International Research Journal of Education and Technology
ISSN 2581-7795

Research Trend of Indian Institute of Technology, Bombay based On Web of Science database during 2015 to 2019.

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Abstract

The present paper investigated the Scientometrics study of Indian Institute of Technology, Bombay (IITB) during 2015 to 2019. The study based on the research productivity pattern among IITB faculties during five years. The bibliographical data downloaded from the Web of Science database. The study highlights IITB's international research collaboration, chronological research output, authorship pattern, preferred journals, types of publications and degree of collaboration. The data analysed with the help of Microsoft Excel and VOSview Software. The total number of 8069 papers with 73839 citations analysed during 2015 to 2019. It is found that, IITB faculties preferred first choice as USA. The study provides overview of research productivity pattern based on various parameters of IIT, Bombay.

Key Words: Scientometrics; Research Productivity; IIT Bombay; IITB; Research Trend;

Introduction:

Education is an essential part of life and learning phase to everyone. Many reputed institute provides higher education in the various subjects such as Engineering, Science & Technology, Arts & Humanities, Social Science, Computer Science, Medicine, Law, Economics, Religions and various subjects. Many top institute in India provides the excellent education to build students. The huge amount of research generated from the faculties from the top institutes in India and world in the various fields. Present day, research is published in the various types of documents. It may be available in the form of online mode or offline mode. Therefore, academician from various fields can access publication information within few seconds.

Research publications is easily communicating with the help of internet and especially academic social media portals such as Acdemia.edu, Researchgate, LinkedIn etc. Indian Government started online eLearning through various online platforms such as Swayam, e-PGPathshala, e-ShodhSindhu etc. Present days, various academician preferred open access medium for publications. Hence, the millions of publications are available in the open access platforms. The present study highlights research productivity of Indian Institute of Technology, Bombay (IITB) based on the various parameters. The present paper investigated research productivity of IITB's faculties during 2015 to 2019.

A short Profile of IIT Bombay:

Indian Institute of Technology, Bombay is one of the prominent institute in India for research and development. IIT Bombay. (2020) The IIT Bombay established in the year 1958. (Council of Indian Institute of Technology, 2020) IITB had 'Institutes of National Importance' as per Parliament declared in 1961. The institute offered various UG, PG and Ph.D. from various departments, schools, centers and interdisciplinary centers. The IIT Bombay received many recognition and awards at national and international level. Recently, International level, IITB received 152 QS world Universities ranking in the year 2020. The IITB received fourth rank at National Institutional Ranking Framework (NIRF). Similarly, IITB ranked second position in the Atal Ranking of Institutions on Innovation Achievements,' (ARIIA) 2020. The IITB is continuously contributing research towards the development of society. The institute carried out various notable research projects and events for academic community.

Material, Methodology & Limitation:

The bibliographic data is retrieved from the Clarivate Analytics's Web of Science Database for the period 2015-2019. The data analysed and verified with the help of Microsoft Excel and VOSviewer Software. The current study highlights the research productivity and outcome based on the various Scientometrics indicators such as publications arranged by chronologically, authorship pattern among IITB faculties, preferred journals by faculties, national and international collaboration, types of published documents and institute wise collaboration. The total number of 8356 records retrieved from the Web of Science database during five years i.e. 2015 to 2019. Clarivate Anlytics. (2020) The bibliographic data downloaded under Organization Enhanced (OG) search under the Web of Science database.

The bibliographic data downloaded on 6th July 2020. The current research followed Scientometrics methods to evaluate research trend of IIT, Bombay.

Objective:

- To assess IITB publications chronologically;
- To know types of publications published by IITB;
- To identify citations received to IITB;
- To know international collaboration;
- To find out author productivity among IITB faculties;

Review of Past Studies:

The based on the Institutional Scientometrics various studies are conducted. Some of the past research productivity based on the Indian Institute of Technology, India. Few noticeable studies are: **Singh, V.K. (2015)** carried out Scientometrics analysis of IIT Bombay during 1990 to 2014 based on the Web of Science Database. The total number of 13,208 article analysed during the study. The most prolific author observed as Ghosh, P. followed by Varma, R. **Mohanty, R. & Jena, P., (2020)** analysed civil engineering research based on the Scientometrics analysis among IIT, Bombay during 2006 to 2016. The total 734 records analysed from the IIT, Bombay. The bibliographical data downloaded from the Scopus Database.

