RESEARCH OUTPUT OF INDIAN INSTITUTE OF TECHNOLOGY (IIT) DELHI FROM 2017 TO 2021: A BIBLIOMETRIC ANALYSIS

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Abstract: The present research paper reflects the research output of the Indian Institute of Technology (IIT) Delhi from 2017 to 2021. The paper carried out various parameters of bibliometric such as total output and cited publications; year-wise distribution of research output; most prolific author, top cited articles of the IIT Delhi authors, and most preferred source by authors. This study found that the most preferred document form is article with 9471(63.47%) publications followed by Conference Papers with 4005 (26.84%) publications and the most productive year is 2021(23.70%) followed by 2020 (21.14%) among IIT Delhi publications during the study period. The study explored that in terms of the number of publications, Singh, B. is the most productive author of IIT Delhi followed by Panigrahi, B.K. IEEE Transactions on Industry Applications contributed the highest research output (160) among the top ten preferred sources of IIT. In the subject-wise contribution, Engineering subject produced the highest 6942(46.52%) articles followed by Material Science 3492 (23.40). The study found that the article titled "The Lancet Commission on Pollution and Health" authored by Landrigan, P.J. et al. published in the year 2018 received the highest number of citations.

Keywords: Research Productivity; Bibliometrics; IIT Delhi; Scopus.

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1.0 Introduction

Research is the art of scientific investigation which helps to build knowledge. It is an original addition to the available knowledge for further advancement. In the higher education system, It is evident that recognition and acknowledgment are influenced by research. India is increasingly valuing the evaluation and ranking of higher educational systems. The top ranking of higher education institutions shows that research output and impact play an important role in the overall performance evaluation of institutions. Research is considered one of the main indicators to rate higher education institutions. Publications reflect the research activities of an institution and can be used to help get a better idea of the institution's research productivity.

One of the most widely used tools for identifying, collating, measuring, analyzing, and reviewing the research productivity of individuals or groups, institutions, countries, or organisations, is bibliometrics. Bibliometrics allows for comparisons of research productivity between individuals, groups, institutions, and countries. Many bibliometric and scientific studies have been done to evaluate the research productivity of different disciplines and institutions. Therefore, the current study has been conducted to find out the research output or latest publishing trends of IIT Delhi through some bibliometric indicators.

1.1 Bibliometric

The word 'Bibliometric' was coined by Pritchard in 1969. It is a combination of two words 'biblio' and 'metrics'. The word 'biblio' is derived from a Latin and Greek Word combination 'biblion', which means book, or paper. On the other side the word 'metrics' refers to 'measurement'. Bibliometrics is a statistical analysis of written publications, such as books or articles. It is a type of research method used in library and information science. Some definitions used for 'Bibliometrics' are as under:

According to Bellis (2009), "Bibliometric is a set of methods to quantitatively analyze scientific and technological literature."

According to Potter (1981), bibliometrics is "the study and the measurement of the publication pattern of all forms of written communication and their author."

Pritchard (1969) defined it as "the application of mathematics and statistical methods to books and other media of communication".

1.2 Indian Institute of Delhi (IIT)

Indian Institute of Technology Delhi is one of the 23 IITs created to be Centers of Excellence for training, research, and development in science, engineering and technology in India. Established as the College of Engineering in 1961, the Institute was later declared an Institution of National Importance under the "Institutes of Technology (Amendment) Act, 1963" and was renamed as "Indian Institute of Technology Delhi". It was then accorded the status of a Deemed University with powers to decide its academic policy, conduct its examinations, and award its degrees. Since its inception, over 48000 have graduated from IIT Delhi in various disciplines including Engineering, Physical Sciences, Management, and Humanities & Social Sciences.

2.0 Objectives

The study has been conducted by taking following objectives into consideration;
- To identify the category-wise research output of IIT Delhi;
- To identify the year-wise research productivity of IIT Delhi;
- To identify the most prolific authors;
- To identify the top ten preferred sources for publications;
- To identify the top ten most cited publications of IIT Delhi.

