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Research Performance of National Institute of Technology Rourkela: A Scientometric Analysis

Bijayananda Pradhan^a Ramesh Kuri^b Kunwar Singh^c Gireesh Kumar T K^d Pritam Kumar Pati^e

ABSTRACT

This paper's main objective is to perform a scientometric study on the National Institute of Technology, Rourkela, research publications, as reflected in the Scopus Database. The study evaluated the quantitative growth, author and Institute collaborations, using different scientometric dimensions. Appropriate keywords were used to cover the entire spectrum of research publications that yield 9233 results from the database. To make the analysis concise to get better outcomes, authors have limited the study period to the publications produced from 2000 to 2019. This study analyzed different aspects of research productivity, such as year-wise growth of publications, most preferred sources for the publications, authorship pattern, subject-wise distribution of papers, etc. Furthermore, the study also explored the international research collaboration patterns of the authors. The analysis identified 2018 as the most productive year with a publication of 1339 research papers and 102692 citations for all publications during the selected period, with an average of 11.12 citations per paper. The majority of the papers have double authorship patterns, and the degree of collaboration and collaborative co-efficient is apparent with a total of 0.97 and 0.61, respectively. The study further identified that Mahapatra, S. S was the most productive author with 295 articles and 5650 citations and the "Core/shell nanoparticles: classes, properties, synthesis mechanisms, characterization, and applications" by Ghosh Chaudhuri R Paria S. published in Chemical Reviews of 2012 is the most highly cited (2045) paper and 'IOP Conference Series Material Science and Engineering' is the topmost preferred source of publication. Scientometric studies are useful tools for measuring the scientific and technological progress that cannot be directly measured. Various scientometric indicators are used as analytical tools to perform such assessments.

Keywords: *Scientometric analysis, Authorship pattern, Subject domain, Scientometric study, Open access, Research productivity, NIT Rourkela*

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1. INTRODUCTION

Research productivity is considered one of the various dimensions to measure an institution's performance and an individual. It is a deliberate practice to measure and evaluate an institution's research productivity to plan and enhance its recognition. Such assessments enable the Institution and individual to realize the shortfalls and thereupon to upgrade the performance. The number of research publications produced in different disciplines can be retrieved and analyzed with different indexing and citation databases. Scopus, Web of Science, PubMed, ICI, Google Scholar, etc. are tools that cover a wide range of publications to perform the citation analysis.

Further, scientometrics is a discipline that analyses scientific publications to explore the trend and growth of science. A scientific field studies the evolution of science through some quantitative measures of scientific information. The number of scientific articles published in a given period, their citation impact, etc. Scientometric studies are useful tools in quantitatively measuring the scientific and technological progress that cannot be directly measured otherwise. Various scientometric indicators are used as analytical tools to perform such assessments.

This study intends to analyze the National Institute of Technology Rourkela's research productivity for a specific period to evaluate and assess the publication impact. NIT Rourkela, formerly Regional Engineering College Rourkela (REC Rourkela) established on 15 August 1961(<https://www.nitrkl.ac.in/>). It has been recognized as an Institute of National Importance by the National Institutes of Technology Act, 2007. This institute has 22 different Engineering, Physical Science, Management, and Humanities departments that incorporate extra academic activity and the central workshop. According to the latest list published by the Times Higher Education (THE) World University Rankings, Rourkela's NIT in 2020 reached 801-1000 in the world category. The Human Resources Development Department (MHRD) has included NIT Rourkela in the NIRF ranking for 32 and 16th position among technical schools (including IITs). NIT Rourkela is the third-best NIT among all NITs and the first among Odisha institutes in India.

This research was conducted to assess the National Institute of Technology Rourkela's research productivity based on the Scopus database's publication. This study evaluates the quantitative growth, the collaboration between the author and the institute, and the research's effectiveness due to the different scientometric dimensions.

To make the analysis concise and get better outcomes, authors have limited the study period to the publications produced from 2000 to 2019.

2. REVIEW OF LITERATURE

Research studies are carried out to understand the characteristics of variables on specific subject areas. As a scientific means, research studies can either be qualitative or quantitative, where the researchers have to collect data and variables to support their studies and justify their statements. Nowadays, research is often used to evaluate scientific literature. This study's results may assist increase the visibility of institutions, trends in research performance, research collaboration, etc. and grab funding agencies' attention to support the research pursuits.

Different research methods, tools, and techniques are used to measure research publications' patterns and explore the research impact qualitatively and quantitatively. The assessment can be for a particular subject field, specific field of research, or set of researchers or measuring a particular research paper's impact. Scientometric techniques have also been used to measure and analyze the scientific literature of particular institutions. There are many such studies performed nationally and globally. Some of the studies are analyzed here to support the present research study.

