frequency with which two documents are cited together by another document. Co-citation provides a tool for monitoring the development of scientific field, and for assessing the degree of inter-relation among specialties. It helps in locating network of frequently cited paper. A study on co-citation document can bring light to the subject specialties, further studies over a period of time. Like documents co-citation, this can also be developed for authors and journals.

2.5.4 Direct Citation Counting

It is the technique to determine the number of citations received by a given document or set of documents over a period of time from a particular set of citing documents where from citation data for analysis are taken. The impact factor and immediacy index are the two measurements to overcome the limitations of citation counting. The impact factor was coined by Eugene Garfield and defined it as "The ratio of the number of times a journal is cited in a given period of time to the total number of source items published in the journal during specified time period". Results of citation count reflects the impact factor of a journal after taking into consideration the age of publication as well as its size and frequency. Impact factor of a journal in a given year is defined as the ratio of number of citations of articles received (published in that journal) in that year and the two preceding to the number total number of "citable items" published in that journal during the two preceding years. The immediacy index is calculated by dividing the number of citations to articles published in a given year by the number of articles published in that year.

2.6 Scientometrics

The origin of this field can be traced back in the beginning of 19th century. In the 21st century this field is growing with full pace and attracts the researchers out of the walls of universities and institutions. Alan Pritchard was the first to use the term statistical bibliography. And thereafter enormous growth has been achieved in this field and there evolved numerous disciplines like webometrics, cybermetrics, infometrics, econometrics, altmetrics etc. Eugene Garfield described the term Impact factor in 1995, as a method of selecting journals for inclusion in a genetics citation index in 1961 as a mean of joining articles via their references. Scientometrics is a part of sociology of science and it has application to science policy making and involved in quantitative studies of scientific activity.

The term came to prominence with the founding of the journal named "Scientometrics" by T. Braun in 1977. Scientometrics refers to those quantitative measurements which are used in the analysis of science regarded as process of information communication (Repanovici, 2010). It involves quantitative studies of scientific activities, including among other publications and so overlaps bibliometrics to some extent. The primary aim of scientometrics is to determine the state and prospect of a subject and its further development. There exist two categories of scientometric techniques one dimensional or scalar and two dimensional or relationship. One dimensional

technique is based on direct counts and graphical representation of specific bibliometric entities or particular data elements in these items such citation, keyword or address. Two dimensional techniques on the other hand, based on co-occurrence of specific data elements such as the number of times the keywords, classification codes, citation and addresses are mentioned together. The scientometric measurements are done on the basis of the following parameters: forms of publications, growth of publications, annual growth rate of the publications (AGR), Compound Annual Growth Rate (CAGR) of the publications, Relative Growth Rate (RGR) and doubling time of publications and analysis of most prolific authorship pattern. The primarily used scientometric measurements include: H-index and G-index.

2.6.1 Definitions of Scientomterics

Some of the definitions framed by individuals from time to time on scientometrics are quoted below:

Tague-Sutcliff defined scientometrics as "the study of the quantitative aspect of science as a discipline or economic activity. It is a part of the sociology of science and has application to science policy making. It involves quantitative study of scientific activities including, among other publication, and so overlaps bibliometrics to some extent."

Nalimov and Mulchenko defined scientometrics as the quantitative methods which deals with analysis of science viewed as an information process.

Dobrov and Karennol defined scientometrics as "the measurement of information process".

Beek has defined as "the quantitative evaluation and inter comparision of scientific activity, productivity and progress".

Brookstein defined scientometrics as "the science of measuring science".

Mikhilov defined it as "that scientific information and the law of processes of scientific discipline devoted to all quantitative aspect of science and scientific research".

2.6.2 Scientometric measurements

a) H-index

The h-index was introduced by J.E Hirsch (2005) and simultaneously measures the quality and sustainability of the impact of a research publication. It is an attempt to measure, both the scientific productivity activity and the apparent scientific impact of a scientists which is based on a scientists most cited paper and the number of citations they received. The h-index is based on a scientist's citations, which incorporates productivity as well as citation impact. It is defined as the maximum value of *h* such that the given journal/author published *h* papers that have each been cited at least *h* times. We calculate this value by observing at least *h* published papers with *h* citations.

b) G-index

The g-index was proposed by Leo Egghe (2006) in his paper "theory and practice of the g-index" in 2006 as an improvement on the *h*-index. It is calculated on the basis of distribution of citations received by a given research publication. G-index is to measure the productivity of the researcher based on their publication such that given 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. It can be equivalently defined as the largest number *n* of highly cited articles for which the average number of citations is at least *n*.

c) Forms of publication

In this parameter the types of academic publishing are examined, form in which the scholarly articles are published frequently is studied. The scholarly articles may be of the following forms:

Books and Monographs, Edited Book, Journal Article, Book Chapters, Book Reviews, Conference Proceedings, Technical Reports, Scientific Reports, White Papers, Blogs and other forms of online writing.

d) Growth of publications

Number of articles published are analyzed year wise. This parameter gives the year or time period in which most and least number of articles are published.

e) Annual Growth Rate (AGR) of publications

This parameter gives the growth rate of the publications on yearly basis for a specific period of time. This value is dependent on the number of publications in the initiating year (from which the

rate is calculated) and the number of publications in the ending year (the year till which the study is conducted)

Annual Growth Rate is calculated with the formula given by Kumar and Kaliyaperumal, 2015 as:

$$AGR = \frac{End\ Value - First\ Value}{First\ Value} \times 100$$

f) Compound Annual Growth Rate (CAGR)

The compound annual growth rate is calculated by taking the nth root of the total percentage growth rate, where 'n' is the number of years in the period being considered. This is calculated using the formula available on https://www.investopedia.com/terms /c/cagr.asp. It is written below:

$$CAGR = [(\frac{Ending\ Value}{Beginning\ Value})^{1/n} - 1)]$$

g) Relative Growth Rate and Doubling Time of publications

The of overall publications has been measured on the basis of Relative Growth Rate (RGR) and doubling time (Dt) model as developed by Mahapatra, 1985. The mathematical representation of the mean relative growth rate of articles over a specific period is derived from the following formula:

$$RGR = \frac{W2 - W1}{T2 - T1}$$

Where,

RGR = Growth rate over the specific period of the interval

W1 = Log e (natural log of the initial number of contributions)

W2 = Log e (natural log of the final number of contributions)

T1 = the unit of initial time

T2 = the unit of final time

Doubling Time

Form the calculation, it is identifying that there is a direct equivalence existing between the Relative Growth Rate and doubling time. If the number of contributions of a subject double during a given period, then the difference between the logarithm of the numbers at the beginning and at the end of the period must be the logarithms of the number 2. If one uses a natural logarithm, this difference has a value of 0.693 (Beaie and Acol, 2009).

The formula of corresponding doubling time (Dt) for contributions and pages measurement.

$$Dt = \frac{0.693}{R}$$

2.7 Conclusion

Scientometrics as a subject has seen incessant growth in the recent years. It is one of the most important measure for the assessment of scientific production. With the advent of Science and Technology and application in Information processing, storing and disseminating there has been a tremendous change in data management. This has also helped in the collection of data for scientific study. In other words, application of information technology has facilitated access to data and information which is a very essential aspect for quality research productivity and attaining a research output of global standards. Scientometrics/bibliometrics/ infometrics/webometrics/cybernmertics are studies which does rigorous quantitative analysis of data on their respective aspects and facilitates research, innovation and knowledge enhancement which may in case of an author, an institution, a R&D organization, research publication, web content management and analysis and scholarly information communication. Developing countries like India are giving more emphasis on research, innovation, digital transformation which are dependent on grants from funding agencies. These funding agencies allots grants only on the data that they are provided by any R & D organization, and data are provided through studies like scientometric, bibliometric, webometric assessment of research activities.

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CHAPTER – 3

LIBRARY AND INFORMATION SCIENCE RESEARCH

3.1 Introduction

For social, economic and technological up gradation of people and society as a whole discovery and addition of new knowledge to the existing is indispensable. This is possible only through research which channelizes the pathways to discoveries and inventions. It is evident that in ancient days also kings and elites patronized and sponsored research works and people involved in these works were given high dignities and scholarships. The pace of research has accelerated after the industrial revolution and it was demand of time to meet the thirst of the society for attaining maximum technological advancement. Planned and organized research at national and international levels were initiated by different nations after the industrial revolution due to factors like increasing population and consumers, rigorous depletion of natural resources, changing climatic conditions, perceiving the need to have military and defense infrastructure, need for curing diseases to prolong human life, need to save space and time. All these factors propelled nations worldwide to promote research and development activities to mitigate the alarming constrains in development of human civilization. In present times, our security, health, education and economy depend primarily on scientific research. In a nutshell, research is an intellectual activity of gathering information and thus concluding all the materials and findings to give justification of the solution of a problem thereby helping to solve a problem.

3.2 Library and Information Research: History with special reference to India and global perspective

Library Science evolving as an interdisciplinary or multidisciplinary field applying the practices, perspectives, and tools of management, information technology, education, in two broad perspectives - to libraries' collection, organization, preservation, and dissemination of information resources and the political economy of information. The first American School for Library Science was founded by Melvil Dewey at Columbia University in 1887, where the

inception of imparting Library Science education took place. Martin Schrettinger, a Bavarian librarian coined the discipline in the name of his work during 1808 to 1828. Historically speaking Library Science has also been included in archival science. This incorporates the process of information acquisition, evaluation, application by people in-situ and ex-situ libraries with diverse cultures, training people for careers in libraries, ethical aspects guiding library service and organization, legal aspects of library and information resources, application of computer and information technology in documentation and records management, people's interaction with classification system and technology, organization of information resources to serve the need of specific selected user groups. Martin Schrettinger wrote second textbook on Library Science during 1808 to 1829. Thomas Jefferson devised a classification method for his collections inspired by Baconian method, these collections later on took the form of Library of Congress. Melvil Dewey in 1876 came up with his famous classification schema prevalent now-a-days in its latest editions namely Dewey decimal classification (DDC). The term Library Science appeared as published literature in Lee Pierce Butler's book "An Introduction to Library Science" in 1933.

In Indian perspective, the pioneer in the discipline of Library Science is Dr. Shiyali Ramamrita Ranganathan, father of Library Science in India. A mathematics professor turned librarian who took Library Science education and training of Library profession in London is known for his widely accepted theories "The Five Laws of Library Science" published in 1931. He developed a very conceptual analytico-synthetic classification system, Colon Classification and published in 1933. He published a theoretical book giving the foundations and concepts of Library Classification named "Prolegomena to Library Classification" in 1937.

Dr. S.R. Ranganathan guided Dr. D.B. Krishna Rao, who was the first research scholar to obtain Ph.D. degree in LIS from the University of Delhi in 1957. Thereafter, no other university either initiated the PhD program or conferred PhD degree in Library Science. Later on, in 1977, Punjab University, Chandigarh which turned out the second Ph.D. to Dr. Pandey S.K. Sharma who was awarded Ph.D. under the supervision of Dr. J.S. Sharma.

3.3 Library and Information Science Research

Library and Information Science (LIS) research has been multi-dimensional, interdisciplinary and diverse since its inception as a discipline of study. Due to this reason, the research in LIS is

applicable to parent and established disciplines of the universe of knowledge. According to Wani etal. "The field of Library and Information Science is no longer confined to four walls of classification and cataloguing but has been broadened to embrace new concepts like automation, information retrieval, metadata, open access and other web related technologies". Concepts like classification and cataloguing are having practical application and these concepts are basic foundations of LIS education which are to be taught to the students to enter into practical librarianship. These are concepts has evolved due to worthless efforts and research of library professionals like Melvil Dewey, Dr. SR Ranganathan who whole heartedly took librarianship as a profession and thought critically to design and introduce new schemas in librarianship to facilitate the library users. This would be impossible without their research and practical approach to librarianship.

LIS research helps in identifying issues that affect the growth and development of librarianship as well as that of the LIS education. The genesis and development of LIS research in India may be traced back to the year 1924 when Dr. S.R. Ranganathan joined this profession. His seminal contribution to various facets of LIS enriched the discipline and elevated its status from art to a discipline in social sciences. Library Science which was started as a school now grown up to a full-fledged department renamed and called as Library and Information Science. In due course of time many universities in India including open universities have introduced M.Phil. and Ph.D. programs in LIS. Now LIS has become a full-fledged discipline like other social science's discipline and enriching itself day by day. Research initiatives in Library and Information Science are also increasing day by day. Research initiatives in Library and Information Science are also increasing day by day. Research in Library and Information enables to know the needs and expectations of the actual and potential users. The extent of user's satisfaction or dissatisfaction could only be known through research. The most important advantage of LIS research is to improve the status of LIS professionals. In India LIS has changed its traditional mode of providing services to the users into a new scenario. In LIS, as other fields require constant innovation and research so that new techniques can be discovered and the same can be applied for uplifting its professionals. Major changes in the trends related to LIS research commence during 1980 to 1990 where there was a continuous shift of research related to various areas from traditional based systems to machine operated systems. In LIS traditional manual techniques started declining and new ICT enabled techniques started growing for serving users.

LIS in global scenario has reached up to a superior level and the professionals of LIS have started working towards the practical aspects of modern libraries.

Mittal (2011) studied the research trends in library and information science in India during the period of Jan 1990 to June 2010 as reflected through scholarly journals using the Kamada-Kawai algorithm to the network of relations between descriptors and making spatial distribution of these. The study reveals that research in LIS initiated with areas namely library practice, user services, cataloguing, user studies, university libraries, public libraries, information retrieval, library education, citation analysis, bibliometrics and moving on to areas like copyright, library technology, digital libraries, institutional repositories, CD-ROM databases and electronic periodicals and trending presently to areas like open access, Web 2.0, World Wide Web, access to information etc.

Bibliometric study of research output is the most commonly used research method in India. Most of these studies used bibliometric techniques such as citation analysis to analyze library and information science research. One of the well-known relational bibliometric methods is co-word analysis.

Co-word analysis a specific visual representation of data. It is known that keywords of an article describe its content. Two keywords co-occurring within the same article indicates the link between the topics to which they refer. The presence of many co-occurrences around the same word or pair of words points to a locus of strategic alliance within articles that may correspond to a specific theme. Thus, co-word analysis is an example of graphical modelling technique illustrates association between keywords by constructing multiple networks that highlight association between keywords. Co-word analysis reveals patterns and trends in a specific discipline by measuring the co-occurrence of keywords representative of relevant publications produced in this area. The research carried out by the Indian library professionals and researchers are structured in the following areas:

- Bibliometrics, Scientometrics, Webometrics
- Libraries, Librarianship, Library Management
- Library Technology, Information Technology
- Information Work, Knowledge Management

- Acquisition, Collection Development, technical services
- User, User Services, User Studies
- Information Literacy, Distance Learning, Copyright, Educational Technology, publishing etc.

3.4 Prominent areas of research in Library and Information Science in the last decade:

As per review of certain literature the following areas are found to be the prominent areas of research in the field of LIS:

1. Academic Libraries: As quoted by Dr. S. Radhakrishnan "Libraries are the heart of any Academic institution", research on these libraries is also an essential need in order to facilitate quality service to its user as well as implementing latest technologies and tools to cope up with global standards of Library Service. Some of the core areas on which research in Academic Libraries are conducted are: Analysis of web-based library services; Usage Growth and Collection Development of Journals in Libraries; study of organizational structure of University Library; Development of University libraries; Development and management College Libraries; study of information sources and services from print to e-print journals and their effect on Library services in University Libraries. Most of the topics found under this area are related to the analysis of university libraries in terms of applicability of Latest advancement in the field of Library and Information Science because there are continuous demands from the students and faculty members to improve academic library services. Research in this area is also necessary to formulate certain ways to cope with the current demands of users in the age of information explosion.

2. Bibliometrics

This is the most prominient and common area of research since last decade in the field of Library and Information Science. This area of research covers studies on Total Number of Publications (TNP); Total Number of Citations (TNC); Citations per Paper (CPP); Relative Citation Impact (RCI) and Papers Not Cited (PNC) as measures of output and impact. CPP is a relative indicator computed as the average number of citations per paper. It has been widely used in bibliometric studies to normalize a large disparity in volumes of published output among disciplines, countries and institutions for a meaning full comparison of research impact. RCI is a

measure of both the influence and visibility of a nation's research in global perspective. It is defined as "a country's share of world citations in the sub-specialty/country's share of world publications in the sub-specialty". RCI = 1 denotes a country's citation rate equal to world citation rate; RCI < 1 indicates a country's citation rate less than world citation rate and also implies that the research efforts are higher than its impact; and RCI > 1 indicates a country's higher citation rate than world's citation rate and also imply high impact research in that country. Bibliometric research also includes study topics like analysis of document type distribution of citations, application of Bibliometric Laws, analysis of most productive countries and publisher, analysis of the journal literature used for study, analysis of obsolescence of literature: half-life of journals.

