Annals of Library and Information Studies 49,1; 2002; 23-27

INSTITUTIONAL DISTRIBUTION IN COMPUTER SCIENCE RESEARCH IN INDIA: A STUDY

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ABSTRACT

The study is based on 1408 research papers published in the international journals on computer sciences contributed by the Indian scientists from 1991 to 2000. The institutional distribution of research has been studied. The scatter of literature is a two-way process controlled by number of institutions contributing literature and the number of journals publishing these contributions. However, major portion of these contributions, as per the analysis, comes from a few institutions, like IITs (located at Kharagpur, Kanpur, Delhi, Chennai and Mumbai), Indian Statistical Institute at Kolkata and Indian Institute of Science (IISc) at Bangalore. The study shows that India has potential of carrying out computer science research of international standard.

KEYWORDS - *Institutional distribution; Computer science research; Research trend; Scientometrics.*

INTRODUCTION

The performance of an institution can generally be measured through the number of research papers in the peer-reviewed journals emanating from that institution. The institution, which is generating a good number of research papers in a particular field, may be considered as a frontier institution in that field.

Four tiers of institutions conduct computer science research in India: (i) Institutions of national importance, e.g. IITs, IISc and ISI; (ii) Academic institutions, like, universities, colleges, deemed universities (iii) Government-sponsored R&D institutions and (iv) Industry-sponsored R&D laboratories.

The institutions belonging to first two tiers are contributing most research papers in the peer-reviewed journals in the concerned field. These two tiers of institutions are engaged in academic research as well as result-oriented applied research.

OBJECTIVES

The objectives of the study are to find out:

- Most productive research institutions
- Rank of the institutions in this field

SCOPE

This study covers 1408 research articles published in *Science Citation Index* (*SCI*)-covered international journals in computer science from 1991 to 2000. Only research papers have been considered for the study. *SCI* covers about 150 to 200 journals in the field of computer science, which varies year to year. *SCI* covers most significant research

journals in this field. *SCI* does not cover any Indian computer science journals. Those journals not covered by *SCI* could not be included in this study.

METHODOLOGY

Data pertaining to 1991 to 2000 was downloaded from the annual CD versions of the *Science Citations Index* (SCI). The search from SCI was executed through Boolean searching procedure, which is described below:

- At first, address search was carried out by the term *India*. (Set 1)
- Then the searches by the journal names were carried out. For example, *Fuzzy Sets and Systems*.
- Then all the journal names were combined by the operator *OR*. Limited journal names could be taken for a single set. For example, *Fuzzy Sets and Systems OR Computers & Mathematics OR* ……. (Set 2)
- Then address and journal names have been combined into a new set through the operator *AND*, like, *Set 1 AND Set 2*.

In this way all the research papers contributed by Indian scientists in the last ten years were downloaded and saved in custom format with the following fields: authors, title, source, doc-type, cited reference and address, in comma delimited form and saved in report files.

Then data was converted into database files in MS-FoxPro. For extracting data, a number of FoxPro programmes were written and executed to get the summarised and cumulative data. The data were next rearranged from MS-FoxPro database files into MS-Excel worksheets to analyse, to compare and to collate the results.

RESULTS AND ANALYSIS

In the present study it is found that a number of institutions were involved in computer science research in India during 1990s. Table 1 shows the top fifteen institutions from 1991 to 1995. Table 2 shows the top fifteen institutions from 1996 to 2000. In the first half of 1990s Indian Institute of Science secured first rank and contributed 11.96% of total research output. Indian Statistical Institute and Indian Institute of Technology, Kharagpur secured second rank and each one contributed 11.64% of total research output. University of Delhi secured third rank contributing 7.81% of total research output. Other institutions in accordance with their descending order of rank are IIT Madras, IIT Delhi, IIT Kanpur, University of Calcutta, IIT Bombay, Visva Bharati, Jadavpur University, Harcourt Butler Technological Institute (HBTI) Kanpur, TIFR, Tripura University and Banaras Hindu University. These fifteen institutions contributed 75.1% of total research output.

Table 1: Top Fifteen Institutions in 1991 to 1995

Sl. No.	Rank	Univ./ Institute	1991	1992	1993	1994	1995	Total	%
1	1	IISc	7	14	12	20	22	75	11.96
2	2	ISI	3	22	8	21	19	73	11.64
3	2	IIT Kharagpur	6	25	14	13	15	73	11.64
4	3	Univ. of Delhi	7	19	11	7	5	49	7.81
5	4	IIT Madras	6	5	3	10	17	41	6.54
6	5	IIT Delhi	3	7	6	6	5	27	4.31
7	6	IIT Kanpur	4	4	5	5	4	22	3.51
8	6	Univ. of Calcutta	7	5	4	3	3	22	3.51
9	7	IIT Bombay	3	4	4	4	4	19	3.03
10	8	Visva Bharati	1	6	5	4	2	18	2.87
11	9	Jadavpur Univ.	3	3	2	2	3	13	2.07
12	10	HBTI Kanpur	4	3	1	3	0	11	1.75
13	11	TIFR	1	0	2	1	6	10	1.59
14	11	Tripura Univ.	1	4	5	0	0	10	1.59
15	12	BHU	1	1	0	3	3	8	1.28