Many studies based on the comparison of the Indian Institute of Technology, India. Hence, researcher investigated various comparative past studies of IITs based of Scientometrics and other metrics. Likewise, **Hasan, N. & Singh, M. (2015)** identified collaborative research productivity of five IITs India. The total number of 3868 papers anlyzed from IIT Bombay during 2009 to 2013 based on the Web of Science Database. The study focused on the collaborative research productivity, authorship pattern, foreign country and institute collaboration among IIT Bombay, Delhi, Kanpur, Kharagpur and Madras. It is found that, IIT Bombay average citation per paper 6.17 higher than other four IITs. However, **Banshal, S. K., Singh, V. K., Basu, A., & Muhuri, P. K. (2017)** analysed the research performance of 16 old IITs in India during 1990 to 2014. The total number 12,937 papers anlyzed from the IIT Bombay during 1990 to 2014. It concluded that, IITB performed good as based on the various parameters such as highly cited papers and international collaborative

papers. **Pradhan, B., & Ramesh, D. B. (2017)** study of Engineering research outcome of IIT, Madras and Bombay based on the International Scopus Database during 2006-2015. **Pradhan, B. & Ramesh, D. B., (2018)** carried out the six IITs Scientometrics study based on the Scopus database. The bibliographic data retrieved during 2006 to 2015. The total number of 11998 papers anlyzed from IIT Bombay's faculties. It is found that, IITB faculties published 8008 journal articles with 80427citations during 2006 to 2015. **Kumar, A., Singh, M., & Ranjan, C. (2018)** measured research output of 23 IITs during 1989 to 2018. The total number 136,156 records retrieved from the 23 IITs in India. **Das, Tapas Kumar, & Sahu, Sudam Charan. (2020)** analysed bibliometrics study of five old IITs during 2008 to 2017 based on the Scopus database. The total number of 82563 papers out of 17887 papers contributed by IIT Bombay faculties.

Data Analysis and Observations:

IITB faculties research productivity and international collaboration analysed purely based on the downloaded bibliographic data from the Clarivate Analytics's Web of Science during 2015 to 2019. The researcher has compiled and analysed the publication productivity accordingly and presented in the paper.

1. Research Publication Productivity (IITB):

The below Table 1 indicates the growth pattern of publications and citations among IIT Bombay faculties during 2015 to 2019. The Table 1 arranged according to publications. The highest number of publications published in the year 2019. The highest number of citation (27.09%) received to IITB publications during 2015. The IITB average citation per paper is 9.15 during 2015 to 2019. It is also observed that, the highest average citation per paper 15.50 recorded in year 2015.

Table 1 Growth Rate Pattern of Publications and Citations of IITB

Year	TNP	%TNP	TNC	%TNC	ACCP
2015	1290	15.99	20001	27.09	15.50
2016	1421	17.61	16902	22.89	11.89
2017	1641	20.34	21545	29.18	13.13
2018	1767	21.90	10848	14.69	6.14
2019	1950	24.17	4543	6.15	2.33

Total	**8069**	**100.00**	**73839**	**100.00**	**9.15**

***PY**= Publication Year; **TNP** = Total Number of Publications; % of **TNP** = Percentage of Publications; **TNC** = Total Number of Citations; **%TNC** = Percentage of Total Number of Citations to Publications; **ACCP** =Average Citation Count for Publication*

2. Types of publications preferred for research communications:

The Table 2 indicates that, IITB publications forms during 5 years. The maximum research output in the form of Journal articles (90.53%) followed by articles in the proceeding papers (2.74%), Reviews (2.92%). The highest number of citations (91.06%) received to the journal articles.

Table 2: Type of Publications: IITB

Type of Documents	**TNP**	**%TNP**	**TNC**	**%TNC**
Articles in Journals	7305	90.53	67236	91.06
Articles in Book Chapters	2	0.02	0	0.00
Article in Data Paper	1	0.01	11	0.01
Articles in Early Access	39	0.48	17	0.02
Articles in Proceedings Papers	221	2.74	972	1.32
Biographical-Items	4	0.05	1	0.00
Book Reviews	8	0.10	0	0.00
Corrections	47	0.58	43	0.06
Editorial Materials	78	0.97	174	0.24
Letters	5	0.06	30	0.04
Meeting Abstracts	118	1.46	5	0.01
News Item	1	0.01	0	0.00
Reprint	1	0.01	0	0.00
Reviews	236	2.92	5346	7.24
Review in Book Chapter	1	0.01	0	0.00
Reviews in Early Access	2	0.02	4	0.01
Grand Total	**8069**	**100.00**	**73839**	**100.00**

***TNP** = Total Number of Publications; % of **TNP** = Percentage of Publications; **TNC** = Total Number of Citations; **%TNC** = Percentage of Total Number of Citations to Publications;*

3. Journal Preferred

The IITB faculties majority research papers published in the form of journal articles. The below Table 3 highlights ranking of preferred journals as first rank received to RSC Advances (1.54%) followed by Scientific Reports (1.26%) and IEEE Transactions On Electron Devices (0.92%). The highest number of citations (6.47%) received to the Physical Review Letters. The below Table 3 highlights top 10 preferred journals by IITB faculties during 2015 to 2019.

