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Development of Faculty Profile Management System Using Indian Research Information Network System: A Study of Indian Institute of Technology (IITs) in India

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Abstract

Academic institutes and R&D organizations collect, curate, organize research-related activities from various diverse sources. The Faculty Profile System or Research Information Management System plays a crucial role in academic institutions organizing scholarly communication data. The research related metadata collected through the Faculty Profile System could be used for various purposes, including research assessment of faculty and department, decision making on allocating funding, ranking of the institute, etc. The study aims to develop a faculty profile management system using the Indian Research Information Network System (IRINS) for seven IITs and analyze the faculty members' research contributions through bibliometric indicators. The study attempted to analyze seven IITs' research performance is based on the publication and citation for the period 2010-2019.

Keywords: Indian Research Information Network System (IRINS), Publication, Citation, h-index, Indian Institute of Technology (IITs), Altmetric, Authorship Pattern, Collaboration Pattern.

1. Introduction

The research output and activities of the Institutes or individuals need to be archived with a matured architecture adhering to International Standards. Institute-level research activities, if organized adequately, as a nation could save huge money and effort. At an international level, non-profit organizations such as Consortia Advancing Standards in Research Administration Information (CASARI) and Open Researcher & Contributor ID (ORCID) are continuously making the research data interoperable and reusable. The Research Excellence Framework (REF) of the UK, Excellence in Research Australia (ERA) of Australia and National Institutional Ranking Framework (NIRF) in India are the national level agencies to assess the performance of the academic institutions in the respective country with various performance indicators. Performance-Based Research Fund (PBRF) is the new framework initiated in 2014 by New Zealand to provide funding assistance to higher education institutions.

3. Statement of the Problem

Setting up a Research Information Management System (RIM) or Faculty Profile Management System (FPMS) is becoming a vital part of academic institutions as the scholarly communication ecosystem becomes more competitive, multi-faceted and globalized. Simultaneously, academic institutes are looking forward to identifying strengths, showcase engagement, and measuring the research output's influence (Bryant et al., 2017). The revolutionary information technology made it possible to retrieve bibliographic information from various sources and analyze the research's impact through various

bibliometric indicators such as annual growth rate of publications, citations, average citations, h-index, i-10 index, collaboration pattern, etc. In the present study, "Development of Faculty Profile Management System using IRINS for the analysis of Research Performance in the field of Science and Technology," the researcher intended to develop the faculty profile management system using IRINS for the selected IITs and analyze the performance of the IITs through various bibliometric parameters.

4. Indian Research Information Network System (IRINS)

The Indian Research Information Network System (IRINS) is a Current Research Information System initiated under the leadership of Mr. Kannan, Scientist C at the Information and Library Network Centre (INFLIBNET), Gandhinagar, in September 2017 Palavesam et al., (2019); Shankar Kimidi & Palavesam, (2020); de Castro et al., (2020). In 2018, the IRINS project received financial support within the National Mission on Education through ICT (NMEICT) for its implementation at higher education institutions in India. IRINS has been subsequently executed as a collaborative project by the INFLIBNET Centre, Gandhinagar and the Central University of Punjab, Bathinda. IRINS facilitates organizations to accumulate scholarly communication activities such as faculty members, affiliation, education, research projects, accomplishments, achievements, research articles and patents. IRINS supports the organization to integrate internal data sources such as HR system, institutional repository, and external system such as citation databases, academic identities, publishers Websites, national and international preprint archives, etc. (IRINS, 2021).

5. Review of Literature

Gangan Prathap (2014) has discussed the performance of educational institutes from India, which are research-intensive. For the longitudinal performance analysis of quality and quantity from 2003 to 2011, datasets from 2013, SIR world reports are used. Hasan & Singh (2015) attempted to evaluate the top five IITs based on publications indexed in Web of Science in five years, i.e., from 2009-2013.

