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Article

Research Productivity and Citation Analysis of Indian Institute of Technology, Madras: An Overview

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A B S T R A C T

Metrics studies increasingly used to assess the quantity and quality of scientific research output in many research fields worldwide. This study aimed to evaluate the research productivity of the Indian Institute of Technology, Madras. To identify the Research productivity of the Indian Institute of Technology, Madras, the Web of Science database was used. Records were searched in database published between 1989 and 2018. The contributions of faculty members were evaluated based on the publication, total number of citations, average citations and h-index. The result of the study found that majority (8.90%) of articles have been published in the year 2018, 90.28% of articles are included in the Web of Science, 16.37% of records related to Materials Science Multidisciplinary subject and 8.18% of records have been published by the faculty members with the collaboration of faculty members of Council of Scientific Industrial Research (CSIR) India among top 10 organisations. The study also found that Gosh S, has highest publications (487) and secured 1st rank followed by Choi Y, (430) and Hou W.S. (417) secured 2nd and 3rd rank respectively.

Keywords: Research Productivity, Citation Analysis, Indian Institute of Technology, Madras, Web of Science, Bangalore

Introduction

The quality and level of scientific research is a well indicator of an organisation as well as country's developmental status (Vose and Cervellini, 1983). Publication in high status refereed journals has become a major criterion of academic success in the competitive environment of global higher education. Universities are engaged in a global arms race of publication and the academics are the shock troops of the struggle (Altbach, 2015). It is useful to keep in mind that the publications and rankings games are limited to a very small part of the academic system in any country. In recent years, there has been increasing interest among researchers and policy makers in the notion of research productivity. Research productivity is one of the major measures of university academic performance and a core indicator for calculations of university rankings. However, it is obvious that there exists the significance of cultural heritage for the styles of knowledge production by Asian academics as well. Higher education in Asia is approaching a historical moment recently, the average annual growth rates of research publications have been particularly high in Asia (National Science Foundation, 2012).

Research productivity is easier to measure than other kinds of academic work teaching has been mentioned, community engagement and such important functions as university-industry linkages are also difficult to define and

quantify. Thus, research is not only the gold standard, but almost the only semi reliable variable. But even measuring research productivity is problematical (Altbach, 2015).

The global rankings count journals that are indexed in main global indices such as the Science Citation Index, Web of Science, Scopus, their equivalents for other disciplines. These indices list only a small number of journals and tend to favour publications in English, the global scientific language. The rankings and other national evaluations also count research grants and other awards. Again, this may be appropriate for the hard sciences, but not necessarily for other disciplines. The rankings also do not take into account the vast differences among countries and academic institutions. Neither the indices nor most universities recognize a range of other measures of productivity as well as significant changes in knowledge distribution that have taken place in recent years.

An analysis of institutional productivity may help to provide an insight into the dynamics of the field under consideration and this type of analysis provides useful indicators of scientific productivity. It is possible to indicate the quality and productivity in a specific field, in a country or region or an organisation.

Keeping in view the importance of research productivity, this study has been under taken to examine the research productivity of faculty members of Indian Institute of Technology, Madras as reflected in the Web of Science. It also made an attempt to know the subject wise distribution of records, growth of records, research collaboration of faculty members with the other organisations as well as other country and so on.

Objectives of the Study

- To know the year wise growth of publications of IIT Madras
- To identify the different types of publications included in the Web of Science
- To identify the most productive authors based on the number of publications
- Ranking of authors based on the total number of citations

Scope and Methodology

For the study, the literature was extracted from 'Web of Science' database during the period 1989-2018. To identify the research productivity of faculty members of Indian Institute of Technology, Madras, a keyword 'Indian Institute of Technology (IIT), Madras' was entered in the search box of the Web of Science and the records were downloaded and recorded in the MS Excel spread sheet for the further analysis.

Table 1.Growth of Publications by Year

Year	Number of records	Percentage
1989	305	1.40
1990	289	1.33
1991	316	1.45
1992	323	1.48
1993	387	1.78
1994	393	1.81
1995	426	1.96
1996	434	1.99
1997	421	1.93
1998	412	1.89
1999	379	1.74
2000	365	1.68
2001	315	1.45
2002	323	1.48
2003	388	1.78
2004	425	1.95
2005	564	2.59
2006	643	2.95
2007	727	3.34
2008	824	3.79
2009	822	3.78
2010	930	4.27
2011	970	4.46
2012	898	4.13
2013	949	4.36
2014	1,059	4.87
2015	1,328	6.10
2016	1,483	6.81
2017	1,731	7.95
2018	1,937	8.90
Total	20,766	100

Analysis and Interpretation of Data

Growth of publications of Indian Institute of Technology, Madras (IITM) as reflected in Web of Science is presented in Table 1. It can be seen from the Table1, that the majority (8.90%) of articles have been published in the year 2018 followed by the 2017 (7.95%), 2016 (6.81%) and 2015 (6.10%). The table also shows that only 1.40% of the articles have been published in the year 1989. The result of the study indicates that between the years 2010-2018

publications trend has been tremendously increased, it is the indication that the faculty members of IITM have greatly involved in the research activities during the period.