3.0 Methodology

In this present study, the research output of IIT Delhi from 2017 to 2021 has been analyzed. The data has been extracted from the largest abstracting and citation database of peer-reviewed literature which is the Scopus database. The data was extracted from Scopus in October 2022 using the strings "AF-ID ("Indian Institute of Technology Delhi" 60032730) AND (LIMIT-TO (PUBYEAR , 2021) OR LIMIT-TO (PUBYEAR , 2020) OR LIMIT-TO (PUBYEAR , 2019) OR LIMIT-TO (PUBYEAR , 2018) OR LIMIT-TO (PUBYEAR , 2017)). The data was shifted to MS Excel for analysis and presented in tabular form for further interpretation. The study is limited to the Scopus database covering a five-year study period.

4.0 Review Of Related Literature

For any research, a review of related literature serves as a mandate to go ahead with. The reviews entail numerous messages and information for further research. Often it serves as whether an area is fit to be studied for doctoral work or not. Further from the previous studies, we get to know about the methodology, applied for, and how the data was collected, analyzed, and presented. Some studies consulted for this work are presented in this section.

Angadi, et al.(2012), studied the research productivity of the University of Madras based on Web of Science by collecting publication data for some time from 1999 to 2011. A total of 3,831 publications were analysed to find out the authorship pattern, most prolific authors, most preferred journals, etc. Baskaran (2013) analysed the research output of Alagappa University during 1999-2011. The study explored the author's productivity,discipline-wise and institution-wise collaboration with the university. The study explored the research output through relative growth rate and doubling time to find out the growth pattern of publications.. Siwach and Parmar (2018) analysed research productivity of Haryana Agricultural University, Hisar and found a total productivity of 2649 publications during 2001-2015 which received 15282 citations. Singh, Parmar and Kumari (2022) studied research output of Kurukshetra University during 2011-2020 and found a total of 3167 publications were contributed by the authors from university which received 26476 citations and ACPP was 8.36.

A few other studies conducted by Kumbar et al, Mukherjee, Kaur & Mahajan, etc. were also consulted for the interpretation and analysis of data.

5.0 Data Analysis

5.1 Type of publications of IIT Delhi during 2017-2021

Table 1 explored that different types of publications are preferred by authors of IIT Delhi during the study period. The majority of literature was published in the form of articles (63.48%) followed by Conference papers (26.84%). Other publications least appeared like book-chapters, editorials, letters, books, data papers, notes, surveys, etc.

Table 1. Types of publications

S.No	Document Type	Publications	%
1	Article	9471	63.48
2	Conference Paper	4005	26.84
3	Book Chapter	659	4.42
4	Review	478	3.20
5	Editorial	141	0.95
6	Erratum	61	0.41
7	Book	39	0.26
8	Note	34	0.23
9	Letter	23	0.15
10	Short Survey	5	0.03
11	Retracted	2	0.01
12	Data Paper	1	0.01
13	Undefined	1	0.01
Total		**14920**	**100**
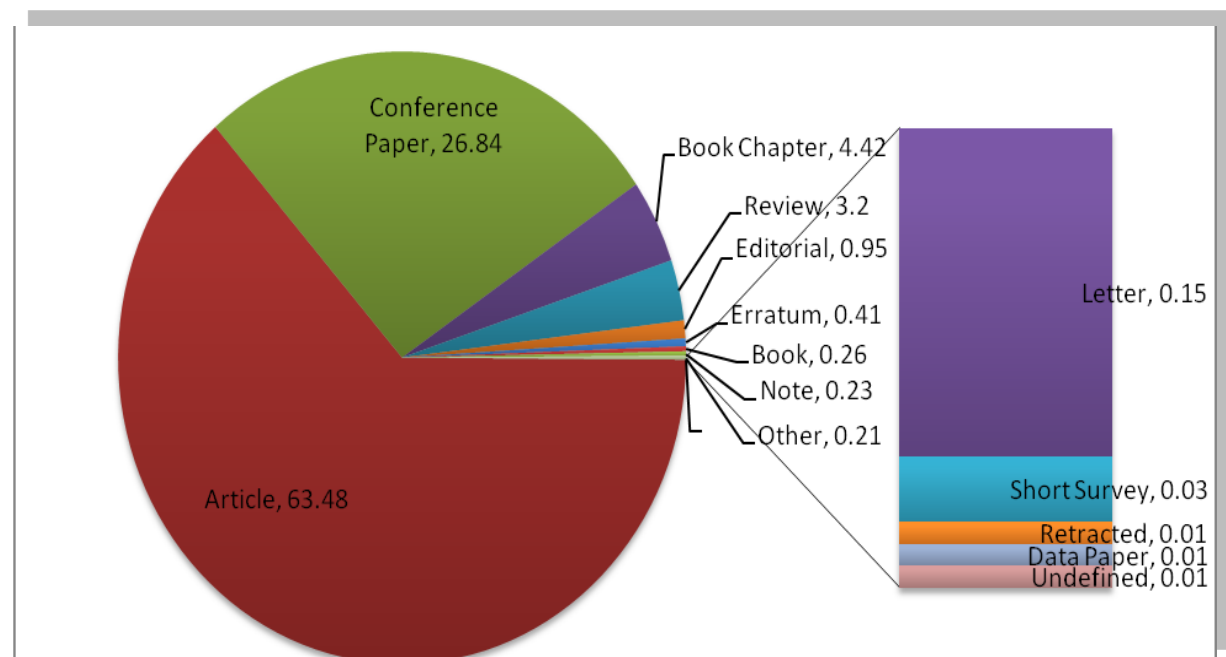
**Fig.1 Category of documents published by IIT Delhi**