Hadimani et al., (2015) has done a bibliographic analysis of scholarly outputs from the Indian Institute of Science Education and Research, Thiruvananthapuram, for 2008-2013. Bid (2016) has performed a scientometric study on the research outputs of IIT Kharagpur during the period 2000 to 2015 from the Scopus database. This article attempted to analyze the growth in the development of research activities of IIT Kharagpur. Gupta, (2002) has done a scientometric analysis of the Indian Institute of Technology, Kharagpur for 1994-98. The analysis has used departments from the institute, which have at least 25% of their publications indexed in SCI.

Wani & Majeed, (2013) has attempted to gauge the scholarly outputs of IIT Delhi, one of the leading engineering and technological institutes from India. Carr-Wiggin et al., (2019) states that the Current Research Information System (CRIS) is being adopted in Canada faster. Product choices and practices vary across the institutes based on usage. Implementing CRIS at the institute level has various benefits like showcasing research performance, increasing the impact of research, etc. Nishy et al., (2012) has done a trajectory analysis of the *iCX* (Impact-citations-exergy) of the leading research institutes in India. Exergy is derived from the standard research indicator like publication count, citations and their impact. The exergy indicator (*X*) is a multiplicative product of the researcher's group's quality and quantity.

6. Objective of the study

This research investigates the existing faculty profile management system or research information management system and its limitations. Develop and provide faculty information systems as a service to the selected IITs. Evaluate and retrieve suitable data sources for the research-related activities; find out a data retrieval mechanism from various sources. Find a mechanism to use the scholarly communication data effectively to assess the research performance of seven IITs. Prepare detailed data analysis through various bibliometric methods. We will achieve this aim by addressing the following objectives:

- To identify the most mentioned papers based on the Altmetric Score;
- To analyze the publications and their share in positively impacted journal
- To study the collaboration pattern of the faculty members in institutional, national and international collaboration;
- To identify the top 25 country collaboration, its share and its impact.
- To analyze seven IITs' performance rank based on H-Index, Energy Indicator, I-UGR Ranking Indicator, Altmetric Mentions.

7. Methodology

This study aims to demonstrate the publication growth of seven IITs for 2010-2019 quantitatively. This section of the chapter discusses data source, bibliometric and scientometric indicators, statistical tools and other formulas used to compare the research data and analysis. Indian Research Information Network System (IRINS) is an open-source Research Information Management (RIM) system / Faculty Profile System developed by the Information and Library Network Centre under National Mission on Education through ICT. The system interconnected more than 5000 faculty members across the country and accumulated 9.17 lakhs of publication metadata through various sources (IRINS, 2021). For this study, 94805 papers of current faculty members of seven IITs were extracted from the database for the period 2010-2019.

8. Data Analysis and Interpretation

This section presents the analysis and interpretation of 94,805 papers retrieved from the Indian Research Information Network System (IRINS) for the period 2010-2019 of seven IITs. The data has been analyzed quantitatively using various scientometrics, bibliometrics indicators and other statistical techniques. The data analysis and interpretations are presented in the following major categories, including Growth of Publication, Citation Metrics, Author Productivity, Journal Metrics, Altmetric Analysis, Collaboration Network and Ranking of Institute.

8.1 Publication Output, Share and Annual Growth

Table 1. Publication output share and average annual growth rate of seven IITs

Name of Institute	Faculty Members	Publications	Average number of publications per faculty	Share of publication	Average annual growth rate 2011-2019
Seven IITs	3868	94805	24.51	100.00	10.05

IIT Kharagpur	678	16676	24.60	17.59	7.66
IIT Bombay	692	16986	24.55	17.92	10.38
IIT Madras	617	16505	26.75	17.41	10.19
IIT Kanpur	451	11240	24.92	11.86	10.49
IIT Delhi	574	16078	28.01	16.96	10.11
IIT Guwahati	407	10866	26.70	11.46	14.76
IIT Roorkee	449	10977	24.45	11.58	10.69

The data gives information regarding the allocation of data of seven IIT's for a decade. Regarding the number of faculties, we see that IIT Bombay (Indian Institute of Technology Bombay) has the greatest number of faculties (692), whereas IIT Guwahati (Indian Institute of Technology Guwahati) has the least number of faculties, around 407. There is a similar pattern in the number of Publication count; it is inversely proportional to the number of faculties. More the number of faculties more is the number of publications. But where as in the Average number of publications per faculty, the trend varies. IIT Kharagpur, Bombay, Kanpur, Roorkee and IIT Madras, Guwahati is roughly stable, fluctuating around 24.50 and 26.70. In IIT Delhi, however, the average number of publications per faculty is 28.01.