Agrahari et al. (2020) evaluated bamboo research results for 29 years (1989-2018). The web of Science (WoS) database was used to take publication notes and analyzed using descriptive statistics. The authors have applied various indices such as the most productive countries, authors, journals, institutions wise, growth rate, and doubling time. The study shows that local and national collaboration is mostly observed in the paper. India is the most productive country globally, followed by China and the Indian Institute of Technology. India is a leader in bamboo research.

Kumar (2020) analysed the Indian Institute of Technology (Indian School of Mines) Dhanbad for twenty years from 2000-2019. The findings of the study pointed out a notable rise in research productivity during this period. Further, the author has also emphasized that the institute's researchers should focus on publishing in open access journals so that their research publications might get complete access and increase the possibility of getting more citations.

Banshal et al. (2019) compared the research performance of private universities in India with IITs, central universities, and NITs. It was observed that private universities in India had increased significantly. According to the AISHE report of 2016, out of 799 universities in India, 277 Private universities are becoming a significant component of the Indian higher education system. The study shows that private universities are exclusively positioning and projecting themselves as universities for high-quality research and innovation. Further, it shows that a few of them are now well placed in the national-level NIRF ranking framework. The results showed that private universities performed well in the research sector, especially in production and production growth rates. This study presents a detailed scientometric assessment of some most productive private universities in India.

Nidhisha and Sarangapani (2019) carried out a scientometric analysis of NIT's research productivity, Calicut, during 2015-2019 using the Web of Science database and identified 875 records. The study analyzed the year wise productivity of the Institution, type of publications, research areas, sources preferred for publication, most productive authors, authorship pattern, collaborating countries, institutions, etc. and found that articles are the most published form documents (95.89%). The most preferred authorship pattern is of two authors (33.14%).

Jeyapragash & Rajkumar (2019) examine the Indian Institute of Technology (IITs) memberships and research contributions in ResearchGate. The study's findings revealed that 18 IITs have contributed and also shared the research information through ResearchGate. Further, the authors have analyzed Memberships of Faculties and Research Scholars, Research Contributions, ResearchGate (RG) Scores of IITs. It was also found that the Indian Institute of Technology, Bombay has more members (8,439) with 6,320 publications and significantly fewer members by the Indian Institute of Technology; Palakkad has 15 members with no publications. It was suggested that Mandi, Gandhinagar, Jodhpur, and Palakkad IITs should come forward to contribute their research contributions in ResearchGate.

Patel & Malhan (2018) analyse the publications' output of the National Institute of Technology, Hamirpur, by using the Web of Science database to collect the data from 2013 to 2017. A total of 859 publications data were retrieved and analyzed. The study's finding shows that NIT, Hamirpur's research output was continuously increasing except a little slow down in 2017. The analysis of the study indicates a high rate of collaborative work. Further,

it was also indicated that most of the publications were research articles, followed by conference proceedings papers.

Patel (2018) conducted a scientometric study to examine NIT's research productivity, Raipur, from 2012 to 2016, as reflected in the science database web. A total of 497 publications were retrieved and analyzed based on year-wise growth, authorship pattern, subject-wise growth, country collaboration, institution collaboration, etc. The authorship pattern revealed that the maximum number of papers was 162(32.60%) from three authors.

Banshal et al. (2017) conducted an analysis of the research performance of 16 earlier established Indian Institutes of Technology (IITs) in India using the Web of Science database. The authors have applied various indicators to identify the productivity, productivity per capita, growth rate of research output, authorship and collaboration pattern, citation impact, and discipline-wise research strengths of the different IITs. Further, the IITs' research performances have been compared with the world two top-ranking engineering and technology institutions (MIT-USA and NTU-Singapore). It was clear from the comparison that IITs have a long way to go if they have to become comparable to the world's best institutions in terms of research performance.

Mandhirasalam (2016) performed a scientometric study on publication output of PSG College of Technology (PSGCT), Coimbatore, based on the Scopus database's data from 1971 to 2014. The study identified that among the 2357 papers published, the highest number of 319 papers was published in 2012. Two thousand one hundred twelve papers (89.6%) were published during the last ten years, i.e., from 2005 to 2014. Journal is the most preferred channel of publication with 1633 papers. 'h' Index of PSGCT is 41. This study reveals that PSGCET has contributed mainly to research in science, engineering, and technology, and faculty's publication output has increased considerably during the last ten years.

