ISSN (Print): 0972-2467
ISSN (Online): 0976-2477
SRELS Journal of Information Management, Vol 54(6), December 2017, p. 277-284 DOI: 10.17821/srels/2017/v54i6/120401

Bibliometrics of Information Technology: Yesterday, Today and Tomorrow

K.C. Garg[1*], Bebi[2] and Kavita[3]

[1]CSIR-National Institute of Science, Technology and Development Studies (CSIR-NISTADS), Dr K.S. Krishnan Marg, New Delhi – 110012, India; gargkc022@gmail.com
[2]Department of Library and Information Science, University of Delhi, Maurice Nagar, Delhi – 110007, India; bebi.mywork@gmail.com
[3]Maharaja Agrasen Institute of Technology, Sector 22, Rohini, Delhi – 100086, India; kavi.man.1999@gmail.com

Abstract

The study presents a bibliometric analysis of 270 papers presented at the international conference "Information Technology: Yesterday, Today and Tomorrow" organized by the Defence Scientific Information and Documentation Center (DESIDOC), Delhi, of the Defence Research and Development Organization (DRDO) during February 19-21, 2015. The study indicates that more than half of the total presentation was contributed by academic institutions (universities and colleges). Distribution of contributions by country and Indian States indicates that out of 270 papers, only seven were from foreign countries and rest 263 from India. Delhi topped the list among the contributing cities, while DESIDOC topped the list among the contributing institutions. Output of authors by gender indicates that male authors contributed more than female authors. The distribution of references cited in the papers shows that among the different information sources, journal citations were the highest and highest number of cited journals was in the discipline of library and information science. The highest number of cited journals was being published from the USA.

Keywords: Artificial Intelligence, Bibliometrics, Conference, Digital Services, Electronic Resources, Information Technology, Networking

1. Introduction

Different channels of information sources are used by scholars to publish their research findings. The two most important channels commonly used are publication of an article in a journal or to present the paper at a conference. A conference is generally a meeting of several people to discuss a particular topic. Most conferences have one or more keynote speakers who deliver the keynote speech and are usually eminent personalities in the related field. Conferences are usually composed of several presentations of research papers. These also feature panel discussions and round table discussions on several issues. Thus, conferences serve as an important medium of primary communication and dissemination of research results like a journal paper and bring new knowledge to the attention of the research community. The papers presented and discussions held at a conference are published as conference proceedings. Conference Proceedings are defined "as an official record of the things said and done at a conference or meeting"[1]. These are usually made available as a booklet or a CD-ROM containing the versions of the papers delivered at a particular conference. Several conferences are held every year on different fields of science, engineering and social sciences at national and international level in different parts of the globe. However, these vary in size and quality as several of the papers presented at these conferences are not peer reviewed.

Defence Scientific Information and Documentation Center (DESIDOC), Delhi, of the Defence Research and Development Organization (DRDO) organized a bilingual international conference during February 19-21, 2015 on the topic "Information Technology: Yesterday, Today and Tomorrow". The aim of the conference was to provide a roadmap, the information technology and its developers have followed in order to make it compatible with every day to day activity of the users.

*Author for correspondence

2. Review of Literature

Several studies dealing with bibliometric and citation analysis of individual journals are available in literature[2-5]. However, only a few studies dealing with bibliometric analysis of the conference proceedings have appeared in the literature. For instance, Bartneck and Hu[6] made a scientometric analysis of the CHI proceedings and found that the CHI conference has grown rapidly over the last 26 years. Only about 8 percent of the countries are responsible for 80 percent of the papers in the CHI proceedings with USA topping the list. Academic institutions followed by research institutions are the main contributors to CHI conference. Maximum number of papers was presented by Carnegie Mellon University (USA) during the 26 years. According to Shamir[7], a vast majority of the peer-reviewed publications in the disciplines of computer science and engineering are in the form of conference proceedings unlike other disciplines of science and technology, where the number of papers published is more in journals as compared to papers presented at conferences. The scientific impact and aging of conference proceedings in comparison to other form of scientific literature was examined by Lisse[8]. He found that the scientific impact of the proceedings is losing ground to other types of scientific literature in nearly all fields, but it has grown from 8% of the references in engineering papers in the early 1980s to 10% in recent years. Proceedings play an important role in computer sciences particularly, where they account for close to 20% of the cited references.

