



Research in digital library field: a scientometric assessment of publications output during 2006-15

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Abstract

The speedy development and acceptance of digital Libraries in recent years has led to vast amount of publications in the field. The present study examines the growth and development of publications output in the field of digital libraries. The present scientometric study is confined to collection of data which are indexed in Elsevier's citation database 'Scopus' during 2006-2015. The total 17268 records were found related to the present study, which have been analyzed to reach at conclusions. The present study quantifies the publication data in various aspects of performance such as year wise growth of publications, most productive authors at world and national level, most prolific source titles, research publications in various subjects, document type, significant keywords, research publications of various countries, distribution of publications by language. The study revealed that maximum papers (10.81%) were published during the year 2013 which was followed by 10.71% in 2007. Fox, E.A. and Urs, S.R. have produced majority of records at the World and National level. Lecture Notes in Computer Science produces the largest number of publications (9.28%). Digital Library Research publication leads with 35.80% of the total publications in computer science and onference papers contribute 50.56% of the

publications. United States is the leading country with 30.60% publications and English is being considered as the dominant language.

Keywords: Digital Libraries, Digital Libraries Research, Bibliometrics, Productivity, Scopus, Scientometrics

1 Introduction

The development of Information Communication Technology (ICT) has put a profound effect on each and every field and has transformed the day to day functioning, hence libraries are no exception. The traditional libraries are being replaced by digital libraries through the evolution of ICTs. The emergence of internet has provided a new dimension to information technology which gave birth to the concept of digital libraries. This concept has flourished very fast in order to explore the benefits and services of the present day libraries. Various software packages for automation of libraries and information networks, e-resources indicate the development of digital libraries. During the 1990's the concept under study was highly recognized in India and changed the information needs and information seeking behaviour of the users. Digital libraries have provided solutions to the major challenges of traditional libraries such as insufficiency of space and storage of materials. They have put a world of information at user's fingertips by providing exhaustive and expeditious information in multimedia forms, anywhere and providing 24/7 access. Digital library collections are not limited to documents but they are the actual digital objects such as images, text etc. Digital libraries have well established and proven information technologies for accessing the database or servers through networks. The basic purpose of these libraries is to develop collection, storage and organizing information in digital form and plays an important role in the dissemination of knowledge and to meet the changing information seeking behaviour of the users.

2 Defining Digital Library

It is a library in which the resources are available in machine readable form, accessible by means of computers. The digital content may be locally held or accessed remotely via computer networks.



According to Digital Library Federation "Digital libraries are organizations that provide the resources, including the specialized staff, to select, structure, offer intellectual access to, interpret, distribute, preserve the integrity of, and ensure the persistence over time of collections of digital works so that they are readily and economically available for use by a defined community or set of communities."

Clifford Lynch (2008) defined Digital library as "System providing a community of users with coherent access to a large organized repository of information and knowledge. The digital library is not just one entity, but multiple sources and seamlessly integrated."

3 Review of Literature

Review of literature is significant for any research. It provides an analysis of the studies already undertaken in a particular field. It enables the researcher to find out the contributions made by various authors. A number of studies on "Scientometrics" have been conducted in various fields based on the data extracted from the databases, and digital library is one of the fields. The present research highlights some of the studies already undertaken:

Mustafa (2015) analysed 88 articles of the journal-World Digital Libraries: An International Journal, published during the year 2008–14. This study investigated the year-wise distribution, authorship pattern of institution-wise, country-wise distribution and contributions and length of articles in each volume. This study concluded that most of the articles in this journal are contributed by India and are written by one author.

Serenko , (2013) conducted the meta-analysis of prior scientometric research in the area of the knowledge management (KM). From knowledge management field a total of 108 scientometric studies were selected for meta-analysis techniques. Results indicated that the works on Knowledge management had increased to ten publications per year by 2012 with inconsistent key findings. Majority of the research on knowledge management was published in non-KM-centric journals. The results of findings stated that the top six most productive countries are USA, UK, Canada, Germany, Australia, and Spain.

Singh et al (2007) evaluated research output of literature on digital libraries. Over 1,000 articles during the period 1998-2004 were collected from LISA Plus with the purpose to find out the growth and characteristics of digital library literature. It has studied the authorship patterns, authors' productivity and prominent contributors, language-wise, year-wise distribution of articles, country-wise distribution of journals, core journals in the subject area, and indexing term frequency. The study revealed that most of the articles were published by single authors. Distribution of articles in different journals nearly follows Bradford's law.