5.2 Yearly research productivity of IIT Delhi

Table 2 depicts the year-wise distribution of IIT Delhi publications during the period 2017-2021. The table shows that a total of 14920 records of IIT Delhi were observed in the Scopus database during the study period. It is very clear from the table that the most productive year was 2021(23.71%) followed by 2020 (21.54%). The table clearly shows that there is an increasing trend in research productivity of IIT Delhi. The table shows that

the total citation per paper is highest in the year 2011. It shows that the old publications received more citations rather than new publications.

Table 2. Year-wise distribution of papers

Year	Publications	%
2017	2540	17.02
2018	2747	18.41
2019	2882	19.32
2020	3214	21.54
2021	3537	23.71
Total	**14920**	100.00
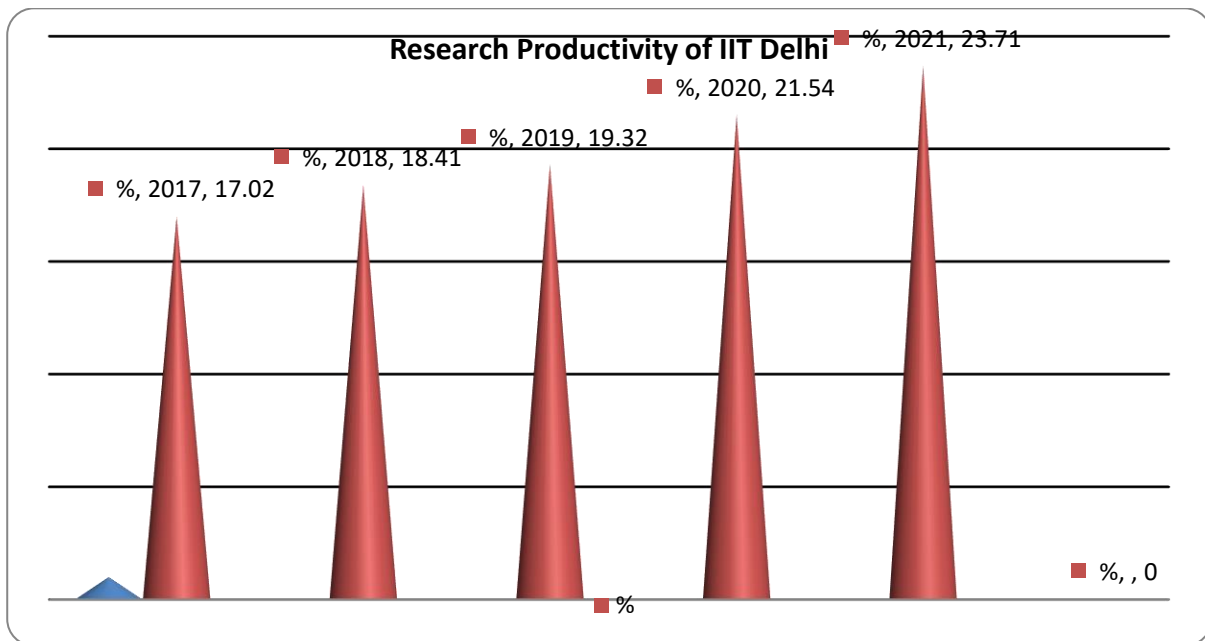
5.3   Most prolific authors

The list of ten top authors who gave the highest contribution during the period 2017-2021 is given in Table 3. In terms of the number of publications, Singh, B. is the most productive author with 1076 publications followed by Panigrahi, B.K. with 268 publications. It is also noticed that these ten authors collectively produced 16.80 percent research output of the total publications of IIT, Delhi.