Recently, Garg and Kavita[9] made a bibliometric analysis of 650 papers presented at the International conference "the role of science and technology in global development" organized by DESIDOC from 5 to 7 December 2013 and found that the highest number of papers was presented by authors located at Delhi and affiliated to DESIDOC. Among all the papers presented at the conference about 25% were contributed by female authors. Garg and Bebi[10] also made an analysis of 74 papers presented at the international conference "content to connectivity: paradigm shifts in knowledge, innovation, information representation, information management systems and librarianship" held at Delhi and found that scholars affiliated with the University of Delhi presented the highest number of papers. Most of the authors were working library professionals or faculty at different library science institutions and 22% were female scholars.

3. Objectives

1. To examine the distribution of contributions by performing sectors;
2. To examine the geographical distribution of contributions by Indian states and cities;
3. To examine the distribution of contributions by institutions;
4. To examine the pattern of contributions of the papers presented by gender; and
5. To identify types of references appended to the papers presented in terms of type of documents, the country of origin and discipline of the cited journals and currency of their citations.

4. Data and Methodology

The source of data for the study was 270 papers that were presented orally at the international conference "Information Technology: Yesterday, Today and Tomorrow" organized by DESIDOC, Delhi from February 19-21, 2015. The bibliographic details of 111 papers which were published in Hindi were translated into English. The entire data for papers in English and Hindi was fed into MS-Excel for analyzing the bibliographic records. The parameters fed into the MS-Excel sheet were the name of the authors, the gender of contributing authors, name of the contributing institutions and the agency to which it belonged, their state and the city. Data was enriched with country of publication and the discipline of the cited journal. All the collected data were tabulated and analyzed to meet the objectives mentioned above. The methods of complete count were used in which all contributing authors or institutions have been given a unit credit. This helps in giving due credit to all participating institutions and authors. However, this results in inflation of data relating to the total number of authors and institutions than the actual number of papers. Straight count gives credit to first author and first institution only.

5. Results and Analysis

In the following paragraphs findings of the study have been presented.

5.1 Distribution of Contributions by Performing Sectors

Since independence, India has developed a vast infrastructure for science and technology. Several agencies involved in scientific research in India are universities and institutes of higher learning like Indian Institutes of Technology (IITs) including National Institutes of Technology (NITs) and other engineering

colleges, medical colleges and hospitals. Besides these, government funded laboratories under the aegis of different agencies like the Council of Scientific and Industrial Research (CSIR), Department of Atomic Energy (DAE), Department of Science and Technology (DST), Department of Biotechnology (DBT), Defence Research and Development Organization (DRDO), Indian Council of Agriculture Research (ICAR) and Indian Council of Medical Research (ICMR) etc contribute to Indian scientific output. Analysis of data on the distribution of contributions according to different performing sectors is given in Table 1. It indicates that like scientific output[11], academic institutions (universities and colleges) were the highest contributors with 41.3% of the papers presented at the conference. This was followed by contributions from engineering colleges (19%) closely followed by DRDO (18.2%), the sponsoring agency of the conference, and ICAR (7.8%). The share of other performing sectors like CSIR, DST, DAE and medical colleges were minuscule as these together contributed approximately 13.7% of the total share of the papers. In all type of papers presented at the conference under different themes listed in Table 1, the largest number of papers was contributed by academic institutions. There was no significant difference in the number of papers presented by delegates from engineering colleges and DRDO.

5.2 Distribution of Contributions by Country and Indian States

The analysis of data by institutional affiliation of authors indicates that of the 270 papers presented at the conference only seven were contributed by authors from UK (4) and one each from USA, New Zealand and Saudi Arabia and the rest 263 by authors from India. Table 2 depicts the distribution of contributions in English and Hindi language by Indian states. The number of papers presented in English language was significantly higher than those presented in Hindi language. Of all the states, highest (26.1%) contributions came from Delhi, the venue of the conference. This was followed by Uttar Pradesh (16%) and Madhya Pradesh (12.2%). These three states together contributed more than half (54.3%) of the total papers. Remaining 45.7% papers were contributed by other 15 states. Further analysis of data depicted in Table 2 indicates that the proportion (percent) of total contributions in English and Hindi languages were almost equal from Delhi, Madhya Pradesh, Maharashtra, Rajasthan and Haryana. However, it differed considerably for Uttar Pradesh, Punjab and Tamil Nadu. Most of the papers presented from Uttar Pradesh were in Hindi, while papers presented by contributors from the states of Punjab and Tamil Nadu were in English language.