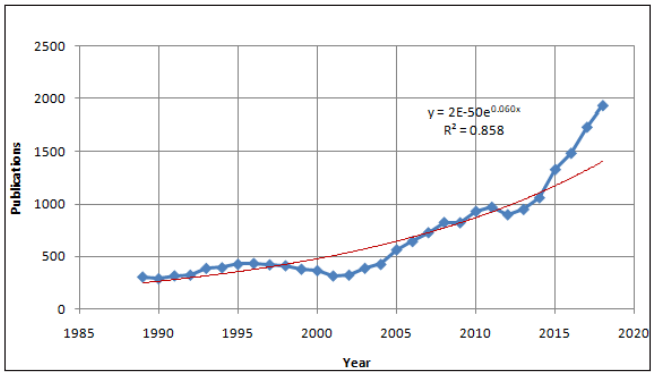

Figure 1.Year Wise Growth of Publications

Table 2.Type of Records Included in the Web of Science

Document Type	Numbers	Percentage
Articles	19651	90.28
Proceedings Papers	952	4.37
Reviews	298	1.37
Notes	225	1.03
Meeting Abstracts	188	0.86
Editorial Materials	181	0.83
Letters	110	0.51
Corrections	82	0.38
Book Reviews	26	0.12
Discussions	16	0.07
Biographical Items	12	0.06
Book Chapter	10	0.05
Correction Additions	05	0.02
News Items	04	0.02
Reprints	02	0.01
Retractions	02	0.01
Data Papers	02	0.01
Total	21766	100

Table 2, represents the types of records are included in the Web of Science database. It is observed from the Table that the 90.28% of articles are included in the Web of Science. It reflects that the authors have produced more number of research articles as compared with the other forms of the research productivity. Table 2, also shows that only 0.01% of Data Papers, Retractions and Reprints have included in the Web of Science database.

Subject wise research productivity of Indian Institute of Technology, Madras (IITM) is presented in the Table 3, which shows that 16.37% of records related to Materials Science Multidisciplinary are included in the Web of Science followed by Chemistry Physical (9.03%), Engineering Mechanical (7.91%%) and Physics Applied (7.45%). The table also shows that only 5.02% of Metallurgical Engineering subject's records have included in the Web of Science. It is notices that the majority of records are related to Materials Science Multidisciplinary. This shows that the faculty members have published comparatively more research articles in reputed journals.

Table 3.Total Number of Records by Subject (Top 10)

Subject Categories	No. of records	Percentage
Materials Science Multidisciplinary	3423	16.37
Chemistry Physical	1888	9.03
Engineering Mechanical	1654	7.91
Physics Applied	1559	7.45
Mechanics	1553	7.42
Engineering Electrical Electronic	1493	7.14
Chemistry Multidisciplinary	1289	6.16
Engineering Chemical	1269	6.07
Thermodynamics	1112	5.31
Metallurgical Engineering	1051	5.02

Table 4.Collaboration of Faculty Members with other Organizations (Top 10)

Organization Name	No. of records	Percentage
Council of Scientific Industrial Research (CSIR) India	1780	8.18
Tata Institute of Fundamental Research	600	2.76
Helmholtz association	572	2.63
United States Department of Energy	508	2.33
Russian Academy of Sciences	487	2.24
Indian Institute of Science IISc Bangalore	479	2.20

Centre National De La Recherche Scientifique CNRS	478	2.20
Hanyang University	476	2.19
Chinese Academy of Sciences	468	2.15
Istituto Nazionale Di Fisica Nucleare	451	2.07

Table 5, shows the collaboration of faculty members with other organizations. It can be seen from the table that 8.18% of records have been published by the faculty members with the collaboration of faculty members of Council of Scientific Industrial Research (CSIR) India among top 10 organisations. It also can be seen from the table that 2.76% of records have been published with Tata Institute of Fundamental Research, followed by Helmholtz association (2.63%) and United States Department of Energy (2.33%). Only 2.07% of records have been published with Istituto Nazionale Di Fisica Nucleare among top 10 collaboration organisations.