3. Citation Analysis

Citation analysis uses various means, including mathematical, statistical, comparison, induction, abstraction, generalization, and logical methods. These methods are used to analyze a variety of scientific journals, papers, objects of citation, and cited phenomena to determine the characteristics of a quantity method and the inherent law of a bibliometric analysis method. Citation analysis was introduced in the 1920s. In 1927, Gross et al. conducted the first citation analysis in the history of literature. They analyzed the references of articles in several chemical engineering periodicals and core periodicals in chemistry education. An increasing number of papers about citation analysis have been presented in the field of bibliometrics. For example, Line and Sandison proposed literature obsolescence. Buckland discussed literature obsolescence and literature scattering, which were based on citation statistics. As a result of various disciplines, regions, and periods of scientific papers, a cited phenomenon frequently has its own characteristics and laws. For example, we can infer a paper, a scientist, or the role of a scientific paper in the process of scientific development. Moreover, the connection and distinction among scientific papers, scientists and scientific journals, science and scientific disciplines can also be inferred. Therefore, the citation analysis method has extensive applications. This method can be effectively applied to many areas by practice, and it plays an increasingly important role.

The citation and cited scientific literature are manifestations of the scientific development of law, which embodies the scientific knowledge and intelligence content of accumulated and continuous inheritance. They also embody the principle of the unity of science and cross-penetration among

multiple disciplines. Therefore, the records of scientific knowledge and scientific research directly infer that scientific literature cannot be isolated but is interrelated. An author of scientific literature inevitably cites the literature of other authors in writing scientific papers to learn from their experiences and results. Therefore, the citing behavior of scientific workers is a widespread phenomenon and is an indispensable part of scientific communication.

4. Computer Application in Libraries/ Impact of ICT in Libraries

Computer machines are very important devices to control any system. In libraries the increasing use of computer systems in providing automated and networking services inspired library professionals to research into those aspects which are necessary to provide quality services to the users. In this area, a lot research is already done or is going on in many Universities like Nagpur University, Pune University and Delhi University. Some core issues and areas in which research may be done on computer application in Libraries are Computerization of Library catalogue and OPAC services of Institutions of Higher Learning, Application of Library Software's in Technical Universities, study of ILMS and digital library software and Free/ Open verses commercial software, Problem and prospects of Library Automation. Impact of Information technology on the services provided by the Library and Information Centers to support research and development; Trend and Impact of Modern Communication Technology in Information Centers and Libraries. This area is not only related to the computerization of Library Activities with the help of software, but related to developing an Information retrieval system for easy and effective Information access. Research in this area shows that computerized information retrieval system is very important for executing Library activities. Thus, research in this area is required to discover new ways to make computerized library activities more user friendly to operate and execute.

5. Digital Library

Digital Libraries use latest techniques to render library services in today's Information and Communication Technology environment. Much research is going on relating to this area but few research scholars are studying about the technology involved in creating digital libraries. The main focus of research under this area is only on finding out the initiatives of digitization in libraries and the related aspects. Some core areas or topics on which research is generally conducted in digital library are Digitization and Open Access initiatives, Trends and development of Digital

Libraries in scientific and research activities and Design and development of digital database for research.

6. Information Handling and Management

Libraries serve the society with knowledge and information. Libraries preserve knowledge for the knowledge seekers and it is very important to research about new ways in the field of Information Handling and Management so that users find easy to use the libraries. Some of the core research areas in this topic may be on : Evaluation of Library Services of any academic institute; Information Services and their efficacy; Provision of Library and Information Services for specially abled users; Information management in media libraries like Akashwani and Doordarshan Kendras; An Assessment of the services of college Libraries in the context of changing information scenario; Status of information services in a community of users; Information Resource Management of College Libraries, study of data retrieval techniques of online databases available in libraries and Quality Management Practices in University libraries. These studies indicate that research is very important in this area to find better ways of handling of whatever the library and Information centers possess, so that it will be easy for the users to use libraries.

7. Information Sources and Services/ Preservation of Information

In this area the study of scanning, storing and presenting of information is studied, implementation of new techniques and tools in preserving information in digital era, use of Optical Character Recognition (OCR) digital preservation, creation of institutional repositories facilitating online storage and retrieval of information, designing information system and Marketing of information products and services are the core activities in this area of study.

8. Open Access and E-journal

Open Access and e-journal (e-resources) have been an important topic for research in most of the Universities. Some of the core areas of research under this category are Open Source movement (Digital Library Software, ILMS), Use of e-journals in any discipline of study etc. Open access resources have been gaining importance because of unrestricted access. Research in this discipline is essential because it helps in providing better service to patrons.

9. Performance Appraisal

It is a important aspect to access working capabilities of employees of library professionals. Some topics on which research is conducted in this area are Skill Development practices in Electronic environment, Job environment and lifestyle analysis, stress management of library professionals etc. Research in this area is very essential because this may result in giving maximum output from library professionals in their routine work.

10. Cost Benefit Analysis

This is an important tool to analyze the usability of any organization in terms of cost involved in management and maintenance of its constituent wings. It is an important area of management of Libraries but it is seen that LIS scholars are not frequently taking it for research.

11. User Study

Users are the most important component of a Library as without them the routine activities of libraries like collecting, processing and managing information content is valueless. It has been a prominient area to continue doctoral research. Some of the core areas for research under this category are: Analysis of reading habits of users, study of Information seeking behaviour and Information needs, Analysis of information literacy skills of the users etc.

3.5 Number of Indian Journals of Library and Information Science indexed in different sources

Journals are very significant information resources as they publish the most original and innovative research work. Due to which these are called primary source of information. The number of journals indexed in sources like Web of Science, Indian Citation Index, Scopus, Journals recommended by UGC and University are tabulated below:

Table 1: Number of Journals of LIS indexed in different databases

Sl. No.	Name of the Source	Number of Journals	%
1.	Scopus	180	46.75
2.	Journals Recommended by UGC	67	17.40

3.	Journals Recommended by Universities	54	14.02
4.	Web of Science	20	5.19
5.	Indian Citation Index	14	3.63
6.	Mixed (In addition to above)	49	12.98

Source: MPhil Dissertation of Malswamkimi, submitted to Dept of Library and Information Science Mizoram University

It has been found that Scopus database has highest number 180 journals indexed and it is followed by Journals Recommended by UGC which is 67 in number. It is further found that Indian Citation Index has 14 journals indexed. Web of Science (WoS) is fourth in rank with 5.19 % LIS journals.

Research in Library and Information Science plays vital role in designing the future of LIS profession. LIS research has given new standards to this profession and contributing immensely for uplifting the careers of LIS professionals. As par the popularity and trending areas of LIS research is concerned User study and ICT related areas are common. But emerging research areas are mostly related with computer science like web ontology, web design and development, OCR, machine learning, social media links, Web 2.0, cloud computing etc. The selection and identification of research topics has essential contribution in devising strategies in research. There is also need for research in discovering the characteristics of research activities in LIS globally. The continuity of LIS research will help the profession in attaining new heights in providing quality services to its patrons.

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CHAPTER 4

Data Analysis and Interpretation

4.1 Introduction

The analysis of data involves critical examination of data keeping the objectives in mind for determining the pattern of relationships among the variables associated with the. Data analysis and findings are important for any research work. Analysis of data requires demands a large number of interrelated operations such as development of groups or categories, applying these categories to raw data through coding, tabulation, correlating to the variables in the data and applying statistical tools and methods to draw inferences. The data which remains unused should be condensed into certain manageable categories and tables for further analysis. After categories of data is transformed into symbols with tabulation and counting, coding operation is done. This is followed by editing that improves the quality of data for coding. This is followed by tabulation, which is a technical procedure where the data classified data are put in the form of tables. Use of software like MS-Excel, SPSS is preferred for tabulation and depiction of analyzed data.

After tabulation, analysis work is done which is based on computation which involves application of various statistical formulae. The analysis and interpretation of data solely depends on the extent of possessive ness of the objectives from the researcher end, his/her subjective knowledge and zeal or enthusiasm or desire to derive the necessary inferences for meeting the objectives along with creation of information that is not essential for meeting the objectives but derived during the long run of analysis of data, the need is also for meeting the inherent relation to the statement of the problem in the research. There is also requirement of familiarity with the background of the study for proper analysis. Keeping in view the objectives of the study; the data is downloaded from Web of Science database using the search string that meets the objectives i.e.

SU= (Information and Library Science), Indexes=SCI-EXPANDED, SSCI, A&HCI; Timespan=2014-2018. This gives the number of results to be 50,595 and the date of data collection is 28.01.2020. The collected data is analyzed, tabulated, mapped, and interpreted to draw the inferences, visualization and conclusion.

4.2 Mapping of Growth of LIS Research

During the period of study, 50595 articles were published on Information and Library Science discipline and its related areas like information system, computer application, metrics study.

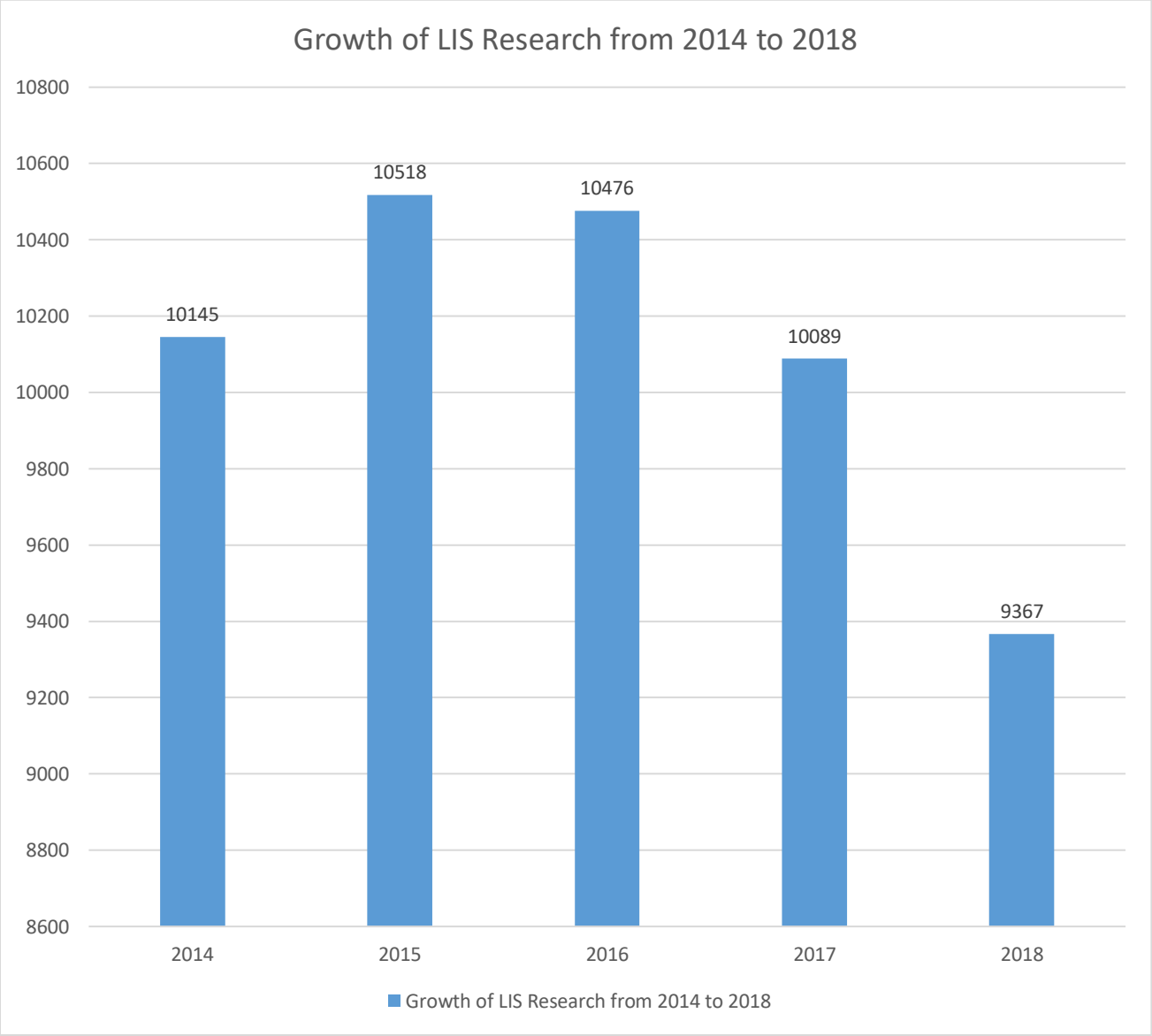

Figure 1. Year-wise visualization of LIS Research

Analysis of the data indicates that the annual research output in Library and Information Science is highest in the year 2015 with 10518 (20.789%). A steady growth in number of publications has been observed from 2014 to 2015. In 2014, 10145 number of papers are published which rose to

10518 in 2015. This number declines from 2016 onwards and it reached to 9367 in 2018 which is least in the period of 2014 to 2018.

Table 2: Year-wise distribution

Publication Years	Count	Percentage
2018	9367	18.514
2017	10089	19.941
2016	10476	20.706
2015	10518	20.789
2014	10145	20.051

4.2.1 Calculation of Average Annual Growth Rate

The calculation of average annual growth rate depicts the real scenario of LIS research. The calculation of Average Annual Growth Rate (AAGR) is done using the formula,

$$\text{AAGR}=\frac{GR1+GR2+GR3+GR4+\cdots\ldots\ldots\ldots+GRn.}{N}$$

Where,

GR1= Growth Rate in Period 1

GR2= Growth Rate in Period 2

GR3 = Growth Rate in Period 3

GR4 = Growth Rate in Period 4

N= Number of periods

It is evident that LIS research is declining since 2015. The average annual growth rate (AAGR) is calculated as follows:

Growth Rate for period 2014 to 2015 = (10518 / 10145) – 1 = 0.0098 %

Growth Rate for the period 2015 to 2016 = (10476 / 10518) - 1 = -0.0039 %

Growth Rate for the period 2016 to 2017 = (10089 / 10476) – 1 = -0.037 %

Growth Rate for the period 2017 to 2018 = (9367 / 10089) -1 = - 0.071 %

AAGR is calculated by dividing the total growth rate by the number of years,

AAGR = (0.0098% - 0.0039% - 0.037% - 0.071%) / 5 = - 0.02042%

This analysis reveals that the annual growth rate is negative i.e. -0.02042% which implies that LIS research output is declining in the period from 2015 to 2018 and positive growth is observed in the period 2014 to 2015.

4.2.2 Publication Growth

The growth of article over the study period is not smooth. The growth increases from 2014 to 2016 and there is sharp decrease from 2017 to 2018. The slope of the curve is negative. (=-198.5)

Table 3: Growth of Publication (2014 to 2018)

Year	Publication Count
2014	10145
2015	10518
2016	10476
2017	10089
2018	9367

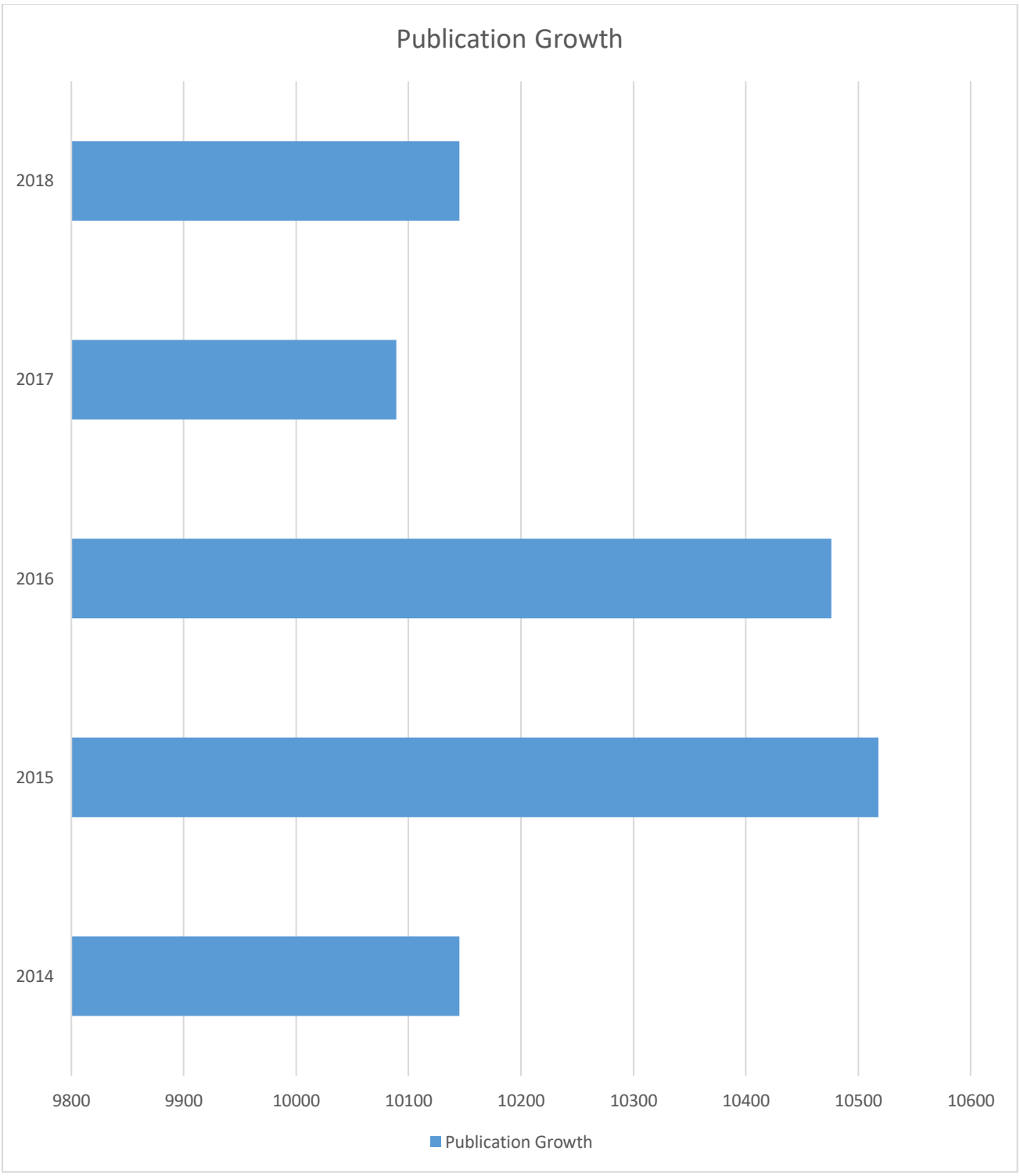

Figure 2: Publication Growth (Horizontally -Year, Vertically- Publication Count

4.2.3 Analysis of most productive year

The data is collected for five years i.e. 2014 to 2018 as mentioned above and the number of publications in each year is shown below:

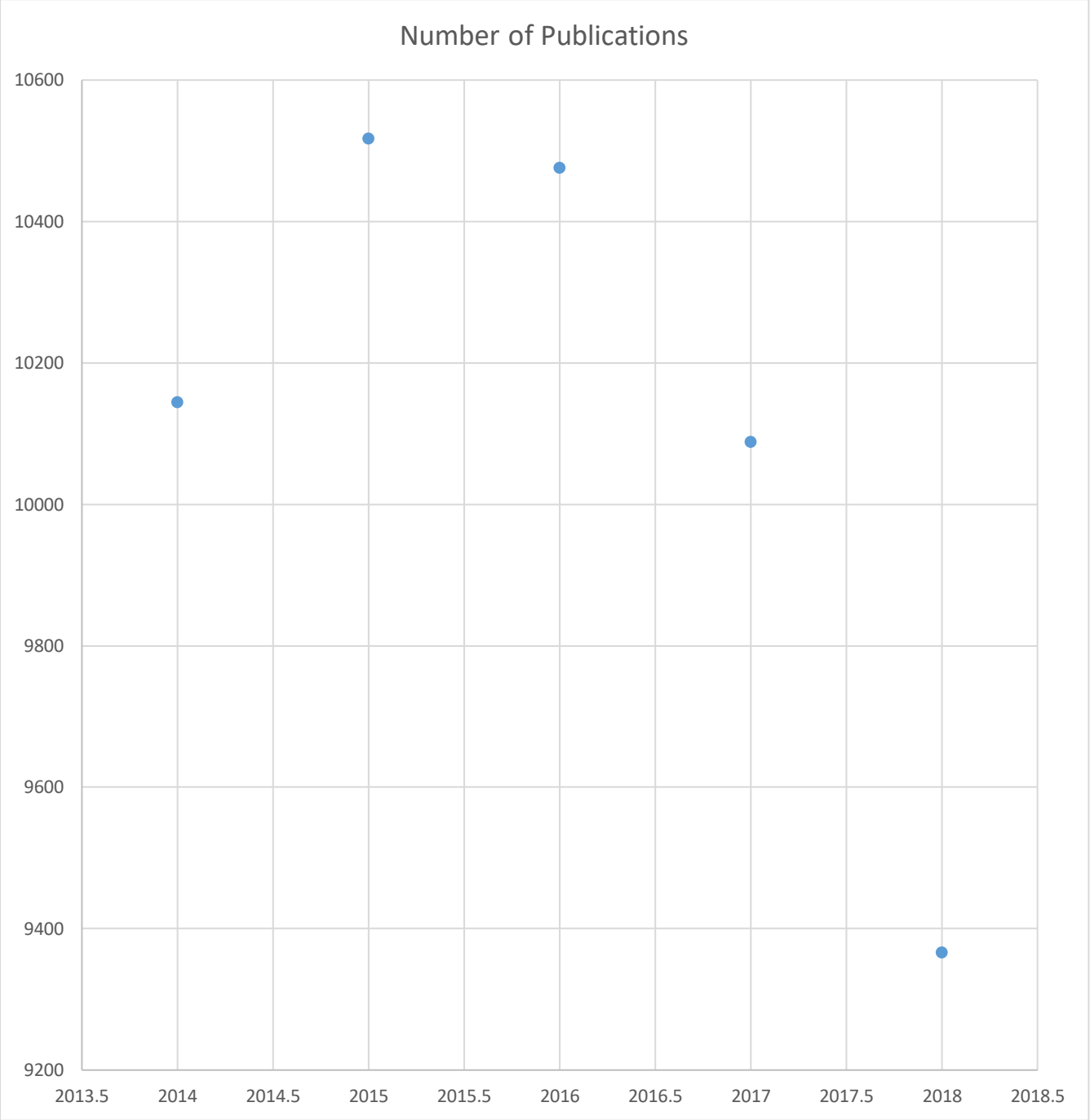

Figure 3: Visualization of Most Productive Year

The figure above depicts the most productive year which 2015 with maximum of 10518 and minimum number of publications are turned out in the year of 2015 which is 9367.

4.3 ACI and RCI

ACI and RCI Absolute Citation Impact (ACI) and Relative Citation Impact (RCI) have been adopted in the study to compare the research performance of different countries to the total global outputs (Kumari, 2009). ACI is computed as the average number of citations per publications, also called Citation Per Paper (CPP).

$$\text{Absolute Citation Impact} = \frac{Total\ Number\ of\ Citations}{Total\ Number\ of\ Pub;ications}$$

RCI measures both the influence and visibility of research credited against a nation to the global perspective.

$$\text{Relative Citation Impact} = \frac{A\ country's\ share\ of\ world\ citation\ in\ the\ speciality}{Country's\ share\ of\ world\ publications\ in\ the\ speciality}$$

If RCI = 1, then Country's citation rate is equal to world citation rate

If RCI<1, then Country's share of citation rate is higher than the world citation rate. This implies research efforts are higher than its impact.

If RCI > 1, then country's share of citation rate is higher than the world citation rate. This implies high impact research in that country.

4.4 h-index

There is different type of metrics to find out the productivity and impact of a researcher. The h-index proposed by Hirsch (2005) is used in this study to find out the impact and significance of different scientists. He explained that "A scientist has index h if h of his or her Np papers have at least h citations each and the other (Np - h) papers have less than or equal to h citations each." (Hirsch, 2005, p. 16569-16572).

The articles included in the present study are collected from the Web of Science (WoS) database. Initially the following search expression was used to gather data.

TOPIC: Information Science and Library Science Research and LANGUAGE: (English) AND DOCUMENT TYPES: (Article) Timespan=2014-2018. Indexes=SCI-EXPANDED, SSCI, A&HCI, ESCI.

Microsoft Excel and VoSViewer have been used to carry out statistical analysis and presentation of data.

4.5 Most Prolific Author

The table below shows the author in the category of top 100 on the basis of contribution of papers in Library and Information Science. The authors are ranked in the order of number of publications. The table shows that the most prolific author in the field of LIS research is Hoffbert B with 948 records, Mcardle MM with 598 records, Campbell L with 558 records. These authors are followed by Wetherbee J, Ellis K, Sendaula S with 115,114 and 114 records respectively. Miller RT, Batten T and Helicher K with 111, 103 and 102 records respectively. The remaining authors have below 100 records in their name. The table below shows the authors with number of records in their name and their rank.

Table 4: Top 10 productive authors (2014 to 2018) in WoS database

Authors	**Records**	**% of 50595**
HOFFERT B	948	1.874
MCARDLE MM	598	1.182
ANONYMOUS	597	1.180
CAMPBELL L	558	1.103
WYATT N	527	1.042
DONOHUE N	523	1.034

RAMSDELL K	484	0.957
SHARBROUGH C	410	0.810
CHADWICK K	400	0.791
KEMP V	356	0.704

The pie-diagram in the following page depicts top 10 authors with highest number of publications in their name.

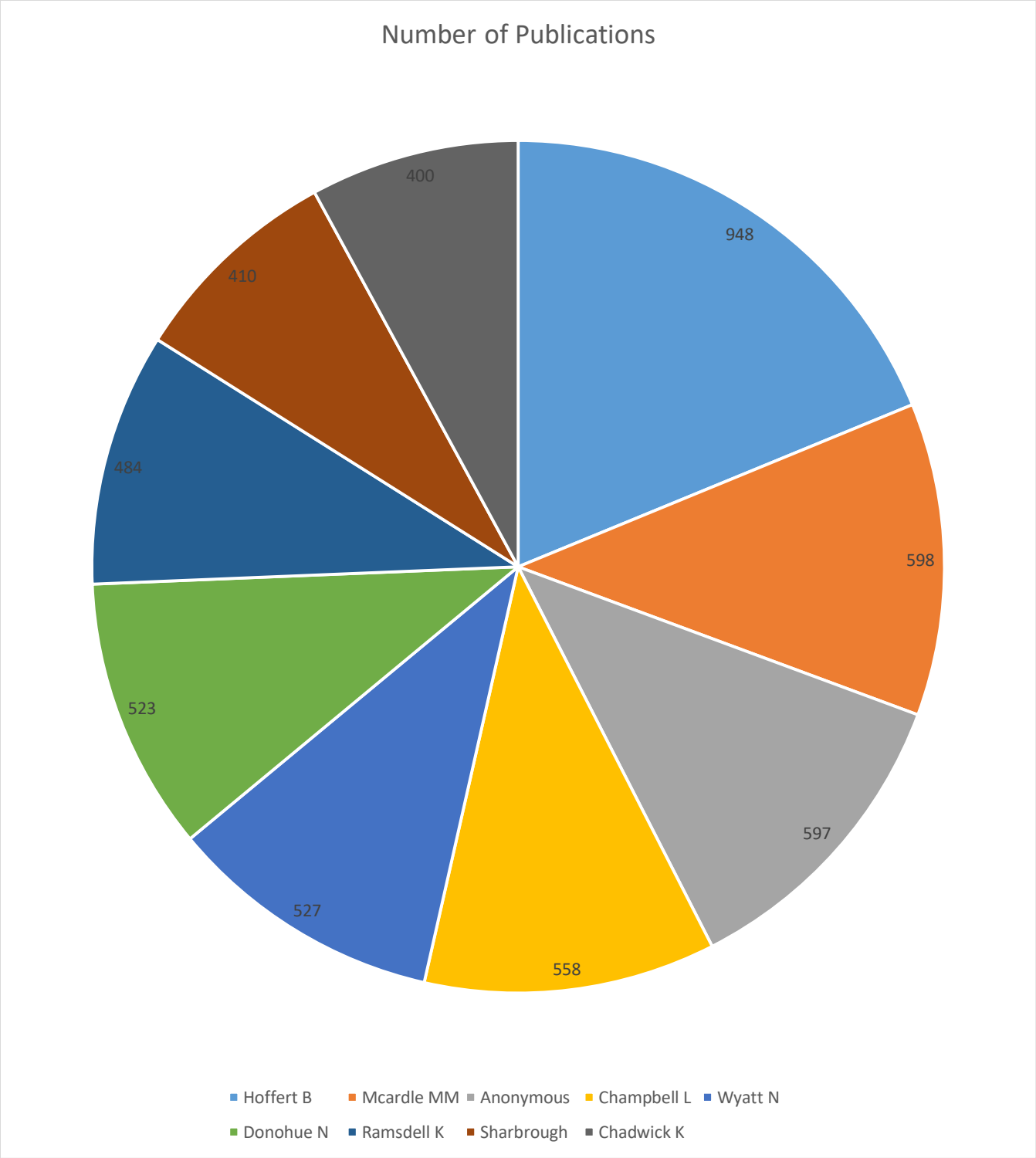

Fig 4: Visualization of Top 10 authors in Library and Information Science as per Web of Science in the time period of 2014 to 2018.

Note: 8 records (0.016%) do not contain data in the field being analyzed.

4.6 Most Productive Nation

The table below depicts the world share of publication as per number of publications from each nation. The leading countries in Library and information science research is U.S.A which is followed by People's Republic of China, England, Spain, Canada, Australia, Germany South Korea and Netherlands, which are top ten nations.

Table 5: Top 50 nations in the field of LIS from 2014 to 2018 as per WoS database

Countries/Regions	Publication Count	% of 50595	Rank
USA	25752	50.898	1
PEOPLES R CHINA	2199	4.346	2
ENGLAND	1844	3.645	3
SPAIN	1605	3.172	4
CANADA	1572	3.107	5
AUSTRALIA	1517	2.998	6
GERMANY	1112	2.198	7
SOUTH KOREA	802	1.585	8
NETHERLANDS	711	1.405	9
TAIWAN	687	1.358	10
BRAZIL	636	1.257	11
ITALY	514	1.016	12
FRANCE	492	0.972	13
SWEDEN	479	0.947	14
INDIA	468	0.925	15

FINLAND	385	0.761	16
SOUTH AFRICA	382	0.755	17
SINGAPORE	347	0.686	18
BELGIUM	331	0.654	19
DENMARK	322	0.636	20
IRAN	309	0.611	21
MALAYSIA	297	0.587	22
NEW ZEALAND	296	0.585	23
SWITZERLAND	263	0.520	24
ISRAEL	234	0.462	25
NORWAY	230	0.455	26
TURKEY	198	0.391	27
JAPAN	196	0.387	28
MEXICO	187	0.370	29
HUNGARY	179	0.354	30
SCOTLAND	178	0.352	31
PORTUGAL	173	0.342	32
AUSTRIA	167	0.330	33
PAKISTAN	156	0.308	34
IRELAND	139	0.275	35

NIGERIA	136	0.269	36
GREECE	135	0.267	37
POLAND	127	0.251	38
SAUDI ARABIA	126	0.249	39
SLOVENIA	104	0.206	40
CHILE	90	0.178	41
WALES	90	0.178	42
RUSSIA	74	0.146	43
CUBA	68	0.134	44
CZECH REPUBLIC	67	0.132	45
U ARAB EMIRATES	67	0.132	46
COLOMBIA	66	0.130	47
SERBIA	64	0.126	48
THAILAND	59	0.117	49
CROATIA	47	0.093	50

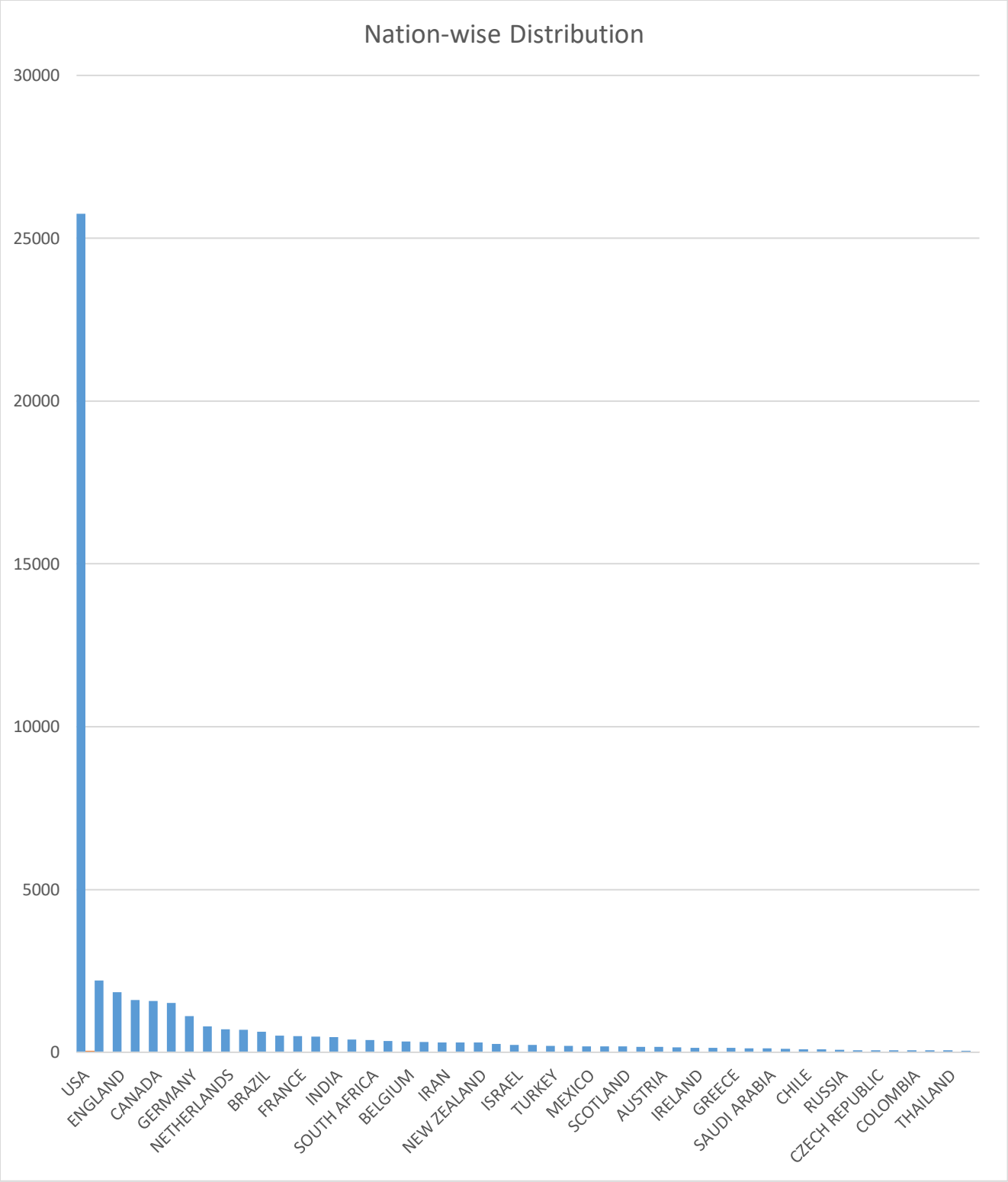

Fig 5: Visualization of top 50 nations in the field of Library and Information Science in Web of Science Database (2014-2018)

4.7 Most Prevalent Research Area

Library and Information Science research is a multi-disciplinary area of research. In the following search string used to gather the data from WoS database the search term used is Information and Library Science which implies that Library Science has not been confined to research on traditional Library services but it has expanded to the ocean of information science which includes topics like artificial intelligence, data mining, cloud computing semantic web etc. Major areas of Research in the field of LIS in India includes:

- Bibliometrics, Scientometrics, Webometrics
- Libraries, Librarianship, Library Management
- Library Technology, Information Technology
- Information Work, Knowledge Management
- Acquisition, Collection Development, technical services
- User, User Services, User Studies
- Information Literacy, Distance Learning, Copyright, Educational Technology, publishing etc.