5.3 Distribution of Contributions According to Indian Cities

The total presentations came from 93 cities located in different states of India. Table 3 lists 10 cities which contributed seven or more papers. Data presented in Table 3 indicates that the highest (96) number of contributions came from institutions located in Delhi/ New Delhi, the venue of the conference. The 10 cities listed in Table 3 contributed more than half (54.3%) of the total papers presented at the conference. Remaining 44.7% contributions came from other 83 cities. Thus, it can be concluded that delegates who presented the papers

Table 1. Distribution of contributions by performing sectors

#	Themes	TNP	AI	DRDO	ENGC	ICAR	Others	Total
1	Electronic Resources and Digital Services (E)	45	32	19	14	8	5	78
2	Artificial Intelligence and Network Security (E)	50	20	17	26	-	-	63
2	Managing Information Technology (E)	64	41	7	21	2	8	79
4	*Soochna and Samaj (H)*	48	26	6	2	15	11	60
5	*Soochna Prabandhan* (H)	35	18	9	7	4	17*	55
6	*Soochna Pradyogiki: Kal, Aaj and Kal* (H)	28	18	10	1	-	4	33
	Total	270	155	68	71	29	45	368**

E: English, H: Hindi TNP: Total number of papers, AI: Academic institutions, ENGC: Engineering colleges,
* Include 7 papers by individuals not affiliated to any sector. Others include institutions under CSIR, DAE, DST and medical colleges.
** The number of papers is more than the actual number of papers, because authors have used the method of complete counting which inflates the total output as several papers counted more than one time.

concentrated in only in few cities.

Table 2. Distribution of contributions by different Indian States in English and Hindi language

Sl. No.	State	English (E)	Hindi (H)	Total
1	Delhi	57 (26.3)	39 (25.8)	96 (26.1)
2	Uttar Pradesh	21 (9.7)	38 (25.2)	59 (16.0)
3	Madhya Pradesh	24 (11.1)	21 (13.9)	45 (12.2)
4	Maharashtra	17 (7.8)	12 (7.9)	29 (7.9)
5	Rajasthan	15 (6.9)	11 (7.3)	26 (7.1)
6	Punjab	23 (10.6)	0 (0.0)	23 (6.3)
7	Haryana	14 (6.4)	8 (5.3)	22 (6.0)
8	Tamil Nadu	19 (8.8)	1 (0.7)	20 (5.4)
	Others*	28 (12.9)	18 (11.9)	46 (12.5)
	Total	217 (59)	151 (41)	368 (100)

* Bengal 7(E) 2(H), Karnataka 6(E) 2(H), Andhra Pradesh 3(E) 4(H), J&K 3 each (E&H), Gujarat 5 (H), Kerala 3 (E) 1(H), Chhattisgarh and Assam 3(E), Himachal Pradesh 2(E), Uttrakhand 1(H)

Table 3. Distribution of contributions by Indian cities

Sl. No.	Name of the city	No. of papers
1	Delhi/New Delhi	96
2	Indore	18
3	Patiala	17
4	Gwalior	12
5	Lucknow	11
6	Jaipur	10
7	Mumbai	10
8	Varanasi	10
9	Chennai	9
10	NOIDA/G. NOIDA	7
	Total	200
11	Cities contributing 6 papers each = 7	42
12	Cities contributing 5 papers each = 3	15
13	Cities contributing 4 papers each = 3	12
14	Cities contributing 3 papers each = 6	18
15	Cities contributing 2 papers each = 21	42
16	Cities contributing 1 papers each = 39	39
	Grand Total	368

5.4 Distribution by Contributing Institutions

An analysis of data on contributing institutions indicate that the total output came from 204 academic and research institutions located in different parts of India. Table 4 lists 16 institutions which contributed 4 or more papers. These 16 institutions contributed more than one-third (35.3%) of the papers discussed at the conference. The remaining 238 (64.8%) of the papers were contributed by 168 institutions located in different parts of the country. Among these institutions, as many as 148 institutions contributed only one paper and the rest contributed two or three papers. Among the top 16 institutes, the highest (40) were contributed by the Defence Scientific Information and Documentation Centre (DESIDOC), the organizing institute of the conference. The share of DESIDOC was about 10.8% of the total contributions.