Table 2: Top Fifteen Institutions in 1996 to 2000

Sl. No.	Rank	Univ./ Institute	1996	1997	1998	1999	2000	Total	%
1	1	ISI	16	17	30	15	18	96	12.29
2	2	IISc	13	13	13	19	25	83	10.63
3	3	IIT Kharagpur	10	15	17	14	16	72	9.22
4	4	IIT Madras	13	13	8	8	17	59	7.55
5	5	IIT Delhi	8	12	10	10	9	49	6.27
6	6	IIT Bombay	6	6	14	11	8	45	5.76
7	7	IIT Kanpur	9	5	10	4	13	41	5.25
8	8	IMSc	3	7	1	2	4	17	2.18
9	9	TIFR	2	5	3	1	5	16	2.05
10	10	Univ. of Delhi	3	1	4	3	4	15	1.92
11	11	Jadavpur Univ.	3	2	5	1	3	14	1.79
12	12	Univ. of Calcutta	2	2	2	3	1	10	1.28
13	13	Visva Bharati	3	1	0	3	1	8	1.02
14	13	JNU	2	2	2	2	0	8	1.02
15	14	BHU	0	0	4	0	3	7	0.90

Table 2 shows the top fifteen institutions from 1995 to 2000. In the second half of 1990s Indian Statistical Institute secured first rank and contributed 12.29% of total research output. Indian Institute of Science secured second rank and contributed 10.63% of total research output. Indian Institute of Technology, Kharagpur secured third rank and contributed 9.22% of total research output. Other institutions in accordance with their descending order of rank are IIT Madras, IIT Delhi, IIT Bombay, IIT Kanpur, Institute of Mathematical Sciences (IMSc), TIFR, University of Delhi, Jadavpur University,

University of Calcutta, Visva Bharati, Jawaharlal Nehru University (JNU) and Banaras Hindu University. These fifteen institutions contributed 69.13% of total research output.

Table 3: Top Twenty Institutions in 1991 to 2000

Sl. No.	Rank	Univ./ Institute	Total	%
1	1	ISI	169	12.00
2	2	IISc	158	11.22
3	3	IIT Kharagpur	145	10.30
4	4	IIT Madras	100	7.10
5	5	IIT Delhi	76	5.40
6	6	Univ. of Delhi	64	4.55
7	6	IIT Bombay	64	4.55
8	7	IIT Kanpur	63	4.47
9	8	Univ. of Calcutta	32	2.27
10	9	Jadavpur Univ.	27	1.92
11	10	Visva Bharati	26	1.85
12	10	TIFR	26	1.85
13	11	IMSc	24	1.70
14	12	BHU	15	1.07
15	13	IICT	12	0.85
16	13	JNU	12	0.85
17	14	HBTI	11	0.78
18	14	Tripura Univ.	11	0.78
19	15	Madras Univ.	9	0.64
20	15	BE College	9	0.64

Table 1 and Table 2 collectively show the progress of research and the changing rank of institutions. Institutions like Indian Statistical Institute, IIT Bombay, Institute of Mathematical Sciences (IMSc), JNU, TIFR, etc. improved their rank, whereas institutions like, Indian Institute of Science, IIT Kharagpur, University of Delhi, University of Calcutta, etc. declined in their rank over the second half of last decade as compared to the first half. The top fifteen institutions have less percentage of research output in the second half of last decade as compared to the first half.

Table 3 shows the top twenty institutions during the last decade. It shows the cumulative total and its percentage over the total research output. Table 3 depicts that Indian Statistical Institute secured first rank and contributed 12% of total research output. Indian Institute of Science secured second rank and contributed 11.22% of total research output. Indian Institute of Technology, Kharagpur secured third rank and contributed 10.3% of total research output. Other institutions in the list of top twenty in accordance with their descending order of rank are IIT Madras, IIT Delhi, University of Delhi, IIT Bombay, IIT Kanpur, University of Calcutta, Jadavpur University, Visva Bharati, Tata Institute of Fundamental Research, Institute of Mathematical Sciences Chennai, Banaras Hindu University, Indian Institute of Chemical Technology, Hyderabad, Jawaharlal Nehru

University, HBTI Kanpur, Tripura University, Madras University and BE College, Howrah. These twenty institutions contributed 74.79% of the total research output. Two institutions, IICT and BE College, which did not find place in the top fifteen institutions (Table 1 and Table 2), but found their ranks in the top twenty institutions (Table 3).

Table 1 to Table 3 show the top ranked institutions based on their research works published in various international journals. Mostly either first-tier institutions or second-tier institutions have secured ranks in these Tables. Third-tier and fourth-tier institutions, except IMSc, TIFR and IICT, do not figure here. However, this does not mean that they carry out less research works. Mostly, they are engaged in result-oriented research which are applied in nature and their research output is not in the form of publication of research articles in the international journals, rather in the forms of patent, software-copyright, standard, etc.

CONCLUSION

India is developing its technological capabilities in CS and is participating in CS research programmes for providing indigenous solutions to various thrust areas besides other areas. Since independence India has set up a vast S&T infrastructure in the country for human resource development as well as for R&D activities towards achieving technological self-support. This includes setting up of a chain of national laboratories under various central government bodies, like, MIT (earlier known as DOE), CSIR, DRDO, ISRO, DoS, DAE, DST, etc. Indian universities, numbering nearly 400 along with the R&D organisations continuously cater to the scientific and technological need of the nation.

To conclude, it can be said that Indian CS research has potential to produce trail-blazing innovations of international standards. The enhancement of national capabilities through domestic and international collaboration by the top ranked institutions has been observed in this study. The institutions, like IIITs, which are established very recently to provide state-of-the-art research facilities as well as academic excellence, are expected to enhance India's R&D capabilities in CS and information technology. So far, Indian CS research is keeping pace with international standard and it holds a good and established position in comparison with other developing countries.

ACKNOWLEDGEMENT

The author is highly grateful to Mr. O. N. Chaddha, Director, INSDOC and Mrs. T.A. Pandalai, Documentation Officer E-II, INSDOC for their kind cooperation and giving permission for using official facilities in carrying out this study. The suggestion from Mr. Bidyarthi Dutta is gratefully acknowledged.

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