Garg and Padhi (2001) analysed 3174 papers published in journals in the field of Laser Science and Technology. It indicated that only 401 papers were single authored and the rest 2773 were co-authored papers. Of the 2773 collaborated papers, only 687 were collaborated at domestic and national levels, and the rest were at international level.

4 Objectives

The basic objectives of the prevalent research are to investigate the advancement of publications on "Digital Library" through scientometric research output analysis from 2006-2015, using following parameters:

- growth of publications year wise
- top most productive authors at world level
- top most prolific authors at national level
- most prolific source titles
- research publications in various subjects
- document type of publications
- significant keywords
- top twenty country's digital library research publications
- distribution of publications by language

5 Methodology

Scopus is prompt and vigorous world's leading citation database for the academic purposes for researchers, faculty and students etc. This study evaluates 'digital library' research output, using

different scientometric indicators, indexed in SCOPUS citations database during the last ten years 2006-2015. Total 17268 results were found related to the present study, which are retrieved through a generic search query "digital Library" used in the field's title, abstract, and keywords on 26 September 2016. The main search string was further restricted to "subject area tag", "country tag", "source title tag", and "affiliation tag", for distribution of publications data by subject, collaborating countries, organization wise and journal-wise, etc. The total results were processed and analyzed further under different sub-headings to get specific results. The main search string used for searching total records on digital library is as follows:

((TITLE-ABS-KEY (digital AND library) AND PUBYEAR > 2006 AND PUBYEAR < 2015))).

6 Data analysis and findings

The data retrieved through search query "digital Library" in the fields title, abstract, and keywords through Scopus is further adapted under diverse meta-data attributes. The entire data interpreted in the paper is properly analyzed, and presented in the form of tables and figures.

6.1 Growth of publications year wise

This study analyzes the year wise growth of publications and the same is given in Table-1

Table-1
Growth of publications year wise

Years	TP	%age
2006	1845	10.68
2007	1859	10.77
2008	1683	9.75
2009	1683	9.75
2010	1600	9.27
2011	1712	9.91
2012	1710	9.90
2013	1866	10.81
2014	1700	9.84
2015	1610	9.32
2006-15	17268	100%

Table -1 illustrates the year wise growth of publications for ten years 2006-2015 in the field of digital library, which comprised of 17268 publications. The highest number of publications listed was 1866 in the year 2013 with a margin of only 7 publications i.e.: 1859 in the year 2007. The total publications remained same in 2008 and 2009. The data also shows a declining slope of publications after 2013.

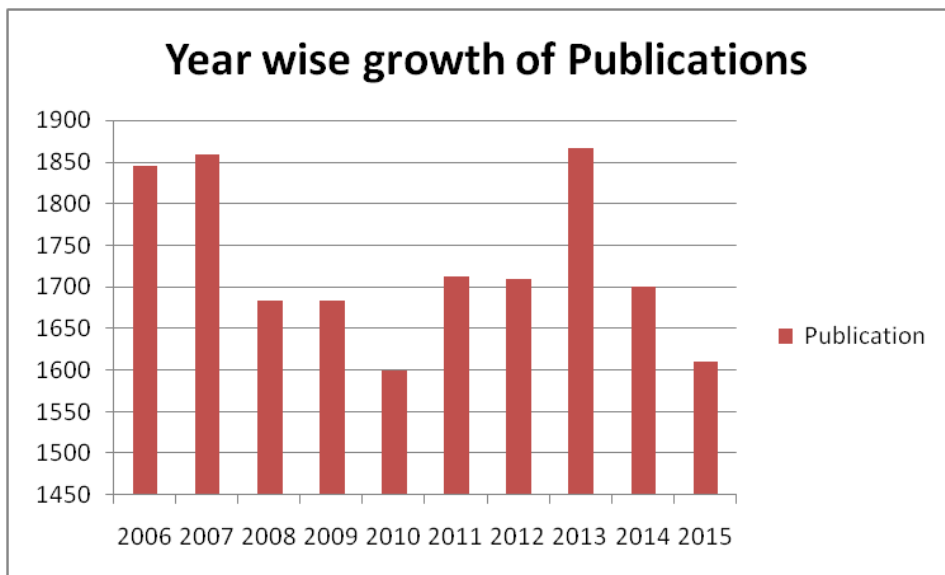


Figure 1: Growth of publications Year wise

6.2 Top most prolific authors at world level

The present study is analyzed to discuss the top most prolific authors at world level as highlighted in Table 2.