Table 3: Journals Preferred by IITB Faculties

Name of Journals	TNP	%TNP N=8069	TNC	%TNC N=73839	Impact Factor
RSC Advances	124	1.54	1086	1.47	3.119
Scientific Reports	102	1.26	1310	1.77	3.998
IEEE Transactions On Electron Devices	74	0.92	463	0.63	2.913
Dalton Transactions	72	0.89	831	1.13	4.174
Inorganic Chemistry	72	0.89	1017	1.38	4.825
Physics Letters B	68	0.84	1297	1.76	4.384
Physical Review D	64	0.79	654	0.89	4.833
Journal Of Physical Chemistry C	59	0.73	420	0.57	4.189
Physical Review B	56	0.69	550	0.74	3.575
Journal Of Alloys And Compounds	51	0.63	550	0.74	4.650

4. International Collaboration:

The below Table 4 focused on the international collaboration of IITB faculties in the world. The Table 4 describes top 10 countries collaboration with IITB faculties. The 50% publications of IITB contributed with collaboration of USA followed by Germany, England, Australia, China, France, Japan and Russia.

Table 4: IITB: International Collaboration

Countries/Regions	**TNP**	**% of 8069**
USA	1082	13.41
GERMANY	573	7.10
ENGLAND	482	5.97
AUSTRALIA	454	5.63
PEOPLES R CHINA	418	5.18
FRANCE	397	4.92
JAPAN	379	4.70
RUSSIA	371	4.60
SOUTH KOREA	349	4.33
ITALY	328	4.06

***TNP** = Total Number of Publications;*

Graphical Presentation:

The below fig.1 reflected 110 country collaboration with IITB. Each big circles indicates the highest number of publications research contribution with IITB. (Nees Jan van Eck & Ludo Waltman, 2020) The fig. 2 indicates research inter-collaboration among 110 countries with India through a visualization graph.

International Research Journal of Education and Technology
ISSN 2581-7795

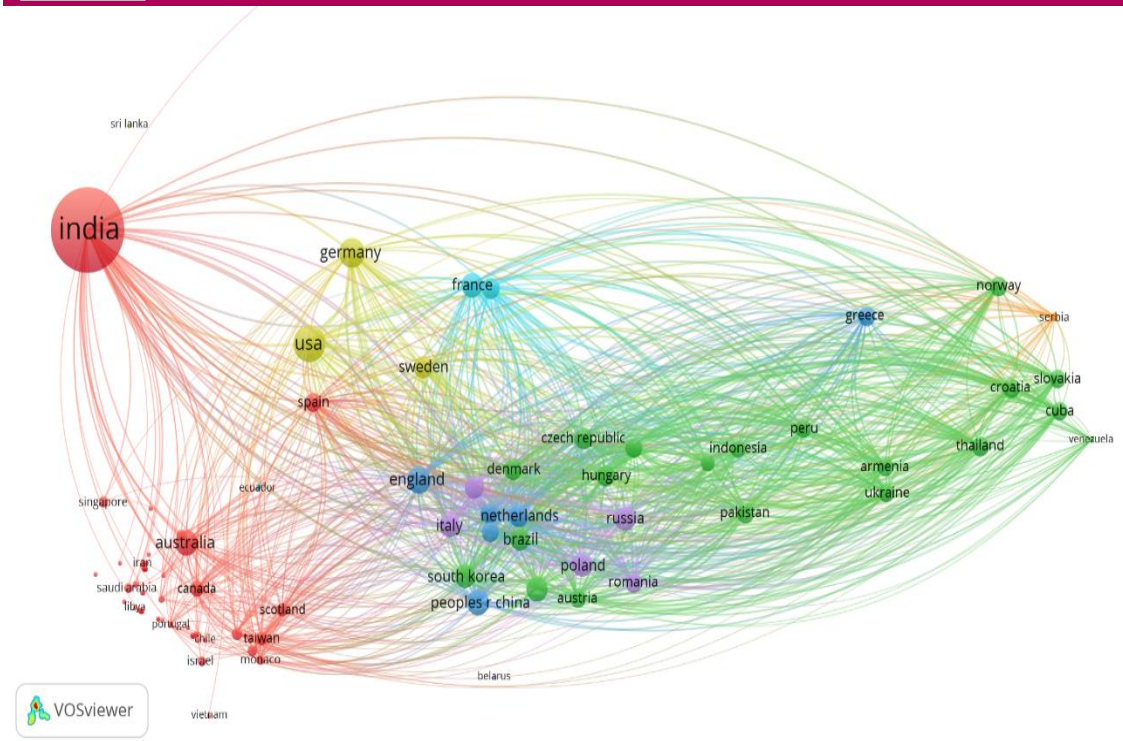

Fig.1 IITB : Visualization Graph of International Collaboration

5. Institutewise Collaboration:

The Table 5 indicates top 10 most collaborative institutes and organizations with IITB. The majority of IITB faculties collaborated with Department of Science Technology, GOI, India (4.23%) followed by Centre National De La Recherche Scientifique (CNRS), France (4019%), Monash University, Australia (4.11%), Russian Academy of Sciences, Russia (3.79%), Polish Academy of Sciences, Poland (3.74%), University of Texas, US (3.73%) and more.