8.2 Altmetric Analysis

Table 2: Publications, Altmetric Mentions and their Share

Name of institute	Publications	Publications with mentions	All Mentions	Mentions per paper	Real Mention per Paper	Share of mention within seven IIT
Seven IIT	94805	13448	642087	6.77	47.75	100%
IIT Kharagpur	16,676	2,143	106,873	6.41	49.87	16.64%
IIT Bombay	16,986	2,882	148,206	8.73	51.42	23.08%
IIT Madras	16,505	2,529	110,222	6.68	43.58	17.17%
IIT Kanpur	11,240	1,855	77,255	6.87	41.65	12.03%
IIT Delhi	16,078	1,964	117,604	7.31	59.88	18.32%
IIT Guwahati	10,866	1,952	77,339	7.12	39.62	12.04%
IIT Roorkee	10,977	1,031	48,234	4.39	46.78	7.51%

The table shows the study of publications and altmetric mention in seven IITs from 2010-2019. Although the number of publications with mentions was relative to the total no of publications in seven IITs, IITR (1,031) fell short to IITG (1,952), which had the lowest publications (10,866). IITR also had the least number of mentions (48234) when compared to other IITs whose mentions were in accordance with the number of publications. For instance,

IITB, with the highest no of publications (16,986), had the highest no mentions (14806), followed by IITKGP (106,873), which had the second-highest no of publication (16,676). IITK with 11,240 publications was the only exception of having mentions (77,255) lesser than IITG (77,339) with just 10,866 publications. However, colleges with lower publications had better mention per paper when compared to their predecessors except for IITB, which continued to top the list at 8.73 mentions per paper and IITR which was still at the bottom (4.39). The trend almost remained the same for real mention per paper as well, with IITD (59.88) surpassing IITB (51.42) to be at the top and IITR climbing to the 4th spot at 46.78 respectively. Finally, the share of mention within seven IITs revealed that only IITB was consistently at the top. Therefore, from the table, it could be inferred that publications and altmetric mentions were not dependent on the number of publications in seven IITs from 2010 - 2019.

Table 3: Publication and share of mention in most mention papers of seven IITs

Name of institute	Publications	All mentions	Average mentions per paper	Share of mentions in seven IITs
Seven IIT	1344	145,006	107.83	100
IIT Kharagpur	200	26016	130.08	14.87%
IIT Bombay	316	35,328	111.80	23.50%
IIT Madras	240	21134	88.06	17.85%
IIT Kanpur	176	20,914	118.83	13.09%
IIT Delhi	227	33,509	147.62	16.88%
IIT Guwahati	197	18981	96.35	14.65%
IIT Roorkee	70	4219	60.27	5.21%

The table shows the study of the top 10% of publication share in most mentions' papers of seven IITs from 2010 to 2019. The data indicate that publications and all mentions were not proportional because only IITB with maximum no publications (316) had the highest no of all mentions (35,328), and IITR with the minimum publication (70) had the lowest no of all mentions (4219). There was no specific relationship between the publications and all mentions for the other colleges. A similar trend could be observed with respect to average mention per paper as well. For instance, the average mention per paper for IITB (111.80) had gone below IITK (118.83), IITKGP (130.08), and IITD (147.62), respectively. However, the trend became relative for the share of mention within seven IITs. In Summary, it was clear that though the mentions and average mentions were fluctuating with respect to the no of publications, the share of mentions within seven IITs increased with the number of publications.