Table- 2
Top most prolific authors at world level

Name of the Author	No. of Publications	%age	Rank
Fox, E.A	81	0.47	1
Giles, C.L.	66	0.38	2
Nelson, M.L	51	0.29	3
Bainbridge, D.	46	0.27	4
Ferro, N.	45	0.26	5
Goh, D.H.L.	44	0.25	6

Agosti, M.	40	0.23	7
Furuta, R.	39	0.22	8
Gonçalves, M.A.	38	0.22	9
Buchanan, G.	37	0.21	10
Mitra, P.	37	0.21	10
Rauber, A.	36	0.21	11
Laender, A.H.F.	32	0.18	12
Joint, N.	31	0.18	13
Theng, Y.L.	31	0.18	13

Table-2 shows the international level authors in terms of productivity enumeration in a descending order. In the world ranking Fox, E.A. is on the lead with 81 Publications (0.47%); followed by Giles, C.L. with 66 (0.38%) publications. Nelson, M.L. and Bainbridge, D. are at third and fourth positions with 51 (0.29%) and 46 (0.27%) publications respectively.

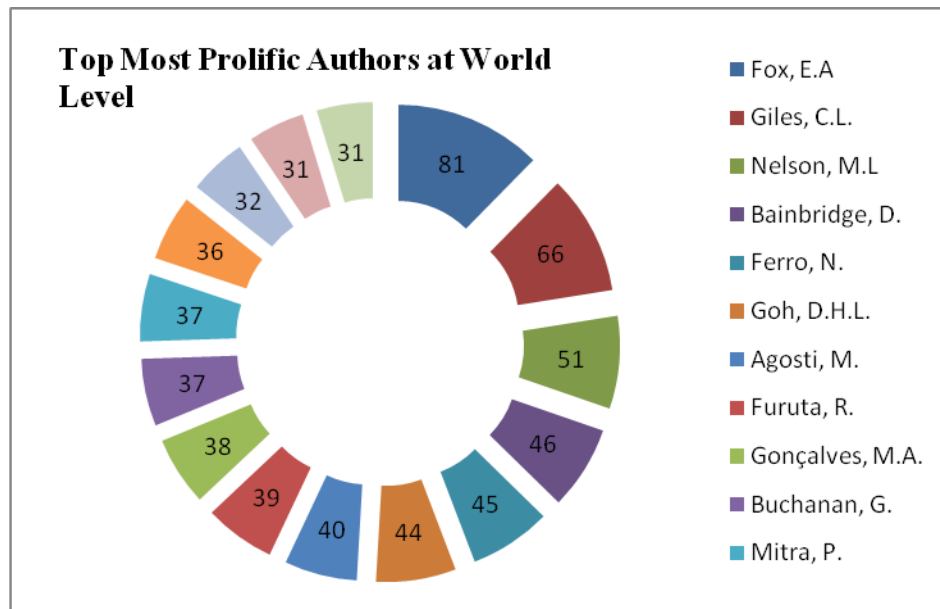


Figure 2: Top most prolific authors at world level

6.3 Top most prolific authors at national level

This study is evaluated to discuss the top most prolific authors at national level as displayed in Table 3.

Table- 3
Top Most prolific authors at national level

Name of the Author	Publications	Rank	%age(national ranking 622)
Urs, S.R.	10	1	1.61
Jawahar, C.V.	7	2	1.12
Varma, V.	6	3	0.96
Arora, J.	5	4	0.80
Bhat, N.	5	4	0.80
Ghosh, M.	5	4	0.80
Goswami, B.	5	4	0.80
Harish, B.P.	5	4	0.80
Patil, M.B.	5	4	0.80
Sharma, M.	5	4	0.80
Abirami, S.	4	5	0.64
Alawi, G.A.A.A.	4	5	0.64
Arora, S.	4	5	0.64
Bagchi, A.	4	5	0.64
Dasgupta, S.	4	5	0.64

From Table- 3, it is surveyed by the study that at Indian level ranking Urs, S.R. got first rank with 10 (1.61%) publications, followed by Jawahar, C.V. at second rank with 7 (1.12%) publications, Varma, V. with 6 (0.96%) publications at third position. Arora, J.; Bhat, N.; Ghosh M.;Goswami, B.; Harish, B.P.; Patil, M.B.; Sharma, M. are securing fourth rank with 5(0.80%) publications each. Abirami, S., Alawi, G.A.A.A., Arora, S., Bagchi, A. and Dasgupta, S. are at rank 5 with 4 (0.64%) publications each.