Table 4. Distribution of contributions by institutions

Sl. No.	Name of the institution	No. of papers
1	DESIDOC (Delhi)	40
2	Chitkara University (Patiala)	17
3	Banaras Hindu University (Varanasi)	8
4	Scientific Analysis Group (Delhi)	7
5	Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya (Gwalior)	6
6	Banasthali University (Banasthali)	6
7	Baba Shaib Bheemrao Ambedkar University (Lucknow)	6
8	Central Electronics and Electrical Research Institute (Pilani)	5
9	Gujrat Central University (Gandinagar)	5
10	Directorate of Soyabean Research (Indore)	5
11	Mahatama Gandhi International Hindi University (Wardha)	5
12	Bharati Vidayapeeth's College of Engineering (Delhi)	4
13	Devi Ahilya Vishwavidyalaya (Indore)	4

14	Indian Institute of Technology (Mumbai)	4
15	National institute of Technology (Kurkshetra)	4
16	Tilak Mahavidyalaya (Pune)	4
	Total	130
	Institutions contributing 3 papers each (10)	30
	Institutions contributing 2 papers each (30)	60
	Institutions contributing 1 papers each (148)	148
	Total	368

5.6 Sub-Disciplines of Papers Presented

The total 270 papers presented at the conference can broadly be classified into 19 sub-disciplines. The number of papers discussed in different sub-disciplines is listed in Table 6. It indicates that the highest number of papers dealt with information and communication technology and its application to library and information services and society, followed by applications of information technology to society like empowerment of women, accounting and banking, spread of education in Hindi and Sanskrit, agriculture, animal husbandry and rural development etc.

5.6 Document Type of Cited References

The 270 papers presented at the conference cited 2750 different types of sources. Table 7 presents the distribution of references cited in six different themes. It indicates that 599 journal titles were cited 1044 times and occupied the first rank, making about (38%) of all citations. It was followed by websites and books which constituted about 20% and 18.7% of the cited literature respectively. Citation of website references has increased in the recent past[12]. These three type of cited documents constitute more than three fourth (76.7%) of all citations. Conference papers are an integral part of information technology literature. Hence, these were prominently cited in Artificial Intelligence and Network Security and Managing Information Technology, which published papers related to information and communication technology. The papers published in Hindi language documents cited less number of journal articles. Further analysis of data on reference per paper (R/P) indicates that it was highest for Artificial Intelligence and Network Security and lower than the average for documents published in Hindi language. It was lowest for *Soochna Prabandhan*. The citation per paper for Hindi documents was low because these papers were written in popular language for the understanding of a common man.

5.7 Discipline of the Cited Journals

The cited 599 journals belonged to 31 different sub-disciplines of science, technology and social sciences. The highest (85) number of journals were in the discipline of library science followed by computer science (75) and communication science, engineering and technology and agriculture sciences each 40. Thus, the number of journals cited from these five disciplines constituted about half (46.7%) of the cited journals. Remaining journals belonged to multidisciplinary sciences (37), material sciences (29), medicine (24), artificial intelligence (21), chemistry (20), physics (18), information technology (17), management and networks each 16, mathematics (15) and electronics (11). In remaining 14 disciplines, the number of journals cited varied between 4 and 9. Since three fourth (76.7%) of journals cited were in electronic resources and digital services, artificial intelligence and network security and managing information technology, hence large number of journals cited belonged to these disciplines.

