

Bibliometric Analysis of Research Publications of Indian Institute of Technology (IIT's) Based on Published Literature as Reflected in Scopus

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Abstract

The Indian Institutes of technology (IITs) in India account for significant research outcomes from the country. This paper is an attempt to analyze the publications of five older IITs during the period 2007 to 2016 as reflected in SCOPUS, multi-disciplinary international database. A total of 10583 research publications have been downloaded and analyzed. This paper tries to give an overview of the research output of the five IITs (IIT Bombay, IIT Kanpur, IIT Kharagpur, IIT Delhi, and IIT Madras) on different parameters like growth rate of research publications, authorship pattern, productivity per capita, degree of collaboration, etc.

Keywords: Bibliometric Analysis, IITs, Research Output, Research Productivity, Scientometric Analysis, Scopus

1. Introduction

The Indian Institutes of Technology (IITs) are among the most prominent autonomous science, technology and management institutes of higher education in India governed by the Institutes of Technology Act, 1961 which has declared them as: “Institutions of National Importance”. Every IIT is linked to the others.

Over the years, IITs have built an impressive collection of state-of-the-art facilities and continue to add to these. Many faculty and research scholars have focused on innovative research in various disciplines and publish research papers in reputed national and International journals.

Bibliometric analysis has evidently been seen as a valuable method for evaluating scientific productivity. This is one of the vital tools to measure scientific activities carried out by researchers, institutions. There are two ways to assess the performance of researchers; one is absolute publication productivity and another is by citation impact. Several indices such as h-index have been developed to assess research. In this paper, an attempt has been made to determine the research performance

of five IITs as reflected in the SCOPUS multidisciplinary database from 2007 to 2016.

2. Literature Review

The study by Banshal and others (2017) on: “Research performance of IITs analyzed the research performance of 16 relatively older IITs based on Web of Science database. They studied productivity, productivity per capita, rate of growth of research output, authorship and collaboration pattern, citation impact and discipline-wise research strengths of the different IITs.

Ole Ellegaard and Johan A. Wallin (2015) performed bibliometric analysis of scholarly productions using Web of science. The study found a linear growth from 1994 onwards in the non-ILS category. It identified the most prolific disciplines and found that multidisciplinary papers have the highest.

Garg and Kumar (2016) conducted a scientometric analysis of research output of Odisha state during 2010-2014. A significant number of papers were published in journals published from the advanced countries of the

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West. More than 40% papers published by the scientists remained un-cited from Odisha.

Hasan and Singh (2015) undertook a scientometrics analysis of research output of five IITs during 2009-2013.

Bakri and others (2017) examined the growth of research in 20 years in Malaysia.

Kanwal (2017) conducted a bibliometric study of world research output on free and open source software literature during 1960-2016 based on the publications indexed on Scopus database. United States topped the list with 47058 (28.39%) publications.

Maharana and Sethi (2013) studied the growth of research activity of the Sambalpur University covered by ISI Web of Science during the period 2007-2011.

Singh et.al. studied the research contribution and impact of IIT, Roorkee from 1993 to 2001. Using a variety of bibliometric methods, including publication and citation analyses, Bonnevie (2003) developed a multifaceted portrait of the Journal of Information Science, focused on the last quarter of the 20th century.

3. Objectives of the Study

The objective of the present study is to examine the research output of five IITs as reflected in SCOPUS during 2007- 2016.

4. Methodology

Scopus database covers nearly 22,000 titles from over 5,000 publishers, of which 20,000 are peer-reviewed journals in the scientific, technical, medical, and social sciences (including arts and humanities). Scopus has various search options and publications can be identified from different states and provinces by searching the 'address' field provided in the search interface. The data for the study was downloaded on 20.09.2017, by using 'IITs' for 2007-2016. To be sure that no record was missed variations of the searched words such as "IIT Bombay" and Indian Institute of Technology, Bombay" were also searched. A total of 10,583 records were retrieved from Scopus as shown in Figure 1 for the five IITs.

5. Data Analysis

Table 1 and Figure 1 reveals the year wise publications of the five IIT's under study. The total number of publications by IITB is 2709 with a high of 453 papers in 2016 Current rank of IITs according to number of documents indexed in SCOPUS is shown in Table 1.