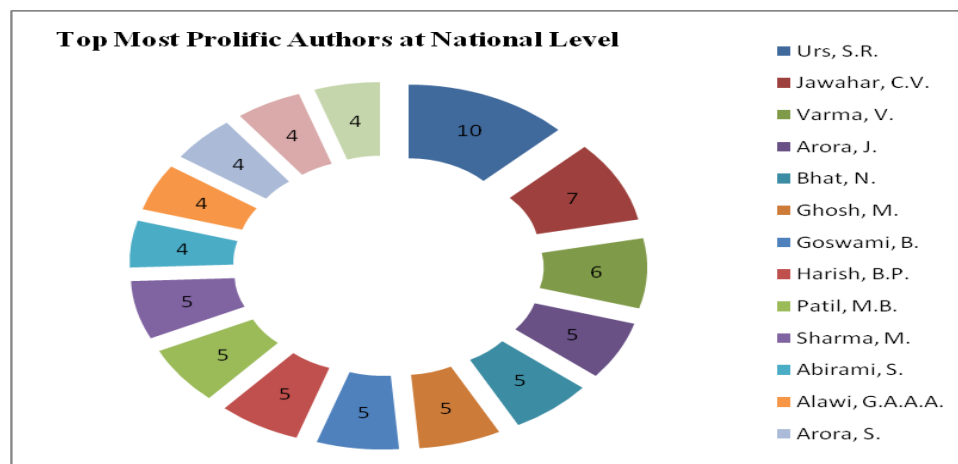


Figure. 3: Top most prolific authors at national level

6.4 Most prolific 25 source titles

The publication on “Digital Library” is analyzed in the most prolific source titles and the same is given in Table 4.

Table 4
Most prolific source titles

Source Title	Publications	Rank	%age
Lecture Notes in Computer Science including Subseries Lecture Notes n Artificial Intelligence And Lecture Notes in Bioinformatics	1602	1	9.28
Ceur Workshop Proceedings	890	2	5.15
Proceedings Of The ACM IEEE Joint Conference On Digital Libraries	651	3	3.77
Communications In Computer And Information Science	254	4	1.47
Proceedings Of The ACM International Conference On Digital Libraries	249	5	1.44
ACM International Conference Proceeding Series	198	6	1.15
Electronic Library	193	7	1.12
OCLC Systems And Services	147	8	0.85
D Lib Magazine	146	9	0.84
Library Hi Tech	135	10	0.78
Proceedings Of The Asist Annual Meeting	126	11	0.73
Proceedings Of SPIE The International Society For Optical Engineering	118	12	0.68
Applied Mechanics And Materials	101	13	0.58
Library Review	87	14	0.50
International Journal On Digital Libraries	86	15	0.50
Proc 9th Wseas Int Conf Simulation Modelling And Optimization Smo 09 5th Wseas Int Symp Grid Computing Proc 5th Wseas Int Symp Digital Libraries Proc 5th Wseas Int Symp Data Mining	85	16	0.49
Journal Of Library Administration	84	17	0.49
Journal Of Chemical Information And Modeling	83	18	0.48
Advanced Materials Research	82	19	0.47
Profesional De La Informacion	71	20	0.41
Serials Librarian	71	20	0.41
Plos One	70	21	0.40
Journal Of The American Society For Information Science And Technology	69	22	0.40
Program	67	23	0.39
New Library World	59	24	0.34

Table 4 determines the distribution of top 25 most publications covering digital libraries and allied areas. Lecture Notes in Computer Science produces the largest number of publications i.e. 1602 (9.28%) followed by Ceur Workshop Proceedings with 890 (5.15%) publications and Proceedings of the ACM IEEE Joint Conference on Digital Libraries are at third position with 651 (3.77%) publications. New Library World got rank 24 with 59 (0.34%) publications. The number of publications in workshops and proceedings shows that workshops and conferences are being organized to keep conversant with the recent advancements in the field.