3.OBJECTIVES

The present study's general objective was to evaluate the publication output of NIT Rourkela for a selected period from 2000-2019. However, the study intended to perform some specific objectives are as follows:

- To find out the growth of research productivity of NIT Rourkela during 2000-2019;
- To examine the authorship pattern and collaboration coefficient of research productivity;

- To find out the most prolific authors from NIT Rourkela during the selected period of study;
- To find out annual growth rate (AGR), Relative growth rate (RGR) and Doubling Time (Dt);
- To identify the highly cited research publications and preferred source for publication;
- To examine the subject-wise distribution of research publications and the institutional and countries collaborations

4. METHODOLOGY

Research performance is one of the essential factors used by accreditation agencies to rank higher learning institutes based on their performance. Research productivity of institutions as a whole and the effect of individual researcher's performance, in particular, is the basis of evaluation for such recognition agencies. The purpose of this particular study is to analyze the research performance of NIT Rourkela. The authors have obtained publication data from the Scopus database about it. A search was carried out by accessing the Scopus database: one of the globally leading and largest abstracting and citation databases of peer-reviewed literature. The following search strategy has been used in the Scopus database to retrieve the data about the study. The search string used for retrieval of data is "AF-ID ("National Institute of Technology Rourkela" 60000934) and PUBYEAR after 2000 and Before 2019 and (limit-to (PUBSTAGE, "final"))." A total of 9233 publications data were retrieved and processed for data cleaning. Finally, it was scrutinized by the scientific tools and techniques to determine the achievement of the study objectives.

5. RESULT AND DISCUSSION

5.1 Year-wise distribution of research productivity

The trend of annual publications and citations over 20 years presented in Figure 1. It is observed from table 1 & figure 1 that there is a seamless progressive growth is found in both publication and citations counts. Upon analysing the data extracted, publications' growth is continuously increasing till 2018 and slightly decreased in 2019. Among the total 9233 publications, the highest number of publications occurred in 2018. It is important to note that in the last twenty years, of these total 9233 publications, almost 52% or 4834 publications

were published from the last four years of 2016 to 2019 (Mukherjee, 2020). This is found to be unexpectedly enormous. Further, to all 9233 publications, a total of 102692 citations were received, with an average of 11.12 citations per paper. The highest i.e., 14624 of citations, appeared in 2016. Over the study period, the NIT Rourkela publication is continuously increasing, whereas a fluctuating trend is found in citations.

Table.1: Year-wise growth pattern of publications with citation

Year	TP	TC	ACPP	Year	TP	TC	ACPP
2000	53	1275	24.06	2011	431	6034	14
2001	40	503	12.58	2012	507	9590	18.92
2002	47	568	12.09	2013	594	8598	14.47
2003	36	778	21.61	2014	693	9404	13.57
2004	45	884	19.64	2015	831	10302	12.4
2005	59	762	12.92	2016	1029	14624	14.21
2006	80	2138	26.73	2017	1160	8929	7.7
2007	116	2655	22.89	2018	1339	6516	4.87
2008	200	3452	17.26	2019	1306	3172	2.43
2009	301	6102	20.27	Total	9233	102692	11.12
2010	366	6406	17.5				