Table 1. Year-wise research publication of IITs during 2007 to 2016

Rank		1		2		3		4		5	
		IITB		IITKGP		IITM		IITD		IITK	
Sr. No.	Year	No. of Doc.	%	No. of Doc.	%	No. of Doc.	%	No. of Doc.	%	No. of Doc.	%
1	2007	152	5.61	198	8.04	151	6.55	130	6.40	71	6.58
2	2008	179	6.61	204	8.29	140	6.07	140	6.90	81	7.51
3	2009	159	5.87	211	8.57	191	8.29	174	8.57	86	7.97
4	2010	174	6.42	233	9.46	203	8.81	161	7.93	92	8.53
5	2011	237	8.75	268	10.89	211	9.16	184	9.06	93	8.62
6	2012	258	9.52	242	9.83	226	9.81	199	9.80	108	10.01
7	2013	329	12.14	237	9.63	234	10.16	236	11.63	92	8.53
8	2014	362	13.36	263	10.68	299	12.98	236	11.63	129	11.96

9	2015	406	14.99	284	11.54	315	13.67	283	13.94	132	12.23
10	2016	453	16.72	322	13.08	333	14.45	287	14.14	195	18.07
	Total	2709	100.00	2462	100.00	2303	100	2030	100.00	1079	100.00

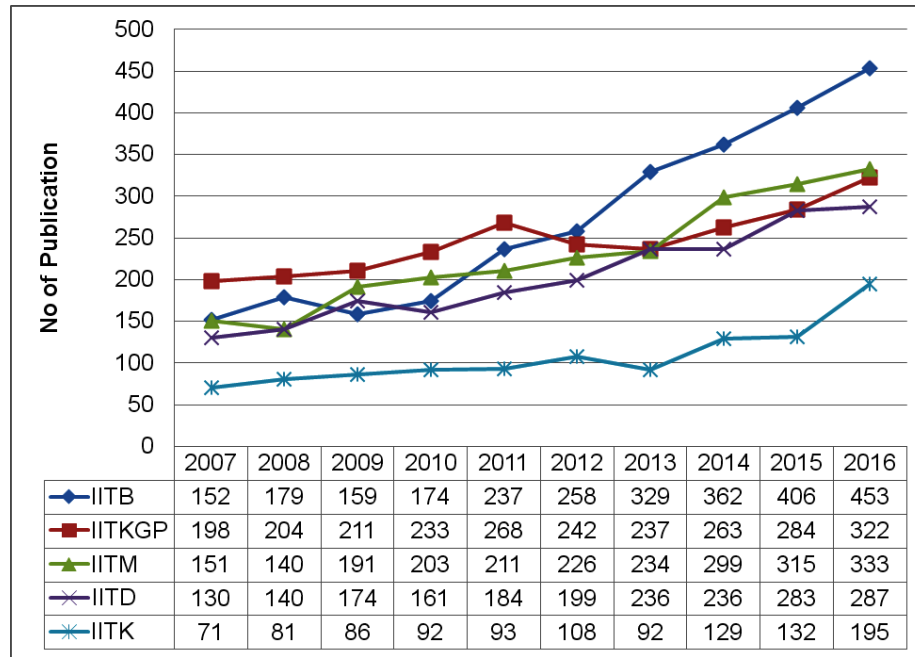


Figure 1. Year-wise research publication of IITs during 2007 to 2016.

6. Type of Documents used for Publishing Research Results

Table 2 and Figure 2 reveals that researchers, publish their research results in different types of documents

like journals, conference papers, book chapters, patents, reports, etc. Journals are the most preferred channels by researchers in IITs to publish their research results.

Table 2. Type of documents

Document Type	IITB		IITKGP		ITM		IITD		IITK	
	# of doc.	%	# of doc.	%	# of doc.	%	# of doc.	%	# of doc.	%
Article	1285	47.43	1442	58.57	1265	54.93	1003	49.41	600	55.61
Conference Paper	1272	46.95	911	37.00	918	39.86	875	43.10	431	39.94
Book Chapter	46	1.70	22	0.89	34	1.48	63	3.10	16	1.48
Editorial	35	1.29	12	0.48	29	1.26	26	1.28	8	0.74
Review	33	1.22	37	1.50	36	1.56	38	1.87	14	1.30
Article in Press	13	0.48	10	0.40	3	0.13	9	0.44	4	0.37
Note	8	0.30	7	0.28	3	0.13	3	0.15	3	0.28
Letter	5	0.18	8	0.32	8	0.35	5	0.25	1	0.09
Book	4	0.15	4	0.16	4	0.17	7	0.34	0	0.00

Erratum	4	0.15	9	0.36	1	0.04	1	0.05	1	0.09
Short Survey	3	0.11	0	0	1	0.04	0	0.00	1	0.09
Abstract Report	1	0.04	0	0	1	0.04	0	0.00	0	0.00
Total	2709	100.00	2462	100	2303	100.00	2030	100.00	1079	100.00