6.4 Digital library research publications in various subjects

The present study also explains the digital library research publications in various subjects:

Table-5
Digital library research publications in various subjects

Subject	Publications	%age	Rank
Computer Science	9607	35.80	1
Social Sciences	5386	20.07	2
Engineering	3701	13.79	3
Mathematics	2267	8.45	4
Medicine	1045	3.89	5
Biochemistry, Genetics and Molecular Biology	796	2.97	6
Arts and Humanities	659	2.46	7
Physics and Astronomy	516	1.92	8
Business, Management and Accounting	398	1.48	9
Decision Sciences	367	1.37	10
Materials Science	326	1.22	11
Earth and Planetary Sciences	307	1.14	12
Chemistry	256	0.95	13
Agricultural and Biological Sciences	212	0.79	14
Chemical Engineering	188	0.70	15
Health Professions	159	0.59	16
Energy	128	0.48	17
Environmental Science	118	0.44	18
Multidisciplinary	85	0.32	19
Economics, Econometrics and Finance	64	0.24	20
Pharmacology, Toxicology and Pharmaceutics	56	0.21	21

Nursing	55	0.20	22
Psychology	39	0.15	23
Immunology and Microbiology	37	0.14	24
Neuroscience	30	0.11	25
Dentistry	19	0.07	26
Veterinary	9	0.03	27
Undefined	4	0.02	28

Table 5 notifies that publications on digital library have been spread out in 28 disciplines that include 4 undefined disciplines. Top five ranked disciplines where digital library publications published are 9607 (35.80%) in computer science; 5386 (20.07%) in social sciences; 3701 (13.79%) in engineering; 2267 (8.45%) in mathematics and 1045 (3.89%) publications are in medicine respectively. More than half of literature is published in computer science.

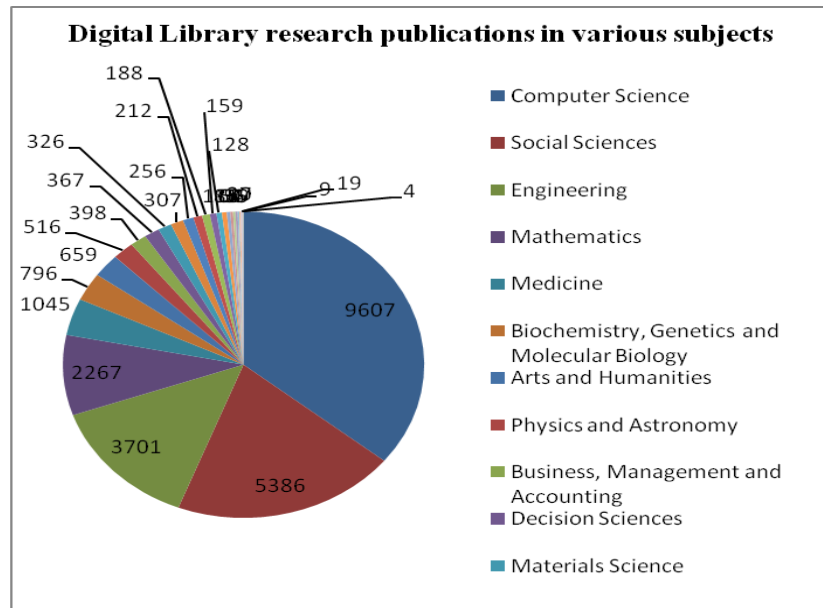


Figure 5: Digital library research publications in various subjects

6.5 Document type of publications

The study also identifies the type of publications published on “Digital Library” and the same is given in Table 6

Table 6
Document type of publications

Document Type	Publications	% age
Conference Paper	8730	50.56
Article	6386	36.98
Review	785	4.55
Book Chapter	587	3.40
Conference Review	285	1.65
Book	156	0.90
Editorial	134	0.78
Note	64	0.37
Short Survey	56	0.32
Article in Press	47	0.27
Letter	31	0.18
Erratum	6	0.03
Business Article	1	0.01
Total	17268	100

Table 6 indicates the division of publications in terms of documents types which are covering digital library and its related fields. More than 87% of the total publications related to digital library are published in Conference papers 8730 (50.56%) and articles 6386 (36.98%). Review, Book Chapter, Conference Review, Books, Editorial, Note, Short Survey, and Article in Press and so on published less than 13% of the total literature related to digital library during the period 2006 to 2015. More significant addition in the conference papers shows that conferences are being organized to keep abreast with the current advancements in this area and publish literature.