In nations like USA, China, England, Spain and Canada the research on Library Science as extensively merged to Information System, Computer Science and Interdisciplinary Applications, Management, Communication, Medical Informatics etc. The table below depicts the most prevalent research area as per WoS database in the time span of 2014 to 2018.

Table 6: Most prevalent research area (2014-2018) in WoS database (Info. and Lib Science)

Web of Science Categories	**No. of research articles**	**% of 50595**
COMPUTER SCIENCE INFORMATION SYSTEMS	6376	12.602
COMPUTER SCIENCE INTERDISCIPLINARY APPLICATIONS	3849	7.607
MANAGEMENT	2599	5.137
COMMUNICATION	1997	3.947
SOCIAL SCIENCES INTERDISCIPLINARY	1215	2.401

MULTIDISCIPLINARY SCIENCES	1165	2.303
HEALTH CARE SCIENCES SERVICES	1043	2.061
MEDICAL INFORMATICS	1043	2.061
SOCIAL SCIENCES BIOMEDICAL	818	1.617
GEOGRAPHY	624	1.233
GEOGRAPHY PHYSICAL	624	1.233
TELECOMMUNICATIONS	430	0.850
LAW	373	0.737
HUMANITIES MULTIDISCIPLINARY	149	0.294
ETHICS	128	0.253
PHILOSOPHY	127	0.251
HISTORY	108	0.213
HISTORY OF SOCIAL SCIENCES	108	0.213
EDUCATION EDUCATIONAL RESEARCH	105	0.208
CULTURAL STUDIES	19	0.038
FOLKLORE	19	0.038
MEDICAL ETHICS	1	0.002

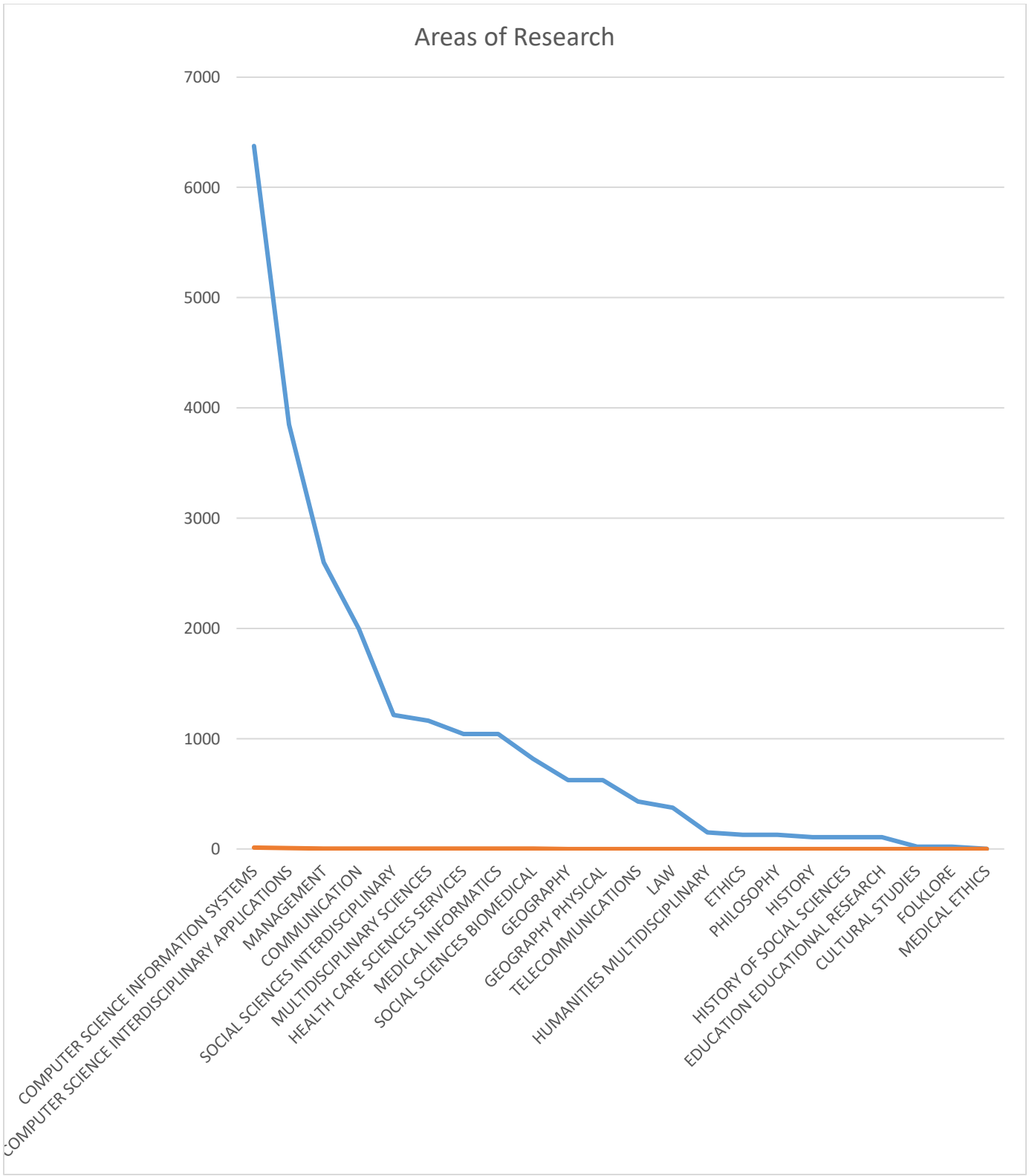

Figure 6: Mapping most prevalent research area in Information and Library Science in the time span of 2014 to 2018 in WoS database.

4.8 Funding Agency wise distribution of data

As per data retrieved from WoS database in the time span of 2014 to 2018, out of 50595 records, 969 are in the name of National Natural Science foundation of China which is 1.915 %. This is followed by United States Department of Health Human Services which holds 715 records which is 1.413% of 50595. Agencies like National Institute of Health NIH USA, National Science Foundation NSF, European Union EU, Fundamental Research Funds for the Central Universities are in the next category.

Table 7: Top 50 funding agencies as per WoS database (2014 to 2018)

Funding Agencies	**Records**	**% of 50595**
NATIONAL NATURAL SCIENCE FOUNDATION OF CHINA	969	1.915
UNITED STATES DEPARTMENT OF HEALTH HUMAN SERVICES	715	1.413
NATIONAL INSTITUTES OF HEALTH NIH USA	627	1.239
NATIONAL SCIENCE FOUNDATION NSF	321	0.634
EUROPEAN UNION EU	176	0.348
FUNDAMENTAL RESEARCH FUNDS FOR THE CENTRAL UNIVERSITIES	156	0.308
NIH NATIONAL LIBRARY OF MEDICINE NLM	144	0.285
NIH NATIONAL CANCER INSTITUTE NCI	124	0.245
MINISTRY OF SCIENCE AND TECHNOLOGY TAIWAN	105	0.208
AGENCY FOR HEALTHCARE RESEARCH QUALITY	101	0.200
NATIONAL RESEARCH FOUNDATION OF KOREA	91	0.180
AUSTRALIAN RESEARCH COUNCIL	89	0.176
NATIONAL COUNCIL FOR SCIENTIFIC AND TECHNOLOGICAL DEVELOPMENT CNPQ	80	0.158

NIH NATIONAL CENTER FOR ADVANCING TRANSLATIONAL SCIENCES NCATS	79	0.156
NATIONAL SCIENCE COUNCIL OF TAIWAN	76	0.150
SOCIAL SCIENCES AND HUMANITIES RESEARCH COUNCIL OF CANADA SSHRC	76	0.150
NATIONAL SOCIAL SCIENCE FOUNDATION OF CHINA	75	0.148
CANADIAN INSTITUTES OF HEALTH RESEARCH CIHR	73	0.144
ECONOMIC SOCIAL RESEARCH COUNCIL ESRC	62	0.123
EUROPEAN COMMISSION JOINT RESEARCH CENTRE	57	0.113
CAPES	56	0.111
HONG KONG RESEARCH GRANTS COUNCIL	56	0.111
ENGINEERING PHYSICAL SCIENCES RESEARCH COUNCIL EPSRC	55	0.109
MINISTRY OF EDUCATION CULTURE SPORTS SCIENCE AND TECHNOLOGY JAPAN MEXT	55	0.109
NATURAL SCIENCES AND ENGINEERING RESEARCH COUNCIL OF CANADA	51	0.101
CHINA POSTDOCTORAL SCIENCE FOUNDATION	49	0.097
GERMAN RESEARCH FOUNDATION DFG	48	0.095
CHINA SCHOLARSHIP COUNCIL	47	0.093
MINISTRY OF EDUCATION CHINA	47	0.093
KOREAN GOVERNMENT	45	0.089
SPANISH MINISTRY OF ECONOMY AND COMPETITIVENESS	42	0.083
NIH NATIONAL HEART LUNG BLOOD INSTITUTE NHLBI	39	0.077
NIH NATIONAL INSTITUTE OF GENERAL MEDICAL SCIENCES NIGMS	39	0.077

MINISTRY OF EDUCATION OF THE REPUBLIC OF KOREA	38	0.075
NATIONAL BASIC RESEARCH PROGRAM OF CHINA	38	0.075
NATIONAL INSTITUTE FOR HEALTH RESEARCH NIHR	38	0.075
JAPAN SOCIETY FOR THE PROMOTION OF SCIENCE	37	0.073
SWISS NATIONAL SCIENCE FOUNDATION SNSF	37	0.073
ACADEMY OF FINLAND	35	0.069
SWEDISH RESEARCH COUNCIL	34	0.067
NIH NATIONAL INSTITUTE OF MENTAL HEALTH NIMH	33	0.065
UNIVERSITI MALAYA	32	0.063
FEDERAL MINISTRY OF EDUCATION RESEARCH BMBF	31	0.061
SPANISH MINISTRY OF SCIENCE AND INNOVATION	29	0.057
AUSTRALIAN GOVERNMENT	28	0.055
CONSEJO NACIONAL DE CIENCIA Y TECNOLOGIA CONACYT	27	0.053
MEDICAL RESEARCH COUNCIL UK MRC	27	0.053
FWO	26	0.051
US DEPARTMENT OF VETERAN AFFAIRS	26	0.051
EUROPEAN SOCIAL FUND ESF	25	0.049

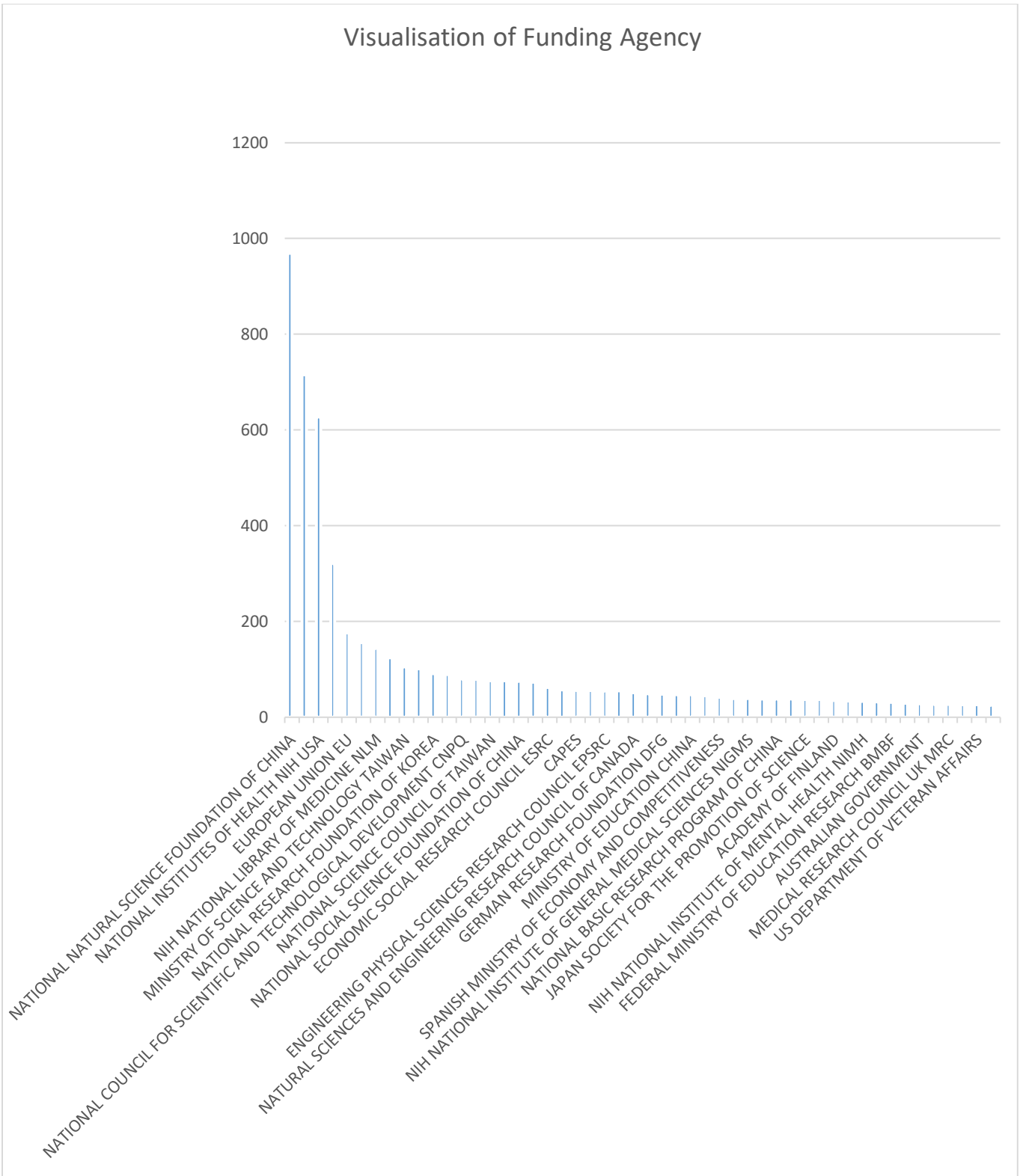

Figure 7: Funding agencies as per WoS database from 2014 to 2018 (2D visualisation)

4.9 Form-wise distribution of publications

The mostly published literatures are in the form of book review with maximum of 24088 records followed by article (Journal), editorial material, news item, review, letter, proceeding paper, correction, bibliographical item, book chapter, software review, database review, reprint, bibliography, hardware review, retracted publication, retraction which are found as per the data retrieved from WoS database in the year from 2014 to 2018. Book review holds 47.609 % of the total records followed by articles, editorial material, news item, review, letter, proceedings paper, correction bibliographic item. Book chapter, software review with 40.678%, 7.163%, 1.494%, 1.261%, 1.053%, 0.913%, 0.439%, 0.188%, 0.040% and 0.036% respectively. The minimum share is taken by reprint, bibliography, hardware review, retracted publication, retraction with 0.022% and each of the remaining with 0.008% respectively.