*TP=Total publication, TC=Total citations, ACPP=Average citation per year

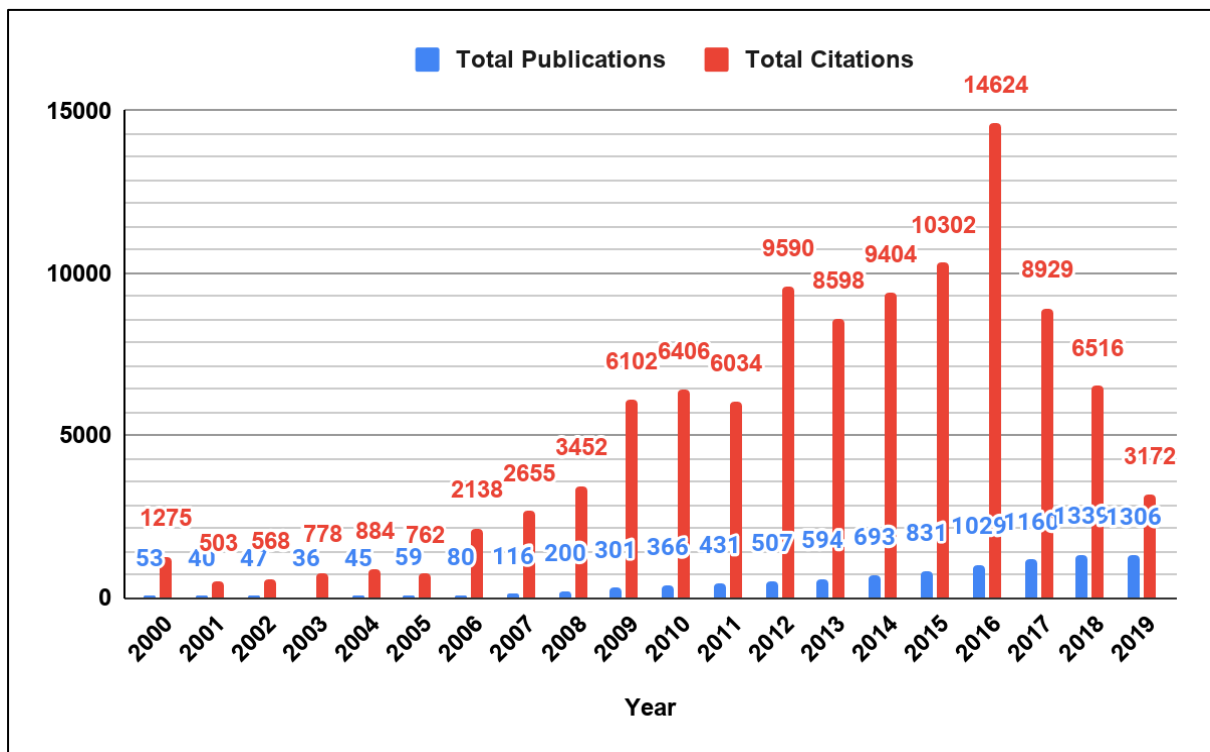


Fig.1: Year-wise growth pattern of publication with citations

5.2 Authorship pattern with DC and CC

Collaboration in research is an essential trigger for the growth of publications. Through an analysis of 9233 publications of NIT Rourkela, the majority, i.e., 8955 of publications were published under multiple authorship patterns. In which two authors published a maximum of 3282 (35.5%) of articles. The authorship collaboration in publications during a specific period can be calculated using the Degree of Collaboration (DC) indicator (Subramaniam, 1983) $DC = \frac{Nm}{Nm+Ns}$. The number of collaborative research papers to the total number of research papers in the discipline during a specific period is measured and varied from 0.83 to 0.99 in different years with an average (mean) collaboration of 0.97. The highest degree of collaboration, 0.99, is calculated in the year 2017. Further, to measure collaboration's strength, the following formula of Collaboration Coefficient $CC = 1 - (\sum(j=1)^k(\frac{1}{j}))$ (Ajiferuke, Burell, & Tague, 1988) has been used. It is measured and found that the CC is varied from 0.51 to 0.65 in different years. The average Collaborative Coefficient is 0.62. The highest collaboration coefficient, 0.65, is calculated in 2019 (Yadav et al., 2020). It is evident from the study that the average CC is more prominent than 0.6, and hence it shows that the NIT Rourkela research collaboration is better.

Table 2. Authorship Pattern with DC and CC

Year	One Author	Two Authors	Three Authors	Four Authors	Five and Above	Multi Authors	Total Authors	DC	CC
2000	9	17	15	9	3	44	53	0.83	0.52
2001	3	24	10	1	2	37	40	0.93	0.53
2002	4	18	21	4	0	43	47	0.91	0.55
2003	5	12	14	4	1	31	36	0.86	0.53
2004	5	20	12	7	1	40	45	0.89	0.53
2005	10	20	22	5	2	49	59	0.83	0.51
2006	12	27	28	8	5	68	80	0.85	0.53
2007	5	51	32	19	9	111	116	0.96	0.59
2008	12	71	54	41	22	188	200	0.94	0.60
2009	15	91	104	60	31	286	301	0.95	0.61
2010	24	151	103	51	37	342	366	0.93	0.58
2011	13	171	131	71	45	418	431	0.97	0.61
2012	9	196	166	82	54	498	507	0.98	0.62
2013	20	243	185	78	68	574	594	0.97	0.60
2014	25	285	174	119	90	668	693	0.96	0.61
2015	15	309	248	133	127	817	832	0.98	0.63
2016	20	353	309	181	166	1009	1029	0.98	0.63
2017	17	384	361	200	198	1143	1160	0.99	0.64
2018	29	432	373	258	247	1310	1339	0.98	0.64
2019	27	407	336	227	309	1279	1306	0.98	0.65
Total	279	3282	2698	1558	1417	8955	9234	0.97	0.62

*DC=Degree of Collaboration, CC= Collaboration Coefficient

5.3 Highly Prolific Authors

A total of 9234 authors, including international authors, have contributed to the 9233 publications from 2000 to 2019. It is apparent that Mahapatra, S. S. was the most productive author during the study period with a complete publication of 295 articles and 5727 citations with an average of 5.15 citations. His h-index is impressive with 38. Subudhi, B. published 191 research articles and received 3793 citations with 19.85 average citations, and his h-Index has appeared as 27. It is justified from the analysis that citation metrics are critical measures for the quality of publications. Citation defines a scientist's research work and its value in the world of research (Kumar Satish, 2018). It is very affirmative to see that NIT, Rourkela scientists are being honored by receiving many citations for their research publications. Figure 2 represents the details of high prolific authors with their total citations and h-indexes.