Table 5.Collaboration of Faculty Members with other Countries (Top 10)

Countries	No. of records	Percentage
USA	1,930	8.87
Germany	1,145	5.26
South Korea	744	3.42
Peoples R China	638	2.93
Russia	583	2.68
France	580	2.66
Switzerland	561	2.58
England	558	2.56
Taiwan	529	2.43
Italy	523	2.40

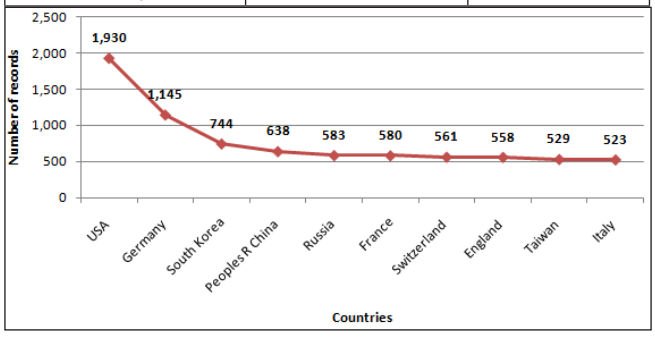

Figure 2.Collaboration of Faculty Members with Top Ten Countries

Table 6, shows the research collaboration of Indian Institute of Technology Madras (IITM) faculty members with other countries. It can be seen from the table that 8.87% of records have been published with the collaboration of USA followed by Germany (5.26%), South Korea (3.42%) among top ten collaboration countries. Faculty members of Indian Institute of Technology Madras have highly collaborated with these countries.

Table 6.Ranking of Faculty Members Based on the Total Number of Records (Top 10)

Author	Records	Percentage	Rank
Ghosh S	487	2.32	1
Choi Y	430	2.05	2
Hou WS	417	1.99	3
Mohanty GB	410	1.96	4
Kumar R	401	1.91	5
Kumar S	380	1.81	6
Dutta D	368	1.76	7
Narayanan S	364	1.76	8
Kim JH	359	1.71	9
Kumar A	353	1.68	10

The study also tried to know the most productive author based on the total number of publications published by the faculty members of Indian Institute of Technology, Madras. Table 4, reveals that among top 10 faculty members, Gosh S. has highest publications (487) and secured 1st rank followed by Choi Y. (430) and Hou W.S. (417) secured rank 2nd and 3rd respectively. It also can be seen from the Table that Kumar A. has been published 353 records and he secured 10th rank among top ten faculty members.

Table 7.Ranking of Faculty Members based on the Total Number of Citations (Top 10)

Author	Citations	h-index	Average Citation per item	Rank
Ghosh S	8077	38	16.19	1
Kumar S	7135	33	18.2	2
Kumar R	7017	33	17.07	3
Kim JH	5821	34	15.78	4
Choi Y	5549	35	12.53	5
Mohanty GB	5297	35	12.52	6
Hou WS	4858	35	11.38	7
Dutta D	4172	32	11.04	8
Narayanan S	3797	32	10.04	9
Kumar A	2459	24	6.72	10

Ranking of faculty members based on the total number of citation is presented in the Table 7. It can be seen from the table that Ghosh has received highest citations (8077). The h-index (38) and average citations (16.19) are respectively

and he secured rank 1. Table also shows that Kumar S, has received a total of 7135 citations and h-index and average citations are 33 and 18.2 respectively he has placed in the 2nd Rank. Kumar R, is in the third place where he has received a total of 7017 citations, his h-index and average citations are 33 and 17.07 respectively among top ten faculty members.

Table 8.Ranking of Journals based on the Total Number of Records

Name of the Journal	Articles	Percentage	Rank
Journal of Applied Physics	225	1.07	1
Transactions of the Indian Institute of Metals	205	0.98	2
Physical Review D	190	0.90	3
International Journal of Heat and Mass Transfer	186	0.88	4
Journal of Sound and Vibration	174	0.83	5
Materials Science and Engineering a Structural Materials Properties Microstructure and Processing	173	0.82	6
Journal of Alloys and Compounds	162	0.77	7
RSC Advances	144	0.68	8
International Journal of Hydrogen Energy	142	0.67	9
Journal of High Energy Physics	135	0.64	10

Ranking of journals based on the total number of records published in the journal is presented in the Table 8. It can be seen from the Table 8, that 225 articles have been published in the Journal of Applied Physics it is placed in the rank 1, followed by Journal of Transactions of the Indian Institute of Metals (205), Physical Review D (190) have received 2nd rank and 3rd rank respectively among top journals. It also can be seen from the Table that Journal of High Energy Physics has been published 135 articles and received 10th rank.

Conclusion

The measurement of academic productivity is neither straightforward nor easy. The key function of faculty members' quality is seldom measured adequately in part because the assessment of teaching effectiveness is not easy and there are not widely accepted parameters. The research productivity of an organisation or Institution is based on the socio-economic factors. In this, we found that the growth of research productivity has been tremendously increased in the last decade. It is the indication that the faculty members have been greatly involved in the research activity and funding agencies as well as concerned Governments have greatly supported by all the way.

The high research productivity in reputed or in indexed or in peer reviewed journals is the indication of the quality of the research of an organisation. The institutions, organisations, or an educational institution need to adopt well established strategic plans, strong international research partnerships, size, diversity of research portfolio, potential funders and a solid base with different research hubs across the country. In this context, the study recommends that the faculty members of the universities/ Institutions need to publish their research articles in highly reputed and peer reviewed journals. Because, the global rankings count journals that are indexed in main global indices such as, the Science Citation Index, Web of Science, Scopus, their equivalents for other disciplines.

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