Table 8: Form of document published as per WoS data from 2014 to 2018 in LIS

Document Form	**Number of records**	**% of 50595**
BOOK REVIEW	24088	47.609
ARTICLE	20581	40.678
EDITORIAL MATERIAL	3624	7.163
NEWS ITEM	756	1.494
REVIEW	638	1.261
LETTER	533	1.053
PROCEEDINGS PAPER	462	0.913
CORRECTION	222	0.439
BIOGRAPHICAL ITEM	95	0.188

BOOK CHAPTER	20	0.040
SOFTWARE REVIEW	18	0.036
DATABASE REVIEW	17	0.034
REPRINT	11	0.022
BIBLIOGRAPHY	4	0.008
HARDWARE REVIEW	4	0.008
RETRACTED PUBLICATION	4	0.008
RETRACTION	4	0.008

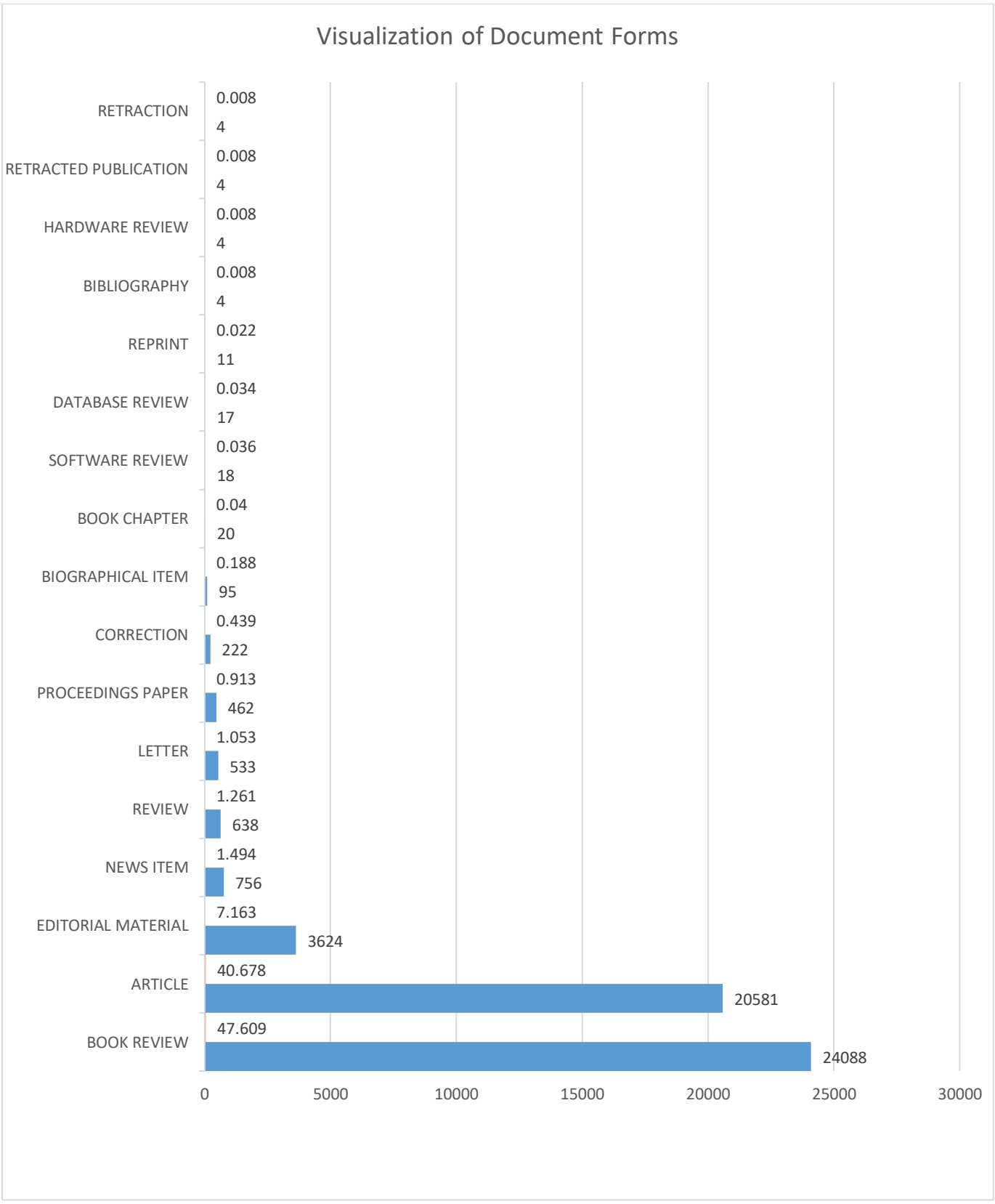

Figure 8: Distribution of forms of documents in WoS database in LIS from 2014 to 2018

4.10 Top 100 productive Journal or Source items

There are large number of Journals in the discipline of Library and Information Science indexed in databases like Scopus, Web of Science. The number of journals in different databases are already listed in the previous Chapter. Now, here will be discussing about the most productive journals in Library and Information Science as per Web of Science databases from 2014 to 2018. The journal named "Library Journal" takes the top position with 23815 publication records. This is followed by "Scientometrics", "Scientist", "Journal of American Medical Informatics Association", "Journal of the Association for Information Science and Technology", "Qualitative Health Research", "Journal of Health Communication", "Journal of Academic Librarianship", "Reference User Services Quarterly", "International Journal of Geographical Information Science", "Telematics and Informatics", "Information Research an international electronic journal" with 1901, 1165, 1043, 1038, 818, 722, 635, 635, 624,622 and 542 respectively. Here the top 100 journals are tabulated below.

Table 9: Top 100 journals in LIS where maximum number of articles are published as per WoS database from 2014 to 2018.

Source Titles	Records	% of 50595
LIBRARY JOURNAL	23815	47.070
SCIENTOMETRICS	1901	3.757
SCIENTIST	1165	2.303
JOURNAL OF THE AMERICAN MEDICAL INFORMATICS ASSOCIATION	1043	2.061
JOURNAL OF THE ASSOCIATION FOR INFORMATION SCIENCE AND TECHNOLOGY	1038	2.052
QUALITATIVE HEALTH RESEARCH	818	1.617
JOURNAL OF HEALTH COMMUNICATION	722	1.427
JOURNAL OF ACADEMIC LIBRARIANSHIP	635	1.255
REFERENCE USER SERVICES QUARTERLY	635	1.255

INTERNATIONAL JOURNAL OF GEOGRAPHICAL	624	1.233
TELEMATICS AND INFORMATICS	622	1.229
INFORMATION RESEARCH AN INTERNATIONAL	542	1.071
INTERNATIONAL JOURNAL OF INFORMATION	495	0.978
PROFESIONAL DE LA INFORMACION	493	0.974
E-CONTENT	490	0.968
JOURNAL OF INFORMETRICS	480	0.949
JOURNAL OF THE MEDICAL LIBRARY ASSOCIATION	460	0.909
ELECTRONIC LIBRARY	440	0.870
TELECOMMUNICATIONS POLICY	430	0.850
INFORMATION MANAGEMENT	409	0.808
COLLEGE RESEARCH LIBRARIES	391	0.773
ONLINE INFORMATION REVIEW	380	0.751
JOURNAL OF KNOWLEDGE MANAGEMENT	373	0.737
LAW LIBRARY JOURNAL	373	0.737
INFORMATION PROCESSING MANAGEMENT	352	0.696
GOVERNMENT INFORMATION QUARTERLY	346	0.684
JOURNAL OF DOCUMENTATION	336	0.664
INFORMATION DEVELOPMENT	332	0.656
ZEITSCHRIFT FUR BIBLIOTHEKSWESEN UND BIBLIOGRAPHIE	317	0.627
AUSTRALIAN LIBRARY JOURNAL	302	0.597
KNOWLEDGE ORGANIZATION	292	0.577

JOURNAL OF INFORMATION SCIENCE	290	0.573
MIS QUARTERLY	282	0.557
LIBRARY QUARTERLY	267	0.528
LEARNED PUBLISHING	257	0.508
INFORMACAO SOCIEDADE ESTUDOS	256	0.506
SERIALS REVIEW	253	0.500
INFORMATION SYSTEMS RESEARCH	252	0.498
PORTAL LIBRARIES AND THE ACADEMY	251	0.496
JOURNAL OF MANAGEMENT INFORMATION SYSTEMS	245	0.484
SOCIAL SCIENCE COMPUTER REVIEW	242	0.478
KNOWLEDGE MANAGEMENT RESEARCH PRACTICE	230	0.455
LIBRARY HI TECH	223	0.441
ASLIB JOURNAL OF INFORMATION MANAGEMENT	204	0.403
INVESTIGACION BIBLIOTECOLOGICA	201	0.397
LIBRARY TRENDS	197	0.389
LIBRARY INFORMATION SCIENCE RESEARCH	194	0.383
INFORMATION TECHNOLOGY PEOPLE	191	0.378
EUROPEAN JOURNAL OF INFORMATION SYSTEMS	189	0.374
HEALTH INFORMATION AND LIBRARIES JOURNAL	189	0.374
JOURNAL OF LIBRARIANSHIP AND INFORMATION SCIENCE	189	0.374
JOURNAL OF THE AUSTRALIAN LIBRARY AND INFORMATION ASSOCIATION	186	0.368
RESEARCH EVALUATION	186	0.368

REVISTA ESPANOLA DE DOCUMENTACION CIENTIFICA	186	0.368
LIBRARY RESOURCES TECHNICAL SERVICES	184	0.364
JOURNAL OF ENTERPRISE INFORMATION MANAGEMENT	183	0.362
INFORMATION SOCIETY	181	0.358
JOURNAL OF THE ASSOCIATION FOR INFORMATION SYSTEMS	177	0.350
AUSTRALIAN ACADEMIC RESEARCH LIBRARIES	174	0.344
INFORMATION TECHNOLOGY FOR DEVELOPMENT	174	0.344
JOURNAL OF COMPUTER MEDIATED COMMUNICATION	171	0.338
INFORMATION SYSTEMS JOURNAL	167	0.330
INFORMACIOS TARSADALOM	156	0.308
SOCIAL SCIENCE INFORMATION SUR LES SCIENCES SOCIALES	155	0.306
JOURNAL OF SCHOLARLY PUBLISHING	149	0.294
TRANSINFORMACAO	145	0.287
JOURNAL OF INFORMATION TECHNOLOGY	133	0.263
REFERENCE SERVICES REVIEW	132	0.261
LIBRI	129	0.255
ETHICS AND INFORMATION TECHNOLOGY	127	0.251
INFORMATION TECHNOLOGY AND LIBRARIES	122	0.241
JOURNAL OF GLOBAL INFORMATION TECHNOLOGY	119	0.235
INFORMATION TECHNOLOGY MANAGEMENT	118	0.233
JOURNAL OF STRATEGIC INFORMATION SYSTEMS	115	0.227
JOURNAL OF GLOBAL INFORMATION MANAGEMENT	111	0.219

PROGRAM ELECTRONIC LIBRARY AND INFORMATION SYSTEMS	111	0.219
INFORMATION CULTURE	108	0.213
DATA BASE FOR ADVANCES IN INFORMATION SYSTEMS	105	0.208
INTERNATIONAL JOURNAL OF COMPUTER SUPPORTED	105	0.208
INTERLENDING DOCUMENT SUPPLY	100	0.198
MALAYSIAN JOURNAL OF LIBRARY INFORMATION SCIENCE	100	0.198
JOURNAL OF ORGANIZATIONAL AND END USER COMPUTING	99	0.196
CANADIAN JOURNAL OF INFORMATION AND LIBRARY SCIENCE	94	0.186
MIS QUARTERLY EXECUTIVE	93	0.184
RESTAURATOR INT JR FOR THE PRESERVATION OF LIB AND ARCHIVAL	85	0.168
AFRICAN JOURNAL OF LIBRARY ARCHIVES AND	84	0.166
INFORMATION AND ORGANIZATION	67	0.132
LIBRARY AND INFORMATION SCIENCE	37	0.073
DATA TECHNOLOGIES AND APPLICATIONS	28	0.055
LIBRARY COLLECTIONS ACQUISITIONS TECHNICAL SERVICES	26	0.051
FF COMMUNICATIONS	19	0.038
VISIONS AND TRADITIONS KNOWLEDGE PRODUCTION AND	19	0.038
ANNALS OF THE NEW YORK ACADEMY OF SCIENCES	1	0.002
BEST PRACTICE GUIDELINES ON PUBLISHING ETHICS A PUBLISHER'S PERSPERSPECTIVE	1	0.002

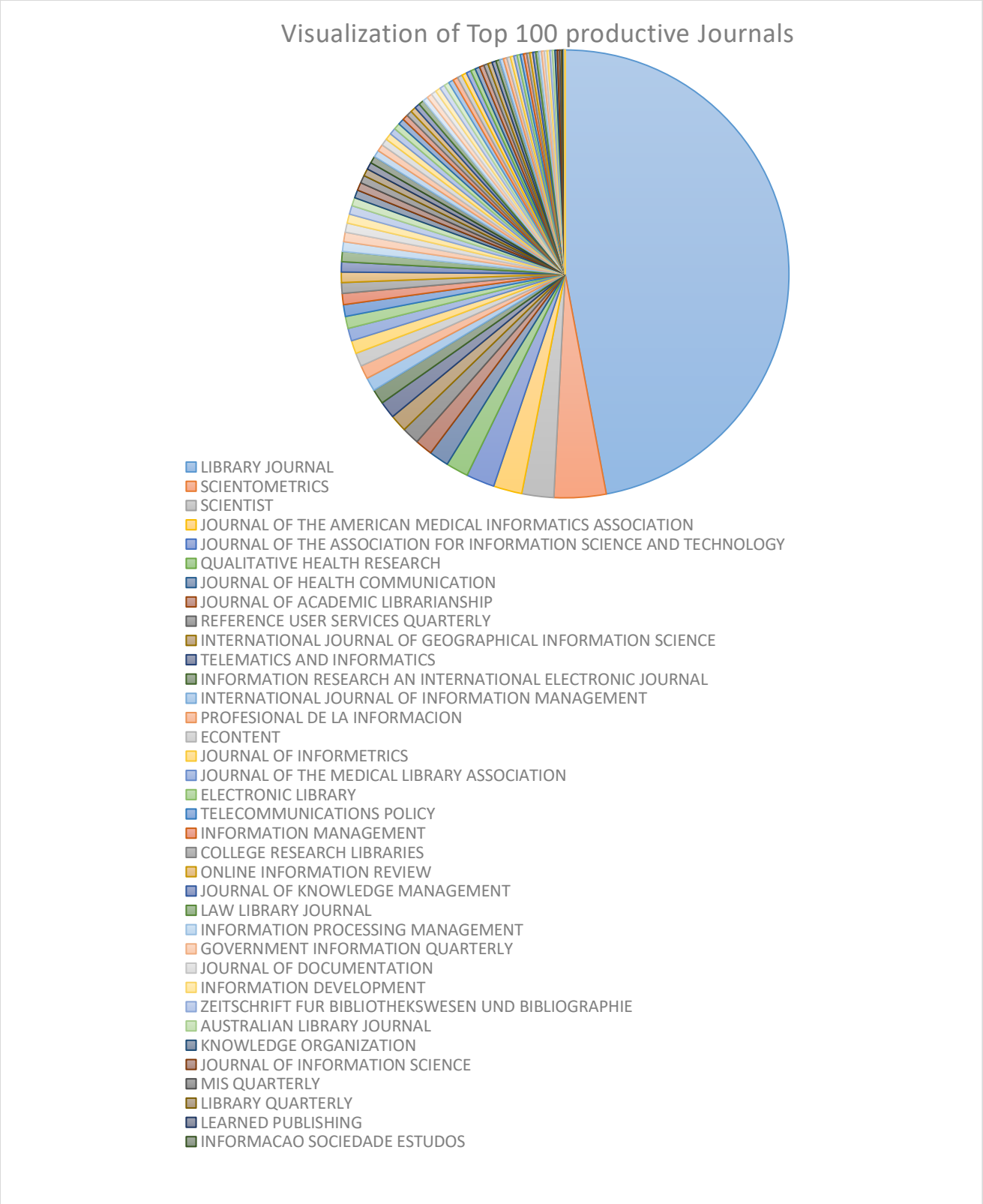

Figure 9: Visualization of Journals in Library and Information Science in top 100 in 2014 to 2018 indexed in WoS database as per number of articles published in each journal.