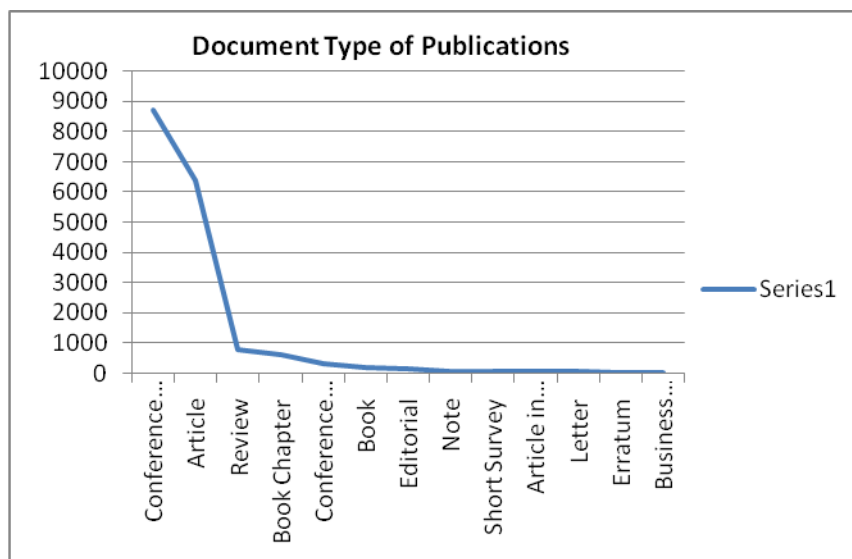


Figure. 6: Document Type of Publications

6.7 List of significant keywords

This study also notifies the list of significant keywords that are discussed in table 7.

Table 7
List of Significant Keywords

Sr. No.	Keywords	No.	Rank	%age	Sr. No.	Keywords	No.	Rank	%age
1.	Digital Libraries	9054	1	52.43	12.	Humans	683	11	3.95
2.	Information Retrieval	1271	2	7.36	13.	Information Services	643	12	3.72
3.	Libraries	1271	2	7.36	14.	Internet	613	13	3.55
4.	Metadata	1006	3	5.82	15.	World Wide Web	571	14	3.31
5.	Article	913	4	5.29	16.	User Interfaces	563	15	3.26
6.	Digital Library	748	5	4.33	17.	Information Management	517	16	2.99
7.	Digital Storage	722	6	4.18	18.	Research	513	17	2.97
8.	Search Engines	721	7	4.17	19.	Library	450	18	2.60
9.	Semantics	714	8	4.13	20.	Design	436	19	2.52
10.	Human	701	9	4.06	21.	Information Technology	411	20	2.38
11.	Algorithms	690	10	3.99	22.	Education	410	21	2.37

Table 7 focuses on 22 significant keywords (along with their frequency of occurrence) emerge in publications during 2006-15. These keywords throw light on the pattern of analysis and expedition in digital library.