Table 5: IITB: Institute National & International Collaboration

Name of Organizations	TNP	% TNP N=8069
Department Of Science Technology, India	341	4.23
Centre National De La Recherche Scientifique (CNRS), France	338	4.19
Monash University, Australia	332	4.11
Russian Academy Of Sciences, Russia	306	3.79

Polish Academy Of Sciences, Poland	302	3.74
University Of Texas, US	301	3.73
United States Department Of Energy (DOE), US	297	3.68
Universite Paris Saclay, France	295	3.66
Pusan National University, South Korea	280	3.47
Korea Institute Of Science Technology Information (KISTI), South Korea	271	3.36

***TNP** = Total Number of Publications;*

6. Authorship Pattern:

The Table 6 reflected IITB author collaborative pattern during 5 years. The 75.92% of IITB publications published by two to five collaborative authors. It is observed that, IITB faculties mostly preferred the collaborative publications. Hence, the IITB's publications received more number of citations to similar authors. The highest citations (18.23%) received to three collaborative authors publications of IITB.

Table 6: IITB: Authorship Pattern

Authors	TNP	%TNP	TNC	%TNC
1	236	2.92	552	0.75
2	1816	22.51	11186	15.15
3	1980	24.54	13458	18.23
4	1374	17.03	11566	15.66
5	955	11.84	7959	10.78
6	534	6.62	5433	7.36
7	304	3.77	2945	3.99
8	199	2.47	1858	2.52
9	123	1.52	1521	2.06
10	84	1.04	1630	2.21

11	48	0.59	579	0.78
12	37	0.46	707	0.96
13	18	0.22	139	0.19
14	16	0.20	233	0.32
15	10	0.12	185	0.25
16	5	0.06	67	0.09
17	5	0.06	85	0.12
18	1	0.01	0	0.00
19	2	0.02	1	0.00
20 Above	322	3.99	13735	18.60
Grand Total	**8069**	**100.00**	**73839**	**100.00**

Degree of Collaboration by Subramanian formula:

$$\text{Degree of Collaboration (DC)} = \frac{\text{Number of multiple authors (Nm)}}{\text{Number of single authors (Ns) + Number of Multiple authors (Nm)}}$$

DC =7833/236+7833;

DC = 7833/8069

DC = 0.970

As per the above Subramanyan, K. (1983) formula, the mean degree of collaboration is 0.970. It indicates that, the highest number of publications contribution within collaborative authors during 2015 to 2019. It indicates that, the highest publications of IITK faculties published in the collaboration.

Finding & Conclusions:

- **Publications:** IITB faculties contributed the total number of 8069 papers with 73839 citations during 2015 to 2019. The 29.18% citations received to papers published during 2017. The IITB recorded average citation per paper 9.15 during 2015 to 2019. It is also observed that, the highest average citation per paper 15.50 recorded in year 2015.
- **Forms of Documents:** The 96.19% publications published in the form of journal articles, reviews and articles in the proceeding papers. The 91.06% citations received to journals articles.
- **International Collaboration:** The 50% publications of IITB contributed with mostly collaboration with USA followed by Germany, England, Australia, China, France, Japan and Russia.
- **Journal Preferred:** The IITB faculties mostly preferred journals as first rank RSC Advances followed by Scientific Reports, IEEE Transactions On Electron Devices, Dalton Transactions, Inorganic Chemistry, Physics Letters B etc.
- **Institutewise Collaboration:** IITB faculties the maximum number of research paper collaboration with Department of Science Technology, Government of India, India (4.23%) followed by Centre National De La Recherche Scientifique (CNRS), France (4.19%) and Monash University, Australia (4.11%).
- **Authorship Pattern:** The 75.92% of IITB publications published by two to five collaborative authors. The highest number of citations (18.23%) received to three collaborative IITB author's publications.
- **Degree of Collaboration:** As per Subramanyan, K. (1983) formula, calculated the IITB faculties degree of collaboration is 0.970.

It is observed that, the present study highlights research productivity pattern and output of IITB during 2015 to 2019. The study shows that, IITB faculties contributed more number of research papers in the reputed and high impact factor journals. The IITB faculties collaborated research with the various international institutes. The USA was the first preference for international collaboration of IITB.

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