4.11 Top 100 organizations enhancing LIS research

Many organizations are promoting Library and Information Science Research. Universities researching in the frontiers of knowledge are extensively promoting research and development activities in LIS. But there are many constraints in promotion and expansion of LIS research. Being an interdisciplinary and multi-disciplinary subject, much R&D activities are essential and this has been kept intact by different organizations like universities. Here, the discussion will be on the basis of data retrieved from WoS database in the time period of 2014 to 2018 in Information and Library Science using the search string mentioned above. Total of 50595 records are obtained and maximum records are in the name of University of Michigan which is 724 in number and 1.431% of the total. This is followed by California State University System, University system of Georgia, State University of New York, Champaign Public Library, University of Texas System, State University System of Florida, University of Illinois system, University of California System, PENNSYLVANIA COMMONWEALTH SYSTEM OF HIGHER EDUCATION PCSHE are in the top of the list with 564, 528, 508, 485, 467, 452, 428, 422, 420 records in their name. The list of top 100 organizations enhancing research in Library and Information Science is tabulated below.

Table 10: 100 organizations enhancing LIS research from 2014 to 2018 as per the records of WoS database

Organizations-Enhanced	Records	% of 50595
UNIVERSITY OF MICHIGAN	724	1.431
UNIVERSITY OF MICHIGAN SYSTEM	724	1.431
CALIFORNIA STATE UNIVERSITY SYSTEM	564	1.115
UNIVERSITY SYSTEM OF GEORGIA	528	1.044
STATE UNIVERSITY OF NEW YORK SUNY SYSTEM	508	1.004
CHAMPAIGN PUBL LIB	485	0.959
UNIVERSITY OF TEXAS SYSTEM	467	0.923

STATE UNIVERSITY SYSTEM OF FLORIDA	452	0.893
UNIVERSITY OF ILLINOIS SYSTEM	428	0.846
UNIVERSITY OF CALIFORNIA SYSTEM	422	0.834
PENNSYLVANIA COMMONWEALTH SYSTEM OF HIGHER EDUCATION PCSHE	420	0.830
UNIVERSITY OF NORTH CAROLINA	407	0.804
HARVARD UNIVERSITY	375	0.741
INDIANA UNIVERSITY SYSTEM	353	0.698
UNIVERSITY OF WISCONSIN SYSTEM	336	0.664
FLOWER MOUND PUBL LIB	334	0.660
MASSACHUSETTS LIB SYST	331	0.654
CHELMSFORD PUBL LIB	295	0.583
UNIVERSITY SYSTEM OF MARYLAND	277	0.547
WUHAN UNIVERSITY	273	0.540
UNIVERSITY OF LONDON	269	0.532
UNIVERSITY OF NORTH CAROLINA CHAPEL HILL	258	0.510
BERKELEY PUBL LIB	255	0.504
CALIFORNIA STATE UNIVERSITY EAST BAY	252	0.498
INDIANA UNIVERSITY BLOOMINGTON	237	0.468
UNIVERSITY OF ILLINOIS URBANA CHAMPAIGN	227	0.449
UNIVERSITY OF MINNESOTA SYSTEM	218	0.431

CITY UNIVERSITY OF NEW YORK CUNY SYSTEM	216	0.427
CHINESE ACADEMY OF SCIENCES	215	0.425
UNIVERSITY OF MINNESOTA TWIN CITIES	203	0.401
UNIVERSITY OF WASHINGTON	202	0.399
UNIVERSITY OF WASHINGTON SEATTLE	194	0.383
UNIVERSITY OF ILLINOIS CHICAGO	192	0.379
PENN STATE UNIVERSITY	190	0.376
RUTGERS STATE UNIVERSITY NEW BRUNSWICK	188	0.372
GEORGIA STATE UNIVERSITY	187	0.370
UNIVERSITY OF GRANADA	185	0.366
CITY UNIVERSITY OF HONG KONG	181	0.358
THE SCIENTIST	175	0.346
UNIVERSITY OF MARYLAND COLLEGE PARK	173	0.342
UNIVERSITY OF TEXAS AUSTIN	173	0.342
LIB CONGRESS	169	0.334
CALIF STATE UNIV	168	0.332
UTAH SYSTEM OF HIGHER EDUCATION	166	0.328
UNIVERSITY OF ILLINOIS CHICAGO HOSPITAL	165	0.326
UNIVERSITY OF ARIZONA	164	0.324
CONSEJO SUPERIOR DE INVESTIGACIONES CIENTIFICAS CSIC	161	0.318

UNIVERSITY OF GEORGIA	157	0.310
KU LEUVEN	155	0.306
NANYANG TECHNOLOGICAL UNIVERSITY	155	0.306
NANYANG TECHNOLOGICAL UNIVERSITY NAT INST OF EDU NIE SINGAPORE	155	0.306
DEXTER DIST LIB	150	0.296
SANTA MONICA PUBL LIB	150	0.296
DREXEL UNIVERSITY	149	0.294
UNIVERSITY OF TORONTO	148	0.293
ARIZONA STATE UNIVERSITY	147	0.291
UNIVERSITI MALAYA	147	0.291
MCGILL UNIVERSITY	145	0.287
COLUMBIA UNIVERSITY	143	0.283
UNIVERSITY OF AMSTERDAM	143	0.283
UNIVERSITY OF TENNESSEE SYSTEM	143	0.283
UNIVERSITY OF WISCONSIN MADISON	143	0.283
NATL LIB SERV BLIND PHYS HANDICAPPED	141	0.279
UNIVERSITY OF PITTSBURGH	141	0.279
AMER JEWISH HIST SOC	140	0.277
UNIVERSITY OF BORAS	139	0.275
UNIVERSITY OF WOLVERHAMPTON	139	0.275

CORNELL UNIVERSITY	138	0.273
WASHINGTON STATE UNIVERSITY	137	0.271
LEONIA PUBL LIB	135	0.267
MAX PLANCK SOCIETY	135	0.267
UNIVERSITY OF WISCONSIN MILWAUKEE	135	0.267
NATIONAL INSTITUTES OF HEALTH NIH USA	134	0.265
UNIVERSITY OF NEW SOUTH WALES SYDNEY	133	0.263
UNIVERSITY OF PENNSYLVANIA	133	0.263
CHICAGO PUBL LIB SYST	131	0.259
OHIO STATE UNIVERSITY	131	0.259
UNIVERSITY OF UTAH	130	0.257
NATIONAL UNIVERSITY OF SINGAPORE	128	0.253
MICHIGAN STATE UNIVERSITY	127	0.251
UNIVERSITY OF MONTREAL	127	0.251
UNIVERSITY OF SHEFFIELD	126	0.249
EVANSVILLE VANDERBURGH PUBL LIB	125	0.247
UNIVERSITY OF KENTUCKY	125	0.247
INDIANA UNIVERSITY PURDUE UNIVERSITY INDIANAPOLIS	124	0.245
ROYAL MELBOURNE INSTITUTE OF TECHNOLOGY RMIT	124	0.245
UNIVERSITY OF SOUTH FLORIDA	124	0.245

ANDOVER HARVARD THEOL LIB	123	0.243
STATE UNIVERSITY OF NEW YORK SUNY BUFFALO	123	0.243
UNIVERSITY OF COLORADO SYSTEM	123	0.243
TEXAS A M UNIVERSITY SYSTEM	119	0.235
UNIVERSIDAD CARLOS III DE MADRID	118	0.233
UNIVERSITY OF BRITISH COLUMBIA	118	0.233
MASSACHUSETTS INSTITUTE OF TECHNOLOGY MIT	116	0.229
SOLANO CTY LIB	116	0.229
UNIVERSITY OF MISSOURI SYSTEM	116	0.229
WESTERN KENTUCKY UNIVERSITY	114	0.225
NORTHWESTERN UNIVERSITY	112	0.221
YONSEI UNIVERSITY	111	0.219
VANDERBILT UNIVERSITY	110	0.217

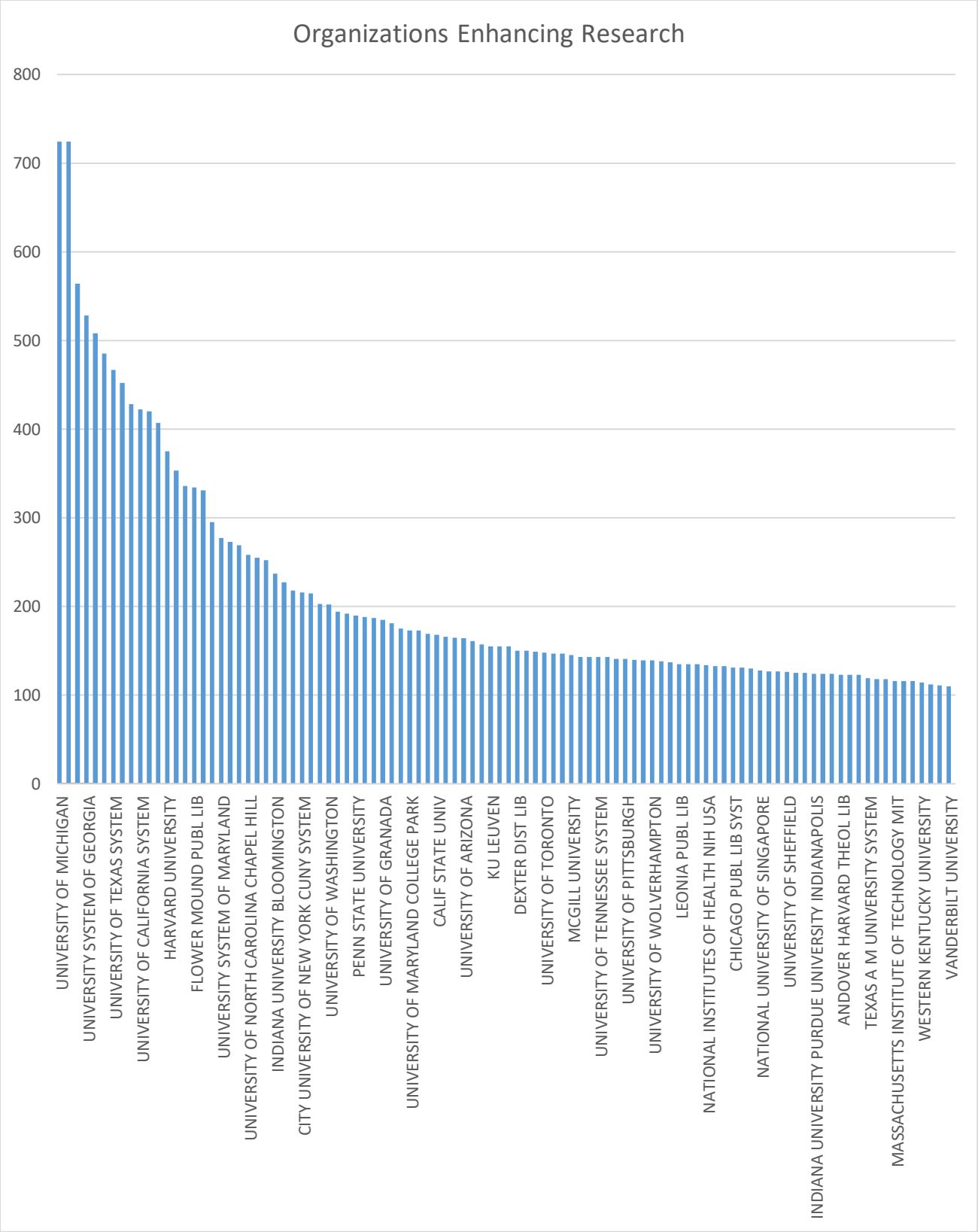

Figure 10: Distribution of top 100 organizations enhancing Research

4.12 Language-wise Distribution of Research Publications

If the data downloaded is analyzed on the basis of language of publication then out of 50595 records in the specified time span of 2014 to 2018 in WoS database, 48966 publications are in English language which is maximum in number and approximately 96.780% of the total publications. This is followed by Spanish language with 765 records, Portuguese with 331 records; German, Hungarian, Japanese, French are also in the list with 307,156,37,32 records respectively.

Table 11: Language-wise distribution of Publications

Languages	**Records**	**% of 50595**
ENGLISH	48966	96.780
SPANISH	765	1.512
PORTUGUESE	331	0.654
GERMAN	307	0.607
HUNGARIAN	156	0.308
JAPANESE	37	0.073
FRENCH	32	0.063
ESTONIAN	1	0.002
UNSPECIFIED	1	0.002

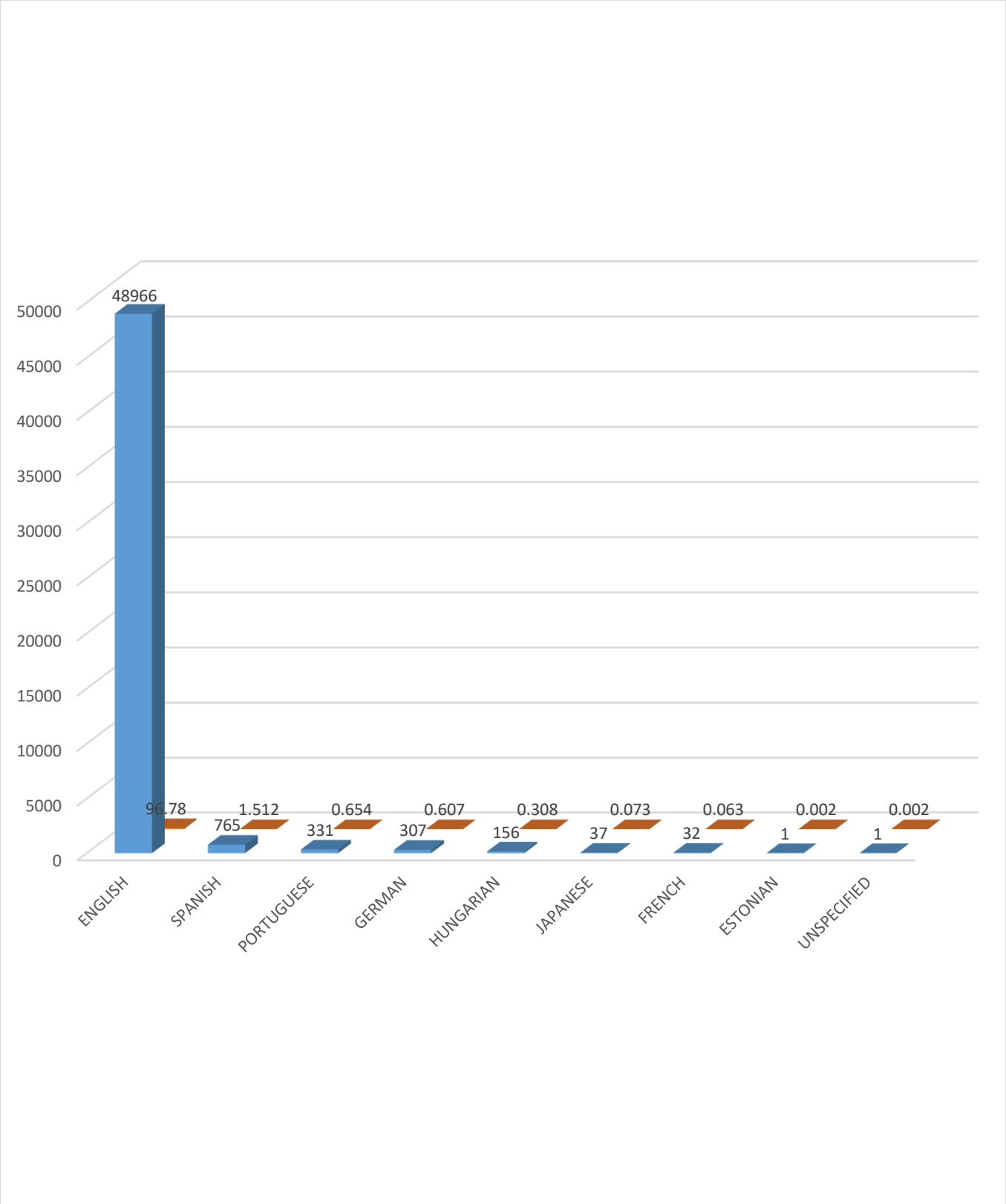

Figure 11: Language-wise distribution of research publications

4.13 Conclusion

In this Chapter collected data were analysed using various scientometric indicators and statistical tools like MS-Excel. The results were presented in the form of various tables, charts, graphs and interpretations.

The following chapter will provide findings, suggestions and conclusion.

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CHAPTER 5

Findings, Suggestions and Conclusion

5.1 Introduction

This chapter highlights the important findings, conclusions and suggestions as the outcome of the study. It gives an objective outlook of the research carried out in Library and Information Science in the time span of 2014 to 2018 as per data indexed in WoS database, a reputed international database.

It has been found that the research literature output on Library and Information Science for the study period of 5 years i.e. from 2014 to 2018 is 50595 records by approximately 500 authors, published in about 100 journals or source items, in 17 types of document, 8 type of languages, 50 different countries, 22 most prominent research areas, 50 funding agencies and 100 organizations or institutes enhancing research. The records were downloaded, organized, sorted and analysed using MS-Excel. The major findings as per the objectives are summarized in this chapter.