Table 5. Distribution of authors by gender

Sl. No.	Title	Male author	Female authors	Total authors (Female %)	Papers Male/Female (Collaborative)
1	Electronic Resources and Digital Services	51	30	81 (37.0)	25/13 (7)
2	Artificial Intelligence and Network Security	88	29	117 (24.8)	29/5 (16)
3	Managing Information Technology	84	60	144 (41.7)	25/10 (29)
4	*Soochna and Samaj*	64	27	91 (29.6)	33/7 (8)
5	*Soochna Prabandhan*	38	20	58 (34.5)	18/7 (10)
6	*Soochna Pradyogiki: Kal, Aaj and Kal*	40	16	56 (28.5)	16/5 (7)
	Total	365	182	547 (33.3)	146/47 (77)

Table 6. Distribution of output by sub-disciplines

#	Sub-disciplines	No. of papers
1	Applications of ICT to library and information services and society	43
2	Information Technology and its applications	26
3	Advance computing	18
4	Electronics	13
5	Artificial intelligence	12
6	Networking and network security	12
7	Cryptanalysis	11
8	Managing of E-resources	11
9	Bibliometrics	10
10	Cyber security	10
11	User behavior towards E-resources	9
12	Communication	8
13	Digital technologies and their use in library and information centers	8
14	Social media, its uses and abuses	7
15	Data warehousing and data mining	6
16	Software engineering	6
17	Librarianship	6
18	Machine translation	5
19	Others	49
	Total	270

Table 7. Distribution of cited references by document types

Sl. No.	Title	J	B	C	W	R	T	O*	Total	R/P
1	Electronic Resources and Digital Services	257	52	32	137	10	5	7	500	11.1
2	Artificial Intelligence and Network Security	270	86	213	75	22	12	43	721	14.4
2	Managing Information Technology	275	132	133	124	6	0	3	673	10.5
4	*Soochna and Samaj*	128	124	10	68	16	3	29	378	7.8
5	*Soochna Prabandhan*	62	32	7	93	1	3	10	208	5.9
6	*Soochna Pradyogiki: Kal, Aaj and Kal*	52	90	45	50	11	8	14	270	9.6
	Total	1044	516	440	547	66	31	106	2750	10.2

J: Journals including magazines, B: Books, C: Conference papers, W: Websites, R: Reports, T: Theses, *O include newspaper citations also, R/P: reference per paper

5.8 Country of Origin of Cited Journals

The 599 cited journals originated from 39 developed and developing countries including India. Table 8 lists eight countries where from most cited journals were published. Indian authors cited journals published mainly from USA and UK. The number of journals cited from the USA constituted more than one-third (36.9%) of the cited journals followed by UK making about 18.5% of the total cited journals. Journals cited from India ranked third. The data presented in Table 8 also indicates that of the total 1044 citations about 70% citations were from USA, UK and India. Rest of the citations was to journals

published from other remaining 31 countries. Table 9 lists 37 journals which were cited more than five times. It indicates that of these 10 were published from the USA followed by journals published from India (8), the Netherlands (6) and UK (5). Rest cited journals were from other countries. Highest number of cited journals was in the discipline of library and information science.

Table 8. Distribution of journals by country of origin of journals

Sl. No.	Country of origin of the journal	Number of journals	Number of citations	Citations per journal
1	USA	221	342	1.5
2	UK	110	187	1.7
3	India	96	203	2.1
4	The Netherlands	64	116	1.8
5	Germany	12	17	1.4
6	Singapore	10	12	1.2
7	China	7	7	1.0
8	Switzerland	5	10	2.0
9	Other 31 countries	74	150	2.0
	Total	599	1044	1.7

Table 9. Most cited journals

Sl. No	Title of the journal	Times cited	Country of publication
1	The Electronic Library	20	UK
2	Annals of Library and Information Studies	19	India
3	KURUKSHETRA	19	India
4	DESIDOC Journal Library Information Technology	14	India
5	Journal of Hydrology	14	NLD*
6	Library Hi Tech	14	UK
7	Bulletin of the Medical Library Association	12	USA
8	Image Communication	11	NLD*
9	YOJANA	11	India
10	ILA Bulletin	9	India
11	IEEE Photon. Technol. Letter	8	USA
12	DESIDOC Bulletin of Information Technology	7	India
13	International Journal of Intelligent Systems	7	UK
14	Library Philosophy and Practice	7	USA
15	Advanced Materials Research	6	CH**
16	College and Research Libraries	6	USA
17	Computer Networks	6	NLD*
18	Electronic Letters	6	UK
19	GRANTHALAYA VIGYAN	6	India
20	IEEE Communication Surveys and Tutorials	6	USA
21	IEEE Transactions on Communication	6	USA
22	IEEE Transactions on Wireless Communication	6	USA
23	Water Resource Management	6	NLD*
24	Ad hoc Networks	5	NLD*
25	Communication of the ACM	5	USA
26	IEEE Transactions on Knowledge and Data Engineering	5	USA
27	Library Review	5	UK
28	Online Information Review	5	UK
29	Scientific American	5	USA
30	Scientometrics	5	NLD*
31	SERLS Journal of Information Management	5	India