Table 4: Publication, news mention and their share of seven IITs

Name of institute	Publications	Publication with mentions	News count	News mentions per paper	Share of news mention
Seven IIT	94,805	13448	66943	4.98	100
IIT Kharagpur	16,676	2143	5899	2.75	8.81%

IIT Bombay	16,986	2882	19315	6.70	28.85%
IIT Madras	16,505	2529	11677	4.62	17.44%
IIT Kanpur	11,240	1855	10140	5.47	15.15%
IIT Delhi	16,078	1964	11345	5.78	16.95%
IIT Guwahati	10,866	1952	7425	3.80	11.09%
IIT Roorkee	10,977	1031	6272	6.08	9.37%

The table shows the study of publications, news mentions and their share in seven IITs from 2010-2019. Even though the number of publications with altmetric mentions was relative to the total no of publications in seven IITs, IITR (1,031) fell short of IITG (1,952), which had the lowest publications (10,866). However, the IITKGP had the lowest news count (5899) despite being the second-highest in total publication (16,676). Average news mentions per article data showed no relationship with the total publication as IITKGP continued to be at the bottom with 2.75 whereas IITR, which had the lowest news count (6272), jumped to the second spot (6.08) only after IITB with 6.70. The trend remains the same, with IITKGP at the bottom (8.81) and IITR falling to 9.37%, only next to IITKGP when it came to the share of news mentions in seven IITs. Overall, there was no correlation between publication, news mentions and its share in seven IITs from 2010-2019.

Table 5: Publication, blog post mention and their share of seven IITs

Name of institute	Publications	Publication with mentions	Blog post mention	Blog post mentions per paper	Share of blog post mention
Seven IIT	94,805	13448	19793	1.47	100%
IIT Kharagpur	16,676	2143	2,980	1.39	15.06%
IIT Bombay	16,986	2882	5,069	1.76	25.61%
IIT Madras	16,505	2529	3,554	1.41	17.96%
IIT Kanpur	11,240	1855	2,522	1.36	12.74%
IIT Delhi	16,078	1964	2,974	1.51	15.03%
IIT Guwahati	10,866	1952	2,793	1.43	14.11%
IIT Roorkee	10,977	1031	1,230	1.19	6.21%

The table shows the study of publication and blog post mention of seven IITs and their share from 2010 to 2019. Despite the fact, the number of publications with blog post mentions was relative to the total number of publications in seven IITs, IITR (1,031) fell short of IITG (1,952), which had the lowest publications (10,866). However, the blog post mentions were rather fluctuating for all the colleges except IITB (5,069), which retained the top position and IITR (1230), which remained at the bottom. The blog post mention per article was almost the same for all the colleges (around 1.50), whereas the share of blog post mention within seven IITs showed random values with IITG (14.11) spiking above IITK (12.74) and IITKGP (15.06) falling below IITM (17.96) respectively. Thus, the number of

publications and blog posts mentions seven IITs and its share was not related from 2010 to 2019.

Table 6: Publication, wiki mention and their share of seven IITs

Name of institute	Publications	Publication with mentions	Wiki mention	Wiki mentions per paper	Share of wiki mention
Seven IIT	94,805	13448	18,089	1.35	100%
IIT Kharagpur	16,676	2143	2,760	1.29	15.26%
IIT Bombay	16,986	2882	4,348	1.51	24.04%
IIT Madras	16,505	2529	2,866	1.13	15.84%
IIT Kanpur	11,240	1855	2,199	1.19	12.16%
IIT Delhi	16,078	1964	3,230	1.64	17.86%
IIT Guwahati	10,866	1952	2,356	1.21	13.02%
IIT Roorkee	10,977	1031	1,662	1.61	9.19%

The table shows the study of research papers and wiki mention of seven IITs from 2010-2019 and their share. The table showed that the number of publications of the seven IITs and their corresponding altmetric mention was relative except IITR, whose altmetric mention (1031) was lesser than IITG (1952), which had the lowest publication (10866) among all the IITs. Further, the trend remained the same for Wiki mention count, with IITB having the highest count (4,348) and IITR having the lowest count (1662), respectively. On the contrary, IITR surpassed IITB in wiki mention per article. IITR with 1.61 was only second to IITD, which had 1.64 wiki mentions per article. However, the trend reversed with IITB having the maximum share of wiki mention within seven IIT at 24.04%, followed by IITD with 17.86%. It could be observed that IITs with more publications performed consistently when compared to IITs with fewer publications. Summarizing, it was inferred that publications were not relative to the wiki mentions and their share from 2010 – 2019.