5.2 Major Findings

Findings of Objective 1

5.2.1 Assessment of the extent of published research in the field of LIS.

Analysis of the data indicates that the annual research output in Library and Information Science is highest in the year 2015 with 10518 (20.789%). A steady growth in number of publications has been observed from 2014 to 2015. In 2014, 10145 number of papers are published which rose to 10518 in 2015. This number declines from 2016 onwards and it reached to 9367 in 2018 which is least in the period of 2014 to 2018. The growth of article over the study period is not smooth. The growth increases from 2014 to 2016 and there is sharp decrease from 2017 to 2018. The slope of the curve is negative. (=-198.5)

Findings of Objective 2

5.2.2 Assessment of most productive nation and journal in the field of LIS

Analysis of the data to get the result of this objective indicates that U.S.A has 25752 number of records for which it is in rank 1 with 50.898% of the total of 50595 records. This is followed by People's Republic of China with 2199 records, England with 1844 records, Spain in the third rank with 1605 records, Canada with 1572 records, Australia with 1517 records, Germany with 1112 records, South Korea with 802 records, Netherlands with 711 records, Taiwan with 687 records which ranks from 2nd to 10th in the nation-wise distribution table in Chapter No. 4 where records of top 50 nations are tabulated with their percentage share and their worldwide rank. It is worth-mentioning that India has 468 records in Her name with 0.925% share and 15th rank among the top 50 nations. Developed nations than India like Singapore, Malaysia, Switzerland, Japan, Mexico, Ireland, Russia are lagging behind India with 18th, 22nd, 24th, 28th, 29th, 35th, 43rd rank respectively.

The downloaded data is sorted as per their source items or Journals. The processed data indicated that the journal named "Library Journal" takes the top position with 23815 publication records (47.070% of 50595 records). This is followed by "Scientometrics", "Scientist", "Journal of American Medical Informatics Association", "Journal of the Association for Information Science and Technology", "Qualitative Health Research", "Journal of Health Communication", "Journal of Academic Librarianship", "Reference User Services Quarterly", "International Journal of Geographical Information Science", "Telematics and Informatics", "Information Research an international electronic journal" with 1901, 1165, 1043, 1038, 818, 722, 635, 635, 624,622 and 542 respectively. The percentage share is 3.757%, 2.303%, 2.061%, 2.052%, 1.617%, 1.427%, 1.255%, 1.255%, 1.233%, 1.229% and 1.071% respectively. The top 100 Journals in LIS as per WoS database in the time frame 2014 to 2018 has been tabulated in the previous chapter with the number of records in those Journals and percentage share in the total of 50595 records.

Findings of Objective 3

5.2.3 Identification of most productive authors and organizations in the field of LIS

Analysis of the data for most productive authors indicates that the most prolific author in the field of LIS research is Hoffbert B with 948 records (1.874%), Mcardle MM with 598 records (1.182%), Campbell L with 558 records (1.103%). These authors are followed by Wetherbee J, Ellis K,

Sendaula S with 115,114 and 114 records respectively. Miller RT, Batten T and Helicher K with 111, 103 and 102 records respectively.

Analysis of data for most productive organization indicates that total of 50595 records are obtained and maximum records are in the name of University of Michigan which is 724 in number and 1.431% of the total. This is followed by California State University System, University system of Georgia, State University of New York, Champaign Public Library, University of Texas System, State University System of Florida, University of Illinois system, University of California System, PENNSYLVANIA COMMONWEALTH SYSTEM OF HIGHER EDUCATION PCSHE are in the top of the list with 564, 528, 508, 485, 467, 452, 428, 422, 420 records in their name, in terms of percentage it is 1.115%, 1.044%, 1.004%, 0.959%, 0.923%, 0.893%, 0.846%, 0.834%, 0.830% respectively.

Findings of Objective 4

5.2.4 Most Prevalent Research area in the field of LIS

Analysis of data for finding out the most prevalent research area in LIS as per WoS database from the time span of 2014 to 2018 reveals that Computer Science and Information System has maximum number of publications in its name which is 6376 and 12.602% of 50595 records (search string being Information and Library Science large number of Information Science related articles are displayed). This is followed by Computer Science Interdisciplinary Application with 3849 records, 7.607% of 50595 records. Management, Communication, Social Science Interdisciplinary, Multi-disciplinary Sciences, Health Care Science Service, Medical Informatics, Social Science Biomedical, Geography, Geography Physical, Telecommunications, Humanities Multidisciplinary etc with 2599 (5.137%), 1997(3.947%), 1215(2.401%), 1165(2.303%), 1043(2.061%), 1043(2.061%), 818(1.617%), 624 (1.233), 430(0.850%), 149(0.294%) respectively. In the previous chapter the 22 most prevalent research area has been tabulated and the number of publications along with the percentage share has been highlighted.

5.3 Suggestions

The analysis on Library and Information Science Research in WoS database from the stipulated time period of 2014 to 2018 has revealed that there are certain areas which are much neglected in

this field. Being amalgamated to Information Science there is much scope for multi-disciplinary research with Computer Science. A few suggestions are enlisted below:

- There should be necessary encouragement for the LIS professionals to work more on new emerging disciplines so that there is transformation from traditional librarianship to modern day Librarianship. The study implied that the research on core areas of Library Science has been transformed to topics fully based on ICT, Computer system, information Science, AI and cloud computing etc.

- There is need for building up explicit research organizations to support research in core areas of Library and Information Science. Only a few organizations are supportive in promotion of research in LIS.

- Research organizations like universities, documentation centers are to be provided with more financial support in the form of research grant and infrastructure to enlarge quality of research as they are lagging behind the top most research institutes.

- Researchers are needed to work on new emerging areas of research like Artificial Intelligence application in libraries, Cloud computing, semantic web, Ontology in addition to most common areas of LIS research like Bibliometrics, Research Output Analysis, Information Literacy, User study, Digital Library, Open Electronic Resources etc.

- The technological development also supports researchers thirst for producing quality research paper. So, researcher in the field of LIS need to be motivated to get their publication published in high impact factor journal.

5.4 Scope for future research

Present was limited to Web of Science database only. It has been realised that downloading publication records from more databases such as Scopus, Google Scholar and other related databases would give good number of publications in the respective field and bring out the real

picture of LIS research. While analyzing the data many sophisticated and advanced tools like Bib Excel, SPSS, 'R' can be used for better visualization and analysis using various parameters. This study is unique study and the concept can be applied in other disciplines too.

5.5 Conclusion

Scientometrics is a major sub-field of bibliomterics which concerns with measurement of impact of research paper, academic journal, knowing scientific citations, use of scientometric tools in policy and management contexts, the measurement, analysis and quantitative study of science communication and policy making. This field evolved from the study of metrics for improving information retrieval from peer-reviewed scientific publications. These are done on the basis of sources like data sets, web pages, social media etc. Major measurement tools for a scientometric study includes h-index, g-index, i10 index, citation analysis, growth of publication, form of publication, average annual growth rate, compound annual growth rate, doubling time, obsolescence of literature etc. With the advent of Science and Technology and application in Information processing, storing and disseminating there has been a tremendous change in data management. This has also helped in the collection of data for scientific study. In other words, application of information technology has facilitated access to data and information which is a very essential aspect for quality research productivity and attaining a research output of global standards. Scientometrics/bibliometrics/ infometrics/webometrics/cybernmertics are studies which does rigorous quantitative analysis of data on their respective aspects and facilitates research, innovation and knowledge enhancement which may in case of an author, an institution, a R&D organization, research publication, web content management and analysis and scholarly information communication. Developing countries like India are giving more emphasis on research, innovation, digital transformation which are dependent on grants from funding agencies. These funding agencies allots grants only on the data that they are provided by any R & D organization, and data are provided through studies like scientometric, bibliometric, webometric assessment of research activities.

Research output enable academics to earn recognition in academic circle locally and internationally. In higher education, research output often served as a major role in attaining success in academics circles as it is related to promotion, tenure and salary. One of the strategies

for determining research productivity is to access the quantity of publication which researcher communicated with primary or other sources. Research productivity and research activities are interrelated. Research involves collecting and analyzing the data. Research productivity is the extent to which faculty engage in their own research and publish scientific articles in referred journals, conference proceedings, writing a book chapter, gathering and analysing original evidence, working with postgraduate students on dissertations and class projects, obtaining research grants, carrying out editorial duties, obtaining patents and licenses, writing monographs, developing experimental designs, producing works of an artistic or a creative nature engaging in public debates and commentaries.

This study taken for five years of time frame reveals a steady growth in the number of publications with maximum number of publications in 2015 which drops in number in 2018 and 2015 being the most productive year. As per most prolific author is concerned Hobbert B is the most productive one followed by Mcardle MM, Campbell L, Wetherbee J, Ellis K, Sendaula S, Miller RT, Batten T and Helicher K. The leading countries in Library and information science research is U.S.A which is followed by People's Republic of China, England, Spain, Canada, Australia, Germany South Korea and Netherlands, which are top ten nations. India ranks 15th in the list leaving behind developed nations like Finland, Denmark, Singapore, New Zealand, Japan, Scotland, Mexico. In nations like USA, China, England, Spain and Canada the research on Library Science as extensively merged to Information System, Computer Science and Interdisciplinary Applications, Management, Communication, Medical Informatics. As per Funding agencies are concerned National Natural Science foundation of China topped the list of 50 organizations This is followed by United States Department of Health Human Services. Agencies like National Institute of Health NIH USA, National Science Foundation NSF, European Union EU, Fundamental Research Funds for the Central Universities, NIH National Library of Medicine NLM, National Cancer Institute NCI, Ministry of Science and Technology Taiwan, Agency for Health Care research quality are in the top 10 categories. As per document form is concerned Book review is in maximum number followed by articles, editorial material, news item, review, letter, proceedings paper, correction bibliographic item, Book chapter, software review, reprint, bibliography, hardware review, retracted publication, retraction is also in the list. Most productive journal found is "Library Journal" takes the top position with 23815 publication records. This is followed by "Scientometrics", "Scientist", "Journal of American Medical Informatics

Association", "Journal of the Association for Information Science and Technology", "Qualitative Health Research", "Journal of Health Communication", "Journal of Academic Librarianship", "Reference User Services Quarterly", "International Journal of Geographical Information Science", "Telematics and Informatics", "Information Research an international electronic journal" which are also in the top category. Organizations which are in the top category in conducting LIS research include University of Michigan, California State University System, University system of Georgia, State University of New York, Champaign Public Library, University of Texas System, State University System of Florida, University of Illinois system, University of California System, PENNSYLVANIA COMMONWEALTH SYSTEM OF HIGHER EDUCATION PCSHE. Maximum of the research publications are published in English though publications in other languages like Spanish, Portuguese, German, Hungarian, Japanese, French are also seen.

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DEPARTMENT	:	LIBRARY AND INFORMATION SCIENCE
TITLE OF DISSERTATION	:	SCIENTOMETRIC MAPPING OF LIBRARY AND INFORMATION SCIENCE RESEARCH IN WEB OF SCIENCE
DATE OF ADMISSION (Commencement of First Sem)	:	03.08.2020
COMMENCEMENT OF SECOND SEM/DISSERTATION (From conclusion of end semester exams)	:	04.02.2019

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2. SCHOOL BOARD	:	07.05.2019

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Conferences and Seminars

Participation:

1) Borgohain, D. (2020). Digital Library development and Digital Library initiatives in India. In proceedings of *"Public Library and Digital Divide: Opportunities and Challenges"* organized by Odisha State Open University, Sambalpur held on 22nd to 23rd February 2019. (pp. 134-142), ISBN-978-81-944673-0-4.

2) Borgohain, D. (2020). Library and Information Science Research in Web of Science Database: An overview. In proceedings of *"National Conference on Digital Scholarship 2020"* organized by Department of Library and Information Science, Central University of Tamil Nadu held on 12th -13th March, 2020. (pp. 134-142), ISBN- 978-93-5406-205-6.

Presentation:

1) Borgohain, D. (2019). Ontologies in Web Portal for future librarians and expectations of new generation library users from digital libraries. In proceedings of *"Transcending Technology: a cognitive learning towards artificial intelligence",* organized by Rajiv Gandhi National University of Law, Patiala, Punjab held on 6th-8th September, 2019. (pp. 496-503), ISBN- 978-93-83043-28-6.

2) Borgohain, D. (2020). Application of Social Media in Digital Library- A special reference to Indian Digital Library Platform. In *"Social Media and Librarianship: Connecting the communities"* organized by Department of Library and Information Science, Mizoram University held on 26th-28th February, 2020.

3) Borgohain, D. (2020). Managing Public Libraries with emerging innovative technologies for the New Normal. In *"Visualizing the changes in Public Library System: Issues and challenges after lockdown"* organized by Department of Library and Information Science, MBB University, Agartala, Tripura held on 06th – 07th August, 2020.

Book Chapters:

1) Borgohain, D & Singh S.N. (2019). LIS education through MOOCs: a special reference to India. In the edited *book "Bridging Educational Divides MOOCs and OERs"* published by NLU, Delhi and NAAC. (pp. 17-23), ISBN- 978-93-84272-25-8.

Workshops/ Training Programs Participated:

1) National Workshop on "Trends in LIS Research: Approaches and Methods" organized by Department of Library and Information Science, Mizoram University and INFLIBNET Centre, Gandhinagar sponsored by DRDO, ICSR-NERC held on 11^{th} – 15^{th} March, 2019.

2) Five days Online Training Program on "Research Methodology and Ethics: Plagiarism Issues, Reference Management Tools and Altmetrics" organized by INFLIBNET Centre, Gandhinagar held on 15^{th} – 19^{th} June, 2020.

3) One Week FDP on "Python 3.4.3" organized by Dept of Physics and IQAC, Barnagar College, Sarbhog association with IIT Bombay held on 27^{th} August to 2^{nd} Sepetember, 2020.

ABSTARCT

On

SCIENTOMETRIC MAPPING OF LIBRARY AND INFORMATION SCIENCE RESEARCH IN WEB OF SCIENCE

A DISSERTATION SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF PHILOSOPHY

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DEPARTMENT OF LIBRARY AND INFORMATION SCIENCE

SCHOOL OF ECONOMICS, MANAGEMENT AND INFORMATION SCIENCE

OCTOBER 2020

1.Introduction

Library and Information Science (LIS) is a discipline which deals with the management of Libraries and Information Centers in various ways. LIS research has been always the ultimate vision of intellectuals and academicians, as it also influences scientifically or technically research in other disciplines. With the advent of Information and Communication Technology (ICT), library professionals are also very keen to meet the emerging challenges and to explore new frontiers of LIS profession and knowledge, to show performance in disseminating knowledge as well as taking a problem in way of collaboration. In order to achieve their goal, the LIS professionals are now more competitive and update the current trends of research in the changing scenario to build a rich collection of LIS publications throughout the globe. According to Rashid (2001), "research is a conscious effort to collect information, to verify the information and to analyze the information". Research is an organized effort to solve the complex and teasing problems. It is generally accepted that research plays a critical role in promoting the prosperity of a nation and the well-being of its citizens in this knowledge-based era (Abbott & Doucouliagos, 2004). Creswell (2008) reported that research not only aids solving practical problems and brings about material improvements, but it also provides insight into new ideas that improve human understanding of various social, economic and cultural phenomena. In recent years, there has been increasing interest among researchers and policymakers in the notion of research output. Research output is one of the major measures of university academic performance and a core indicator for calculations of university rankings. A number of studies have tried to compare research output across nations or academic disciplines and to explore the main factors that enhance the research output of faculty members. Research plays a critical role in promoting the prosperity of a nation and the well-being of its citizens. Universities through research make important contributions to the growth and development of industries and government businesses, thereby promoting national and global development.

1.1 Research Output & Research Productivity

Research output enable academics to earn recognition in academic circle locally and internationally. In higher education, research output often served as a major role in attaining success in academics circles as it is related to promotion, tenure and salary. One of the strategies

for determining research productivity is to access the quantity of publication which researcher communicated with primary or other sources. Research productivity and research activities are interrelated. Research involves collecting and analysing the data. Research productivity is the extent to which faculty engage in their own research and publish scientific articles in referred journals, conference proceedings, writing a book chapter, gathering and analysing original evidence, working with postgraduate students on dissertations and class projects, obtaining research grants, carrying out editorial duties, obtaining patents and licenses, writing monographs, developing experimental designs, producing works of an artistic or a creative nature engaging in public debates and commentaries (Creswell, 1986).

There are a number of researches conducted to assess the research productivity of the researchers, authors, faculties, institutions, fields of studies, and country etc. Roleda et al. (2014) conducted a research productivity study at De La Salle University (DLSU) using Scopus database; and found that research productivity includes journal publications, conference papers, books, and monographs. Sweileh et al. (2014) assessed the scientific research productivity of the An-Najah National University, Palestine based on Scopus database and included the pattern of publication, relative growth rate, authorship pattern, collaborative measures, author's productivity, most prolific authors, and most prolific journals as productivity indicators for his research. Iqbal & Mahmood (2001) studied factors related to low research productivity at higher education level and found that extra teaching load, performance of administrative duties along with academic duties, lack of funds, non-existence of research leave, negative attitude of the faculty towards research, lack of research skills, non-availability of latest books, absence of professional journals, less number of university own journals, are the major causes of low productivity and reduced the research productivity of the university faculty members.