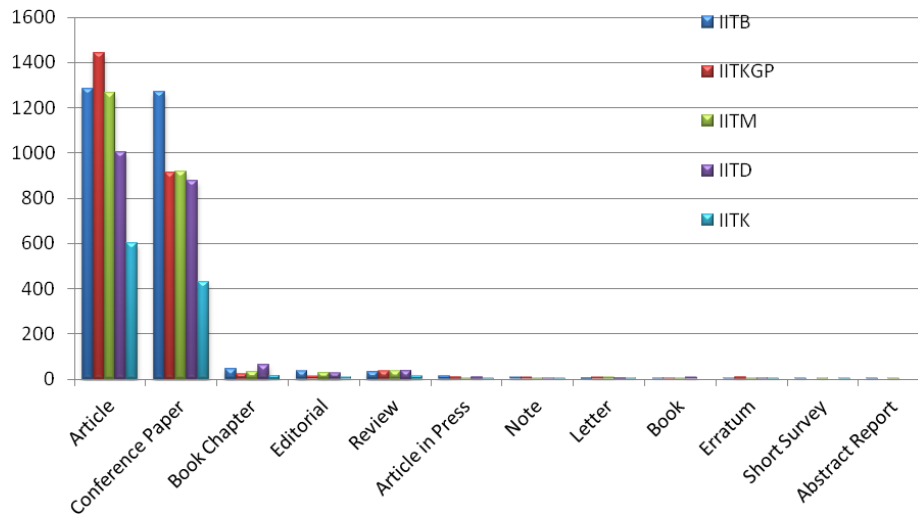


Figure 2. Type of documents.

The subject-wise scientific research output is presented in Table 3. “Engineering” tops the list of subject for all five IITs. Going by the absolute

number of publications, it may be observed that different IITs have strengths in different subject areas.

Table 3. Most preferred subject area of five IIT’s

Subject Area	IITB		IITKGP		IITM		IITD		IITK	
	# of Doc.	%	# of Doc.	%	# of Doc.	%	# of Doc.	%	# of Doc.	%
Engineering	1152	23.28	1117	24.25	1202	27.29	895	24.84	471	23.92
Computer Science	939	18.97	830	18.02	631	14.33	748	20.76	352	17.88
Materials Science	519	10.49	471	10.23	554	12.58	328	9.10	220	11.17
Physics and Astronomy	537	10.85	448	9.73	453	10.29	241	6.69	250	12.70
Mathematics	328	6.63	252	5.47	272	6.18	210	5.83	170	8.63
Chemistry	176	3.56	203	4.41	203	4.61	121	3.36	78	3.96
Chemical Engineering	185	3.74	185	4.02	186	4.22	112	3.11	67	3.40
Energy	145	2.93	128	2.78	180	4.09	219	6.08	54	2.74
Environmental Science	140	2.83	145	3.15	126	2.86	107	2.97	44	2.23
Social Sciences	196	3.96	138	3.00	117	2.66	87	2.41	41	2.08
Biochemistry, Genetics and Molecular Biology	118	2.38	117	2.54	94	2.13	86	2.39	25	1.27
Earth and Planetary Sciences	164	3.31	168	3.65	80	1.82	88	2.44	46	2.34
Medicine	52	1.05	89	1.93	72	1.63	55	1.53	36	1.83

Business, Management and Accounting	80	1.62	82	1.78	54	1.23	109	3.03	29	1.47
Economics, Econometrics and Finance	36	0.73	19	0.41	33	0.75	30	0.83	17	0.86
Decision Sciences	50	1.01	53	1.15	30	0.68	48	1.33	30	1.52
Agricultural and Biological Sciences	35	0.71	80	1.74	25	0.57	40	1.11	8	0.41
Immunology and Microbiology	15	0.30	11	0.24	23	0.52	12	0.33	3	0.15
Multidisciplinary	17	0.34	4	0.09	19	0.43	14	0.39	11	0.56
Health Professions	4	0.08	10	0.22	15	0.34	8	0.22	2	0.10
Arts and Humanities	35	0.71	27	0.59	14	0.32	12	0.33	7	0.36
Pharmacology, Toxicology and Pharmaceutics	21	0.42	20	0.43	11	0.25	13	0.36	5	0.25
Neuroscience	3	0.06	3	0.07	5	0.11	8	0.22	1	0.05
Nursing	1	0.02	2	0.04	3	0.07	2	0.06		0.00
Psychology	1	0.02	3	0.07	2	0.05	9	0.25	2	0.10
Veterinary		0.00	1	0.02		0.00	1	0.03		0.00
Total	4949	100.00	4606	100.00	4404	100.00	3603	100.00	1969	100.00

Table 4 reveals that faculty members, researchers and scientists of IITs have research collaborations with more than 50 Institutes, Universities, colleges and Research laboratories. Collaboration in scientific

research is essential and useful for enhancing visibility of research. This is the reason International collaborations are considered more valuable in the research field.