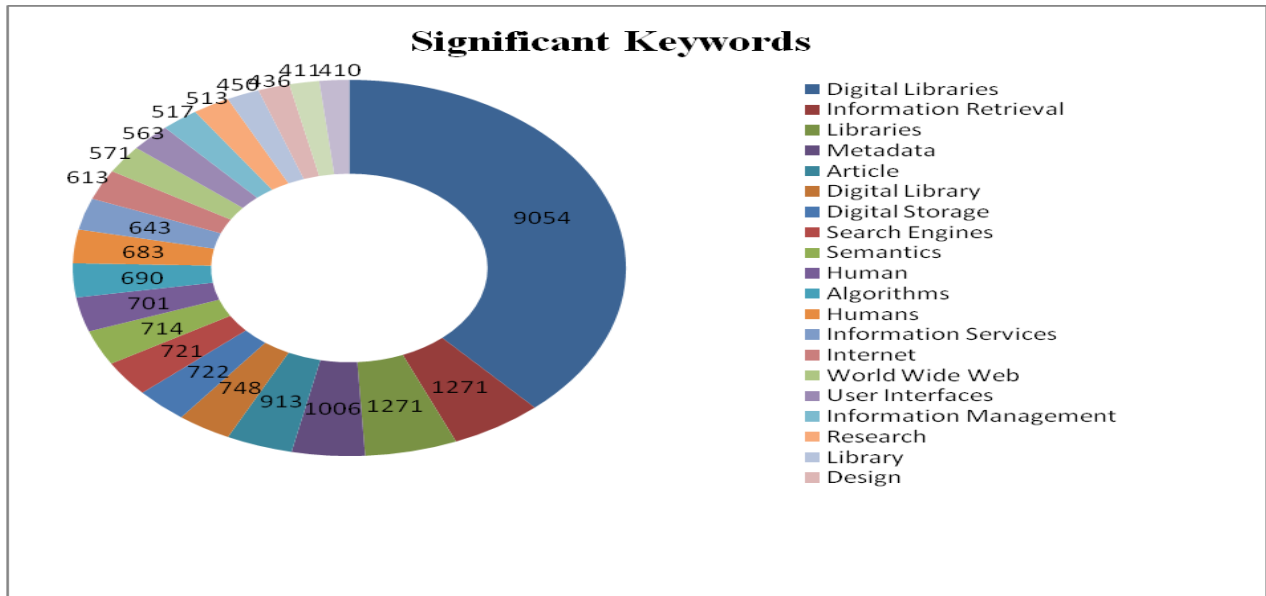


Figure 7: Top 22 significant keywords

5.8 Distribution of publications by country

The study is also focused to find out the number of publications produced on “Digital Library” and the same is given in Table 8

Table 8
 Country wise distribution of publications

Sr. No.	Country	No.	Rank	%age
1.	United States	5285	1	30.60
2.	China	1699	2	9.84
3.	United Kingdom	1176	3	6.81
4.	Germany	1053	4	6.10
5.	Italy	746	5	4.32
6.	Spain	637	6	3.69
7.	India	622	7	3.60
8.	France	604	8	3.50
9.	Canada	564	9	3.27
10.	Japan	388	10	2.25

11.	Australia	378	11	2.19
12.	Brazil	344	12	1.99
13.	Netherlands	330	13	1.91
14.	Taiwan	315	14	1.82
15.	Greece	301	15	1.74
16.	Switzerland	248	16	1.44
17.	South Korea	245	17	1.42
18.	Singapore	213	18	1.23
19.	Austria	208	19	1.20
20.	New Zealand	168	20	0.97

Table-8 indicates the distribution of research productivity by geographical regions. It notifies that larger part of publications 5285 (30.60%) were published in the United States, followed by China with 1699 (9.84%) publications, United Kingdom with 1176 (6.81%) publications, Germany with 1053 (6.10%) publications and Italy with 746 (4.32%) publications ranked first to fifth respectively. India is at seventh rank with 622 (3.60%) publications and so on.