1.2 Scientometrics

In 1969, two Russian scientists Vassily V. Nalimov and Z. M. Mulchenko coined the Russian term “Naukometriya” equivalent to ‘scientometrics’. Tague-Sutcliffe (1992) defined “Scientometrics is the study of the quantitative aspects of science as a discipline or economic activity. It is part of the sociology of science and has application to science policy-making. It involves quantitative studies of scientific activities including, among others, publication, and so overlaps bibliometrics to some extent”. The focus of scientometrics is the measurement of

science and is therefore concerned with the growth, structure, inter-relationship, and productivity of scientific disciplines (Jeyasekar & Saravanan, 2015). There has been growing interest in mapping and visualization. Researchers began to focus on the structure of scientific literature in order to identify and visualize specialties, although they did not use the term "visualization" at that time. The co-word analysis and co-citation analysis are among the most fundamental techniques for science mapping. They are the technical foundations of the contemporary quantitative studies of science. Each offers a unique perspective on the structure of scientific frontiers.

1.3 Web of Science

Web of Science is an online citation indexing service originally produced by the Institute for Scientific Information (ISI) and later maintained by Clarivate Analytics. It gives access to multiple databases that reference cross-disciplinary research, which allows for in-depth exploration of specialized sub-fields within an academic or scientific discipline. Expanding the coverage of Web of Science, in November 2009 Thomson Reuters introduced Century of Social Sciences. This service contains files which trace social science research back to the beginning of the 20th century, and Web of Science now has indexing coverage from the year 1900 to the present. The multidisciplinary coverage of the Web of Science encompasses over 50,000 scholarly books, 12,000 journals and 160,000 conference proceedings. The coverage includes sciences, social sciences, arts, and humanities. The Web of Science Core Collection consists of six online databases: Science Citation Index Expanded (SCIE) (covers more than 8,500 notable journals encompassing 150 disciplines); Social Sciences Citation Index (SSCI) (covers more than 3,000 journals in social science disciplines); Arts & Humanities Citation Index (AHCI) (covers more than 1,700 arts and humanities journals); Emerging Sources Citation Index (ESCI) (covers over 5,000 journals in the sciences, social science, and humanities); Book Citation Index (BCI) (covers more than 60,000 editorially selected books); Conference Proceedings Citation Index (CPCI) (covers more than 160,000 conference titles in the sciences).

1.4 Significance of the Study

There are number of scientometric studies conducted to map the research of specific field at micro-level and macro level. In the field of LIS, few studies have been found which deals with the mapping of LIS research in specific topic or country or database whereas no scientometric

study conducted so far which have the coverage of global level or continental level LIS research indexed in Web of Science. So, the present study will be an attempt to fill up the gap. Therefore, the present study is an attempt to map the LIS research published and indexed in Web of Science. This study will help LIS professionals to understand and develop an interest in such kind of metrics for LIS research and study will also provide the strengths and weaknesses of the field. Further, prospective researchers of LIS may undertake another similar study to explore the LIS profession in a much better way.

1.5 Scope of the Study

The present study is confined to map the research publications of Library and Information Science (LIS) retrieved through Web of Science (WoS). The study will be conducted for five years (5) time duration i.e. from 2014 - 2018. The Web of Science (WoS) indexes research (publications) in the form of conference proceedings, scholarly books, journal publications etc. Research publications available in "all the document types" will be covered in the study.

1.6. Statement of the Problem

Scientometric mapping is a process to identify the growth and development of published literature in a specific field with the help of various scientometric indicators. There is a number of studies have been observed on the mapping of research in some specific field of the study at micro-level or specific country level or particular database level. Still, there is lack of such research that covers wider perspective of LIS subject from Web of Science. Library and Information Science researchers have conducted numbers of micro-level studies in certain fields of specific subject domains but observed rare studies in the field of Library and Information Science at wider level during the proposed study period. Due to lack of such research in the field of Library and Information Science, need arises to investigate the mapping of Library and Information Science research indexed in Web of Science database and it would thus be interesting to conduct the study.

1.7. Objectives of the Study

The objectives of the study are to:

- Assess the extent of published research in the field of LIS.
- Identify most productive nation and journal in the field of LIS.

- Identify the most productive authors and organizations in the field of LIS.
- Find out the prevalent research areas in LIS

1.8. Research Methodology

The study is designed to investigate the scientometric mapping (assessment) of LIS research indexed in Web of Science database. The research method applied here is observation method. The raw data is collected from Web of Science database and is tabulated in MS-Excel file. Web of Science is one of the leading scholarly databases which have the collection of many databases in different fields. It covers more than 90 million records from 256 academic disciplines. Its temporal coverage starts from 1900 to date and provides the scholarly resources from more than 12000 journals, 160,000 conference proceedings as well as 50000 scholarly books. Due to wider coverage of research in various disciplines, Web of Science database has been chosen for data collection to display broader perspectives of LIS research.

The following search expression was used to gather data.
TOPIC: Information Science and Library Science Research and LANGUAGE: (English) AND DOCUMENT TYPES: (Article) Timespan=2014-2018. Indexes=SCI-EXPANDED, SSCI, A&HCI, ESCI.

For the analysis of collected data, MS-Excel and VoSViewer are used for statistical data analysis and presentation of results also other suitable statistical and bibliometric/scientometric tools are used.

1.9. Chapterization

The present study has been tentatively divided into the following chapters:

Chapter 1: Introduction

Chapter 2: Scientometrics: Concept

Chapter 3: Library and Information Science Research

Chapter 4: Data analysis and Interpretation

Chapter 5: Findings, Suggestions and Conclusion

1.10 FINDINGS ACCORDING TO THE OBJECTIVES OF THE STUDY

Findings of Objective 1

1.10.1 Assessment of the extent of published research in the field of LIS.

Analysis of the data indicates that the annual research output in Library and Information Science is highest in the year 2015 with 10518 (20.789%). A steady growth in number of publications has been observed from 2014 to 2015. In 2014, 10145 number of papers are published which rose to 10518 in 2015. This number declines from 2016 onwards and it reached to 9367 in 2018 which is least in the period of 2014 to 2018. The growth of article over the study period is not smooth. The growth increases from 2014 to 2016 and there is sharp decrease from 2017 to 2018. The slope of the curve is negative. (=-198.5).

Findings of Objective 2

1.10.2 Assessment of most productive nation and journal in the field of LIS

Analysis of the data to get the result of this objective indicates that U.S.A has 25752 number of records for which it is in rank 1 with 50.898% of the total of 50595 records. This is followed by People's Republic of China with 2199 records, England with 1844 records, Spain in the third rank with 1605 records, Canada with 1572 records, Australia with 1517 records, Germany with 1112 records, South Korea with 802 records, Netherlands with 711 records, Taiwan with 687 records which ranks from 2^{nd} to 10^{th} in the nation-wise distribution table in Chapter No. 4 where records of top 50 nations are tabulated with their percentage share and their worldwide rank. It is worth-mentioning that India has 468 records in Her name with 0.925% share and 15^{th} rank among the top 50 nations. Developed nations than India like Singapore, Malaysia, Switzerland, Japan, Mexico, Ireland, Russia are lagging behind India with 18^{th}, 22^{nd}, 24^{th}, 28^{th}, 29^{th}, 35^{th}, 43^{rd} rank respectively.

The downloaded data is sorted as per their source items or Journals. The processed data indicated that the journal named "Library Journal" takes the top position with 23815 publication records (47.070% of 50595 records). This is followed by "Scientometrics", "Scientist", "Journal of American Medical Informatics Association", "Journal of the Association for Information Science and Technology", "Qualitative Health Research", "Journal of Health Communication", "Journal of Academic Librarianship", "Reference User Services Quarterly", "International Journal of Geographical Information Science", "Telematics and Informatics", "Information Research an international electronic journal" with 1901, 1165,

1043, 1038, 818, 722, 635, 635, 624,622 and 542 respectively. The percentage share is 3.757%, 2.303%, 2.061%, 2.052%, 1.617%, 1.427%, 1.255%, 1.255%, 1.233%, 1.229% and 1.071% respectively. The top 100 Journals in LIS as per WoS database in the time frame 2014 to 2018 has been tabulated in the previous chapter with the number of records in those Journals and percentage share in the total of 50595 records.

Findings of Objective 3

1.10.3 Identification of most productive authors and organizations in the field of LIS

Analysis of the data for most productive authors indicates that the most prolific author in the field of LIS research is Hoffbert B with 948 records (1.874%), Mcardle MM with 598 records (1.182%), Campbell L with 558 records (1.103%). These authors are followed by Wetherbee J, Ellis K, Sendaula S with 115,114 and 114 records respectively. Miller RT, Batten T and Helicher K with 111, 103 and 102 records respectively.

Analysis of data for most productive organization indicates that total of 50595 records are obtained and maximum records are in the name of University of Michigan which is 724 in number and 1.431% of the total. This is followed by California State University System, University system of Georgia, State University of New York, Champaign Public Library, University of Texas System, State University System of Florida, University of Illinois system, University of California System, PENNSYLVANIA COMMONWEALTH SYSTEM OF HIGHER EDUCATION PCSHE are in the top of the list with 564, 528, 508, 485, 467, 452, 428, 422, 420 records in their name, in terms of percentage it is 1.115%, 1.044%, 1.004%, 0.959%, 0.923%, 0.893%, 0.846%, 0.834%, 0.830% respectively.

Findings of Objective 4

1.10.4 Most Prevalent Research area in the field of LIS

Analysis of data for finding out the most prevalent research area in LIS as per WoS database from the time span of 2014 to 2018 reveals that Computer Science and Information System has maximum number of publications in its name which is 6376 and 12.602% of 50595 records (search string being Information and Library Science large number of Information Science related articles are displayed). This is followed by Computer Science Interdisciplinary Application with 3849 records, 7.607% of 50595 records. Management, Communication, Social Science Interdisciplinary, Multi-disciplinary Sciences, Health Care Science Service, Medical Informatics, Social Science Biomedical, Geography, Geography Physical,

Telecommunications, Humanities Multidisciplinary etc with 2599 (5.137%), 1997(3.947%), 1215(2.401%), 1165(2.303%), 1043(2.061%), 1043(2.061%), 818(1.617%), 624 (1.233), 430(0.850%), 149(0.294%) respectively. In the previous chapter the 22 most prevalent research area has been tabulated and the number of publications along with the percentage share has been highlighted.

1.11 Conclusion

Scientometrics is a major sub-field of bibliomterics which concerns with measurement of impact of research paper, academic journal, knowing scientific citations, use of scientometric tools in policy and management contexts, the measurement, analysis and quantitative study of science communication and policy making. This field evolved from the study of metrics for improving information retrieval from peer-reviewed scientific publications. These are done on the basis of sources like data sets, web pages, social media etc. Major measurement tools for a scientometric study includes h-index, g-index, i10 index, citation analysis, growth of publication, form of publication, average annual growth rate, compound annual growth rate, doubling time, obsolescence of literature etc. With the advent of Science and Technology and application in Information processing, storing and disseminating there has been a tremendous change in data management. This has also helped in the collection of data for scientific study. In other words, application of information technology has facilitated access to data and information which is a very essential aspect for quality research productivity and attaining a research output of global standards. Scientometrics/bibliometrics/ infometrics/webometrics/cybernmertics are studies which does rigorous quantitative analysis of data on their respective aspects and facilitates research, innovation and knowledge enhancement which may in case of an author, an institution, a R&D organization, research publication, web content management and analysis and scholarly information communication. Developing countries like India are giving more emphasis on research, innovation, digital transformation which are dependent on grants from funding agencies. These funding agencies allots grants only on the data that they are provided by any R & D organization, and data are provided through studies like scientometric, bibliometric, webometric assessment of research activities.

Research output enable academics to earn recognition in academic circle locally and internationally. In higher education, research output often served as a major role in attaining success in academics circles as it is related to promotion, tenure and salary. One of the strategies for determining research productivity is to access the quantity of publication which researcher

communicated with primary or other sources. Research productivity and research activities are interrelated. Research involves collecting and analyzing the data. Research productivity is the extent to which faculty engage in their own research and publish scientific articles in referred journals, conference proceedings, writing a book chapter, gathering and analysing original evidence, working with postgraduate students on dissertations and class projects, obtaining research grants, carrying out editorial duties, obtaining patents and licenses, writing monographs, developing experimental designs, producing works of an artistic or a creative nature engaging in public debates and commentaries.

This study taken for five years of time frame reveals a steady growth in the number of publications with maximum number of publications in 2015 which drops in number in 2018 and 2015 being the most productive year. As per most prolific author is concerned Hobbert B is the most productive one followed by Mcardle MM, Campbell L, Wetherbee J, Ellis K, Sendaula S, Miller RT, Batten T and Helicher K. The leading countries in Library and information science research is U.S.A which is followed by People's Republic of China, England, Spain, Canada, Australia, Germany South Korea and Netherlands, which are top ten nations. India ranks 15th in the list leaving behind developed nations like Finland, Denmark, Singapore, New Zealand, Japan, Scotland, Mexico. In nations like USA, China, England, Spain and Canada the research on Library Science as extensively merged to Information System, Computer Science and Interdisciplinary Applications, Management, Communication, Medical Informatics. As per Funding agencies are concerned National Natural Science foundation of China topped the list of 50 organizations This is followed by United States Department of Health Human Services. Agencies like National Institute of Health NIH USA, National Science Foundation NSF, European Union EU, Fundamental Research Funds for the Central Universities, NIH National Library of Medicine NLM, National Cancer Institute NCI, Ministry of Science and Technology Taiwan, Agency for Health Care research quality are in the top 10 categories. As per document form is concerned Book review is in maximum number followed by articles, editorial material, news item, review, letter, proceedings paper, correction bibliographic item, Book chapter, software review, reprint, bibliography, hardware review, retracted publication, retraction is also in the list. Most productive journal found is "Library Journal" takes the top position with 23815 publication records. This is followed by "Scientometrics", "Scientist", "Journal of American Medical Informatics Association", "Journal of the Association for Information Science and Technology", "Qualitative Health Research", "Journal of Health Communication", "Journal of Academic Librarianship",

"Reference User Services Quarterly", "International Journal of Geographical Information Science", "Telematics and Informatics", "Information Research an international electronic journal" which are also in the top category. Organizations which are in the top category in conducting LIS research include University of Michigan, California State University System, University system of Georgia, State University of New York, Champaign Public Library, University of Texas System, State University System of Florida, University of Illinois system, University of California System, PENNSYLVANIA COMMONWEALTH SYSTEM OF HIGHER EDUCATION PCSHE. Maximum of the research publications are published in English though publications in other languages like Spanish, Portuguese, German, Hungarian, Japanese, French are also seen.

1.12. Suggestions

The analysis on Library and Information Science Research in WoS database from the stipulated time period of 2014 to 2018 has revealed that there are certain areas which are much neglected in this field. Being amalgamated to Information Science there is much scope for multi-disciplinary research with Computer Science. A few suggestions are enlisted below:

1. There should be necessary encouragement for the LIS professionals to work more on new emerging disciplines so that there is transformation from traditional librarianship to modern day Librarianship. The study implied that the research on core areas of Library Science has been transformed to topics fully based on ICT, Computer system, information Science, AI and cloud computing etc.

2. There is need for building up explicit research organizations to support research in core areas of Library and Information Science. Only a few organizations are supportive in promotion of research in LIS.

3. Research organizations like universities, documentation centers are to be provided with more financial support in the form of research grant and infrastructure to enlarge quality of research as they are lagging behind the top most research institutes.

4. Researchers are needed to work on new emerging areas of research like Artificial Intelligence application in libraries, Cloud computing, semantic web, Ontology in

addition to most common areas of LIS research like Bibliometrics, Research Output Analysis, Information Literacy, User study, Digital Library, Open Electronic Resources etc.

5. The technological development also supports researchers thirst for producing quality research paper. So, researcher in the field of LIS need to be motivated to get their publication published in high impact factor journal.

1.13. Scope for future research

Present was limited to Web of Science database only. It has been realized that downloading publication records from more databases such as Scopus, Google Scholar and other related databases would give good number of publications in the respective field and bring out the real picture of LIS research. Moreover, this study can be adopted for other disciplines also taking more time duration for study. Using sophisticated software tools like VoSViewer extensive mapping of analyzed data can be done which will give a real picture of research conducted in any discipline by a researcher. This study had left ample of scope to conduct research in depth in the field of scientometric applying various tools and measurements of scientometrics. While analyzing the data many sophisticated and advanced tools like Bib Excel, SPSS, 'R' can be used for better visualization and analysis using various parameters. This study is unique study and the concept can be applied in other disciplines too.