Table 7: Publication, Mendeley mention and their share of seven IITs

Name of institute	Publications	Publication with mentions	Mendeley mention	Mendeley mentions per paper	Share of Mendeley mention
Seven IIT	94,805	13448	432,666	32.17	100%
IIT Kharagpur	16,676	2143	74,568	34.80	17.23%
IIT Bombay	16,986	2882	93,983	32.61	21.72%
IIT Madras	16,505	2529	76,166	30.12	17.60%
IIT Kanpur	11,240	1855	45,948	24.77	10.62%
IIT Delhi	16,078	1964	85,194	43.38	19.69%
IIT Guwahati	10,866	1952	52,885	27.09	12.22%
IIT Roorkee	10,977	1031	33,450	32.44	7.73%

The table shows the study of publication and Mendeley's mention of seven IITs and their contribution from 2010 to 2019. Initially, there was a rise in altmetric mention of IITs with respect to their number of publications. The only exception was IITR which had the lowest mention (1031) despite having more publications than IITG. The same trend followed for the Mendeley mention, with IITB having the highest mentions (93983) corresponding to its highest altmetric mention (2882) and IITR with the lowest mentions (33,450) relating to its lowest altmetric mention (1031). However, the trend reversed with IITD emerging with 43.38, the highest average mention per paper, while IITR is climbing to the 4th position at 32.44 average mentions per paper. Finally, the share of mention in seven IITs suggested that it was not directly proportional to their number of publications. For instance, IITB (16,986), IITD (16,078), IITM (16,505), and IITKGP (16,676), had 21.7%, 19.69%, 17.23%, and 17.60% respectively whereas IITG (10,866), IITK (11,240) and IITR (10,977) had 12.22%, 10.62%, and 7.73% respectively. Thus, it was inferred that Publication and Mendeley mention seven IITs and its share was not relative.

8.3 Journal Metrics

Table 8: Publication distribution in highly impacted journal (CiteScore 10%)

Name of institute	Publications	Citations	Citations per paper
Indian Institute of Technology Kharagpur	3918	95238	24.31
Indian Institute of Technology Bombay	3759	95063	25.29
Indian Institute of Technology Madras	3913	91063	23.27
Indian Institute of Technology Kanpur	2393	57664	24.10
Indian Institute of Technology Delhi	3561	98040	27.53
Indian Institute of Technology Guwahati	2577	65123	25.27
Indian Institute of Technology Roorkee	2098	60131	28.66

The table gives the detail of publication distribution in highly impacted journals (Top 10% in Cite Score Percentile) by seven IITs from 2010 – 2019. The table illustrates that no publication was directly proportional to no citation. IITKGP, IITB, IITM and IITD with higher no of publication had higher citation when compared to IITK, IITG and IITR with lower no of publications. For instance, IITKGP, with the highest publication (3918), had the second-highest citations (95238), whereas IITR, with the lowest publication (2098), had the lowest citation (60131) respectively. The trend remained the same for all the IITs. However, the trend reversed for citation per paper as the top 4 IITs had relatively lower values when compared to their counterparts. It could be observed that IITM, with the second-highest publication (39130), had the lowest citation per paper (23.27), whereas IITR with the lowest publication (2098) had the highest citation per paper (28.66). The only exception was IITD which had better citations per paper when compared to IITKGP, IITB and IITM. Lastly, it could be inferred that number of publications was directly proportional to a citation but inversely proportional to citation per paper.