Table 4. Geographical distribution of publications

Sl. No.	Country	IITB	%	IITKGP	%	IITM	%	IITD	%	IITK	%
	India	2682	35.26	2445	80.06	2291	77.85	2007	77.16	1071	73.71
1.	United States	424	5.57	157	5.14	220	7.48	144	5.54	138	9.5
2.	United Kingdom	184	2.42	48	1.57	40	1.36	52	2	29	2
3.	France	181	2.38	26	0.85	20	0.68	36	1.38	16	1.1
4.	Germany	176	2.31	56	1.83	48	1.63	49	1.88	24	1.65
5.	China	140	1.84	14	0.46	10	0.34	14	0.54	8	0.55
6.	Japan	140	1.84	15	0.49	30	1.02	16	0.62	17	1.17
7.	Switzerland	138	1.81	14	0.46	12	0.41	9	0.35	9	0.62
8.	Sweden	137	1.8	16	0.52	7	0.24	13	0.50	10	0.69
9.	Italy	135	1.77	16	0.52	7	0.24	10	0.38	6	0.41
10.	South Korea	129	1.70	33	1.08	53	1.8	12	0.46	11	0.76
11.	South Africa	127	1.67	32	1.05	8	0.27	12	0.46	8	0.55
12.	Canada	30	0.39	26	0.85	20	0.68	36	1.38	15	1.03
13.	Malaysia	9	0.12	23	0.75	16	0.54	16	0.62		
14.	Singapore	26	0.34	16	0.52	14	0.48	20	0.77	9	0.62
15.	Australia	3270	42.99	192	6.29	187	6.35	44	7.73	110	7.57
Total no of publication country's those are not comes under rank 10th		7607	100	3054	100	2943	100	2601	100	1453	100

Table 5 reveals that around 32% of all publications of IITs have not been cited et.al. cited. There are also many papers that have been cited only once, However, on an average 20% of publications from every IIT have received eight or more citations.

7. Degree of Collaboration

Table 6 reveals the degree of collaboration. Degree of collaboration indicates the trend in authorship pattern. Table 6 indicates that the average degree of author collaboration is 0.96.

Table 5. Citations distributions as reflected on SCOPUS of five IITs

No. of Citations	IITB	%	IITKGP	%	IITM	%	IITD	%	IITK	%
0	900	33.22	724	29.41	786	34.13	644	31.72	346	32.07
1	356	13.14	343	13.93	337	14.63	287	14.14	151	13.99
2	265	9.78	202	8.2	231	10.03	179	8.82	102	9.45
3	162	5.98	169	6.86	162	7.03	129	6.35	72	6.67
4	143	5.28	115	4.67	107	4.65	101	4.98	53	4.91
5	106	3.91	100	4.06	97	4.21	87	4.29	50	4.63
6	75	2.77	89	3.61	84	3.65	71	3.5	32	2.97
7	65	2.4	66	2.68	55	2.39	49	2.41	23	2.13
8	68	2.51	51	2.07	62	2.69	58	2.86	26	2.41
9	46	1.7	47	1.91	32	1.39	48	2.36	16	1.48
10	48	1.77	41	1.67	43	1.87	35	1.72	26	2.41
11-20	241	8.9	269	10.93	172	7.47	179	8.82	116	10.75
21-30	93	3.43	103	4.18	70	3.04	70	3.45	32	2.97
31-40	52	1.92	65	2.64	28	1.22	30	1.48	16	1.48
41-50	24	0.89	18	0.73	13	0.56	21	1.03	10	0.93
51-100	40	1.48	40	1.62	18	0.78	31	1.53	4	0.37
100>	25	0.92	20	0.81	6	0.26	11	0.54	4	0.37
Total	2709	100	2462	100	2303	100	2030	100	1079	100

Table 6. Degree of collaboration

IITs	Single Author (SA)	Multiple Authors (MA)	S.A.+ M.A.	Degree of Collaboration (DC)
IITB	103	2606	2709	0.96
IITKGP	70	2392	2462	0.97
IITM	88	2215	2303	0.96
IITD	101	1929	2030	0.95
IITK	54	1025	1079	0.95
Grand Total	416	10167	10583	0.96

8. Top Five Contributors of IIT's Under Study

An attempt was made to identify the most productive authors in terms of number of papers, percentage of contributions, total citation, average citation and H-index. It was found that IITB authors have a good average citation and H-Index.

9. Findings and Conclusion of the Study

From the above study, it is found that:

1. IITB is the most productive institution among all the five IITs studied with 2709 publications. Every IIT seems to have hit the peak in terms of number of publications in 2016,
2. Papers in journals are the most preferred document type with IITKGP having 1442, i.e. nearly 59% of all its publications as papers in journals, and
3. Faculty members, Researchers and Scientists have research collaborations with more than 50 countries with USA is at the top followed by U.K.

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