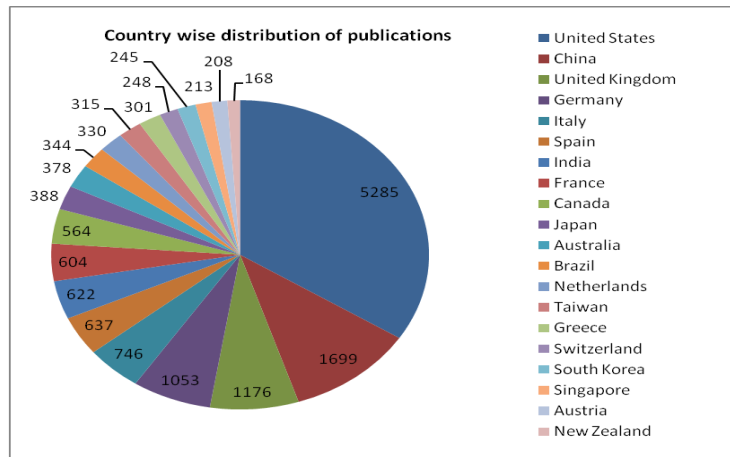


Figure 8: Country wise distributions of publications

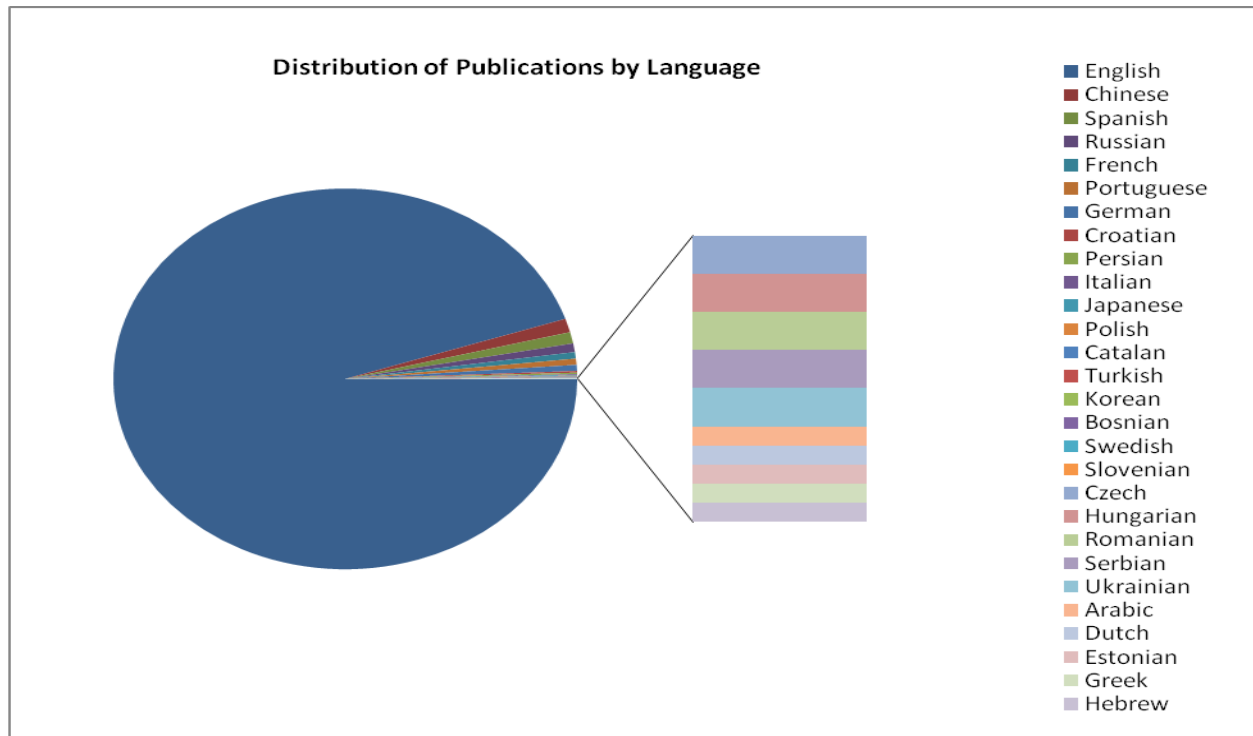
5.9 Distribution of publications by language

The study is also analyzed to find out the number of publications produced in various languages and the same is given in Table 9.

Table 9
Distribution of publications by language

Languages	No. of publications	Rank
English	16501	1
Chinese	201	2
Spanish	167	3
Russian	128	4
French	96	5
Portuguese	90	6
German	88	7
Croatian	25	8
Persian	23	9
Italian	12	10
Japanese	10	11
Polish	8	12
Catalan	8	12
Turkish	7	13
Korean	5	14
Bosnian	4	15
Swedish	4	15
Slovenian	3	16
Czech	2	17
Hungarian	2	17
Romanian	2	17
Serbian	2	17
Ukrainian	2	17
Arabic	1	18
Dutch	1	18
Estonian	1	18
Greek	1	18
Hebrew	1	18

Table 9 shows total publications propagated in diverse languages. Most number of the publications 16501 (Rank 1) were produced in English language. Few of the publications of are also indicated in other languages like French, Russian etc. It is further observed that only 201(Rank 2) of publications in Chinese, 167 (Rank 3) of publication in Spanish, 128 (Rank 4) of publications in Russian, 96 (Rank 5) of publications in French language were produced and so on.



7 Conclusion

Scientometric techniques are being used to know the potential and growth of a particular field. In the present study Scientometric techniques were applied to evaluate the research trends in digital library research that are presented in the form of tables and figures. It was observed that articles on digital library deals with different research areas. A total of 17268 were extracted from Scopus database to evaluate the growth of publications in the field, in terms authorship pattern, source titles, digital library research publication, document type of publications, publications by country and language etc. The present study concluded that year 2013 was found with maximum publications followed by year 2007. Maximum records have been produced by Fox, E.A. and Urs, S.R. at the world and national level respectively. Lecture Notes in Computer Science produces the largest number of publications, followed by Workshops and Proceedings. Digital library research publications in Computer Science are at the top followed by social sciences, engineering and mathematics etc. United States is the top most country to contribute research publications in the related field and English is one of the top most language used. The concept of digital libraries has emerged very fast and has received wider acceptance. Since the technology is upgrading itself every minute and hour, so the study recommends that the more research should

be made in the field of “Digital Library” by teachers, research scholars, scientists to increase the productivity of literature in the field under study.

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