Table 9: .Share of publication and citation in highly impacted journal (CiteScore 10%) and H-index

Name of institute	Share of publication	Share of citation	H-index
Indian Institute of Technology Kharagpur	23.49%	46.76%	102
Indian Institute of Technology Bombay	22.13%	48.96%	103
Indian Institute of Technology Madras	23.71%	49.81%	104
Indian Institute of Technology Kanpur	21.29%	47.08%	90
Indian Institute of Technology Delhi	22.15%	48.49%	108
Indian Institute of Technology Guwahati	23.72%	48.79%	90
Indian Institute of Technology Roorkee	19.11%	44.21%	97

The table gives the detail of the share of publications and citations in highly impacted journals (Top 10% in CiteScore percentile) by seven IITs during 2010 – 2019 within the institute. The share of publications of different IITs almost had the same values except for IITR, which had the lowest value (19.11%). The trend continued for the share of citations, with the only difference IITM and IITG swapped their position. IITG had the highest share of publications with 23.72%, and IITM had the second highest with 23.71%, but after swapping, IITM had the highest share of citations (49.81%) and IITG had the second-highest share of citation (48.79%). Besides, IITR was still at the bottom with 44.21%. However, the H-index values seemed erratic, with IITD (108) at the top and IITK (90) and IITG (90) at the bottom. Thus, it was evident that though the share of publication and share of citation were proportional, H-index was not related to either of them.

8.4 Collaboration and Network

Table 10: Publication output in single-authored, institutionally, nationally and internationally co-authored papers of seven IITs

Name of institute	Publications	Single author papers	Institutionally collaborative papers	Nationally collaborative papers	Internationally collaborative papers
Seven IITs	94805	2119	46143	25,372	21,171
IIT Kharagpur	16676	364	7770	5,071	3,471
IIT Bombay	16986	401	7171	4,953	4,461
IIT Madras	16505	288	8095	4,073	4,052
IIT Kanpur	11240	340	5080	2,971	2,849
IIT Delhi	16078	423	6965	5,278	3,412
IIT Guwahati	10866	178	5922	2,696	2,070
IIT Roorkee	10977	125	5140	3,479	2,233

The data shows that there was no correlation between the total publications of seven IITs with single author publication, publication with institutional collaboration, publication with national collaboration or publication with international collaboration. For instance, IITB, with the highest publication (16986), topped only for international collaboration (4461). Similarly, IITG, with the lowest publication (10866), was at the bottom only for international collaboration (2070). The same trend continued for other IITs. Only IITKGP showed some consistency. With the second-highest publication (16676), it held its position for all the publications except single-author publications, where it stood third highest (364). Thus, it is clear that single-author publication, the publication with institutional, national and internal collaboration, didn't depend on the total number of publications but the institutes.

9. Suggestions

The present study discusses the development of the faculty profile management system and analyses the seven IITs' research performance. In the recent past, universities and private agencies ranking the institutes based on publications, quality of the publication and its impacts, such as National Taiwan University Ranking, I-UGR Ranking, Global Research Benchmarking System (GRBS) and University Ranking by Academic Performance (URAP). The stakeholder may consider the following suggestion for the betterment of research performance;

- Establish a research information management cell at the institute level, identify the high-impact journal in different subject areas, monitor and support funding proposals, international collaboration, and other research-related activities.
- Encourage faculty members to publish the papers in the open-access journal or hybrid journal to reach out wider research community without any barrier by providing funding support to publish papers;
- Encourage faculty members to archive the pre-print and post-print versions of the papers in the institutional repository and share social media to attract more viewership and quicker citations.
- Based on IRINS data, the research could be carried out to compare all the centrally funded institute and their research performance regarding publications, citations, and impact.

10. Conclusion

This study aimed to examine the faculty profile management system and its impact in the higher education system to showcase faculty members' research contributions to the peer group and analyze the selected institute's research performance based on the publications, citation, and impact. The faculty profile system has been created using Indian Research Information Network System for seven IITs and data retrieved, analyzed through various bibliographic indicators. The quantity and quality of research output of seven IITs have been compared. It has concluded that the seven IITs together published 94805 papers, their year-wise publications steadily increased from 5894 papers in 2010 to 13913 papers in 2019, and the average annual growth rate is 10.15. The increased percentage of publications from 2010-2019 reveals that all the IITs (125.78 percentage) research performance is praiseworthy. The IIT Guwahati publication increased percentage from 2010-2019 is 238.94, and it is the highest among the IITs.

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