Table 3. Most prolific authors in terms of research publications

Most Prolific Authors	Publications
Singh, B.	1076
Panigrahi, B.K.	268
Koul, S.K.	238
Mishra, S.	237
Rathore, A.S.	138
Lall, B.	125
Pandey, P.M.	122
Kar, A.K.	106

Mehta, D.S.	99
Bhatnagar, M.R.	97
Total	**2506**
%	**16.80**

5.4 Top ten preferred sources of IIT, Delhi

Table 4 lists the top ten sources that are preferred by IIT Delhi authors and made the highest contribution in terms of research output during 2017-2021. These top ten sources together produced around 6.31% of the total research output. The IEEE Transactions On Industry Applications contributed the highest research output (160) among the top ten preferred sources of IIT Delhi followed by Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics with 126 publications.

Table 4. Top ten source of IIT Delhi

Source/Journal	Publications
IEEE Transactions On Industry Applications	160
Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics	126
AIP Conference Proceedings	108
Lecture Notes In Civil Engineering	91
Scientific Reports	89
Materials Today Proceedings	86
Lecture Notes In Mechanical Engineering	82
ACM International Conference Proceeding Series	72
IEEE Transactions On Industrial Electronics	65
Proceedings Of SPIE The International Society For Optical Engineering	63
Total	**942**
%	**6.31**

5.5. Top cited papers of IIT Delhi during 2017-2021

The top 10 highly cited papers of IIT Delhi during 2017-2021 are listed in Table 5. The paper titled "The Lancet Commission on Pollution and Health " authored by Landrigan P.J et al. published in the year 2018 received the highest number of citations (1817) and the paper 10th position authored by Raj, A. published in the year 2020 received 257 citations.

Table 5. Top cited papers

Authors	Title	Year	Cited by
Landrigan P.J. et al.	The Lancet Commission on pollution and health	2018	1817
Kabir E.,et.al	Solar energy: Potential and future prospects	2018	992
Sethi P., Sarangi S.R.	Internet of Things: Architectures, Protocols, and Applications	2017	794
Sharma S., Zhang M., Anshika, Gao J., Zhang H., Kota S.H.	Effect of restricted emissions during COVID-19 on air quality in India	2020	651
Klionsky, D.J.,et. al	Guidelines for the use and interpretation of assays for monitoring autophagy (4th edition)[1]	2021	590
Sun, Y.,et.al	Majorization-Minimization Algorithms in Signal Processing, Communications, and Machine Learning	2017	579
Dwivedi, Y.K., et.al	Artificial Intelligence (AI): Multidisciplinary perspectives on emerging challenges, opportunities, and agenda for	2021	449

	research, practice and policy		
Scrivener, K., et.al	Calcined clay limestone cements (LC3)	2018	387
Jacob J.M., Karthik C., Saratale R.G., Kumar S.S., Praba	Biological approaches to tackle heavy metal pollution: A survey of literature	2018	292
Raj A., Dwivedi G., Sharma A., Lopes de Sousa Jabbour A.B., Rajak S.	Barriers to the adoption of industry 4.0 technologies in the manufacturing sector: An inter-country comparative perspective	2020	257

6.0 Conclusion

In the present study, the analysis of 14920 records of IIT Delhi found that there is an increasing growth trend of research publication during the five years (2017-2021). The document-wise analysis clearly shows that articles which are the units of journals are the most preferred form by IIT Delhi authors. The study indicates that the largest number of articles were published in" IEEE Transactions On Industry Application". Among the most prolific authors, is Singh, B. observed as the top author with the highest number of publications. The paper with joint authorship entitled "The Lancet Commission on Pollution and health" published in 2018 observed as the most cited paper with 1817 citations.

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