*NLD: The Netherlands, **CH: Switzerland

Table 10. Currency of citations

Sl. No.	Years	No. of references	Percent
1	Prior to 1980	21	2.0
2	1981-1990	30	2.9
3	1991-2000	121	11.6
4	2001-2005	183	17.5
5	2006-2010	307	29.4
6	2011-2014	351	33.6
7	References for which years were not available	31	3.0
	Total	1044	100

5.9 Currency of Citations

Cited references for journals were analyzed for the years these were cited. These have been divided into seven periods mentioned in Table 10. An analysis of data by years of citations of the 1044 journal citations in Table 10 indicates that 80.5% of citations were to the papers

published during 2001-2014 and rest 19.5% were to papers published prior to 2001. This analysis indicates that Indian scholars cited current journal literature.

6. Conclusion

Based on the analysis of 270 papers presented at the conference under different themes indicates that like output in science and technology, academic institutions are the most prolific contributors followed by engineering colleges and DRDO. Academic institutions contributed more than half of the total presentation. Among the states, Delhi made one-fourth of the presentations followed by Uttar Pradesh. These two states together made about 40% of the total presentations. DESIDOC, the organizing institute of the conference contributed the highest (40) number of papers followed by Chitkara University. Distribution by gender of contributors indicate that one-third of the contributors were female, indicating an active participation by female scientists in IT research. Pattern of citations by the type of documents indicates that journals constituted the highest number of cited references followed by books and conference papers. Most of the cited journals originated from USA, UK and India. The highest number of cited journals belonged to the discipline of library and information sciences and cited references were of recent period.

7. References

1. Ali A. (2006). Ane's Encyclopedic Dictionary of Library and Information Science,1, New Delhi, Ane Books India, p. 206.
2. Kumar A, Prakasan ER, Kalyane VL and Kumar V. (2008). Pramana: A Journal of Physics, Annals of Library and Information Studies. 55(1): 201–11.
3. Garg KC, Sharma P and Kumar S. (2008) Scientometric profile of the journal Mausam, Annals of Library and Information Studies. 55(1):76–80.
4. Kumar M and Moorthy AL. (2011). Bibliometric analysis of DESIDOC Journal of Library and Information Technology during 2001-2010, DESIDOC J. Lib. and Inf. Technol. 31(3):203–08.
5. Garg KC and Anjana AK. (2014). Journal of intellectual property rights: A bibliometric study, DESIDOC J. Lib. and Inf. Technol. 34(1):66–73.
6. Bartneck C and Hu J. (2009). Scientometric analysis of the CHI proceedings. Proceedings of the Conference on Human Factors in Computing Systems (CHI2009), Boston, p. 699–708. DOI: Crossref.
7. Shamir L. (2010). The Effect of Conference Proceedings on the Scholarly Communication in Computer Science and Engineering. Scholarly and Research Communication. 1(2). Retrieved on 10 March, 2017. Available at: www.src-online.ca. Crossref.
8. Lisee C, Lariviere V and Archambault E. (2008). Conference proceedings as a source of scientific information, Journal of the American Society for Information Science and Technology. 59(11):1776–84. Crossref.
9. Garg KC and Kavita. (2015). A Bibliometric study, Papers presented at the International Conference The Role of Science and Technology in Global Development, LIS Links, 1(4):2–8.
10. Garg KC and Bebi. (2015). Content to connectivity: Paradigm shifts in knowledge innovation, information representation, information management systems and librarianship, Library Herald. 53(4):414–23. Crossref.
11. Garg KC, Dutt B and Kumar S. (2006). Scientometric profile of Indian science as seen through Science Citation Index, Annals of Library and Information Studies. 53(3):114–25.
12. Madani S., Carnevale RJ, Duda S, Feyder M and Aronsky D. (2006). Prevalence and inaccessibility of URLs in the biomedical literature. In: AMIA Annual Symposium Proceedings, p. 1019. American Medical Informatics Association, 2006. PMCid: PMC1839732.