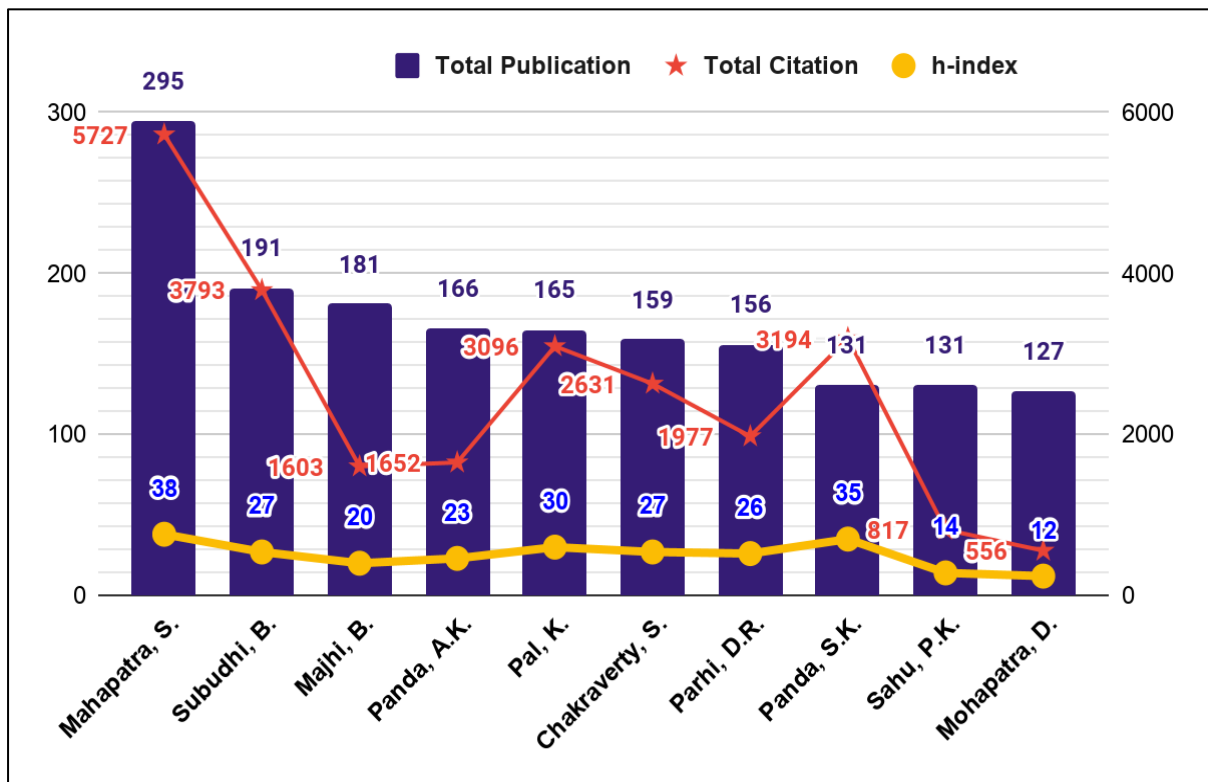


Fig. 2: Highly Prolific Authors

5.4 Average Growth rate (AGR), Relative Growth rate (RGR), and Doubling times (Dt)

Table 3 depicts two measures to assess the growth rate of literature in any subject domain, i.e., Annual Growth Rate (AGR) & Relative Growth Rate (RGR). The AGR determined as per the formula $AGR = \frac{\text{end value} - \text{first value}}{\text{first value}} \times 100$ and found a total average growth rate of

606.97 during 20 years of the study period. The variation trend in AGR is observed from 0.00 (2001) to -2.46 (2019). Further, the RGR determines the growth in terms of a rate of increase in size per unit of size (Hunt, 1990). For calculating the mean relative growth rate (RGR) over the specific period of the interval, the formula $RGR = (1 - 2^r) = \frac{\ln(W2) - \ln(W1)}{T2 - T1}$ is employed and found varies from 0 to 0.15 from 2000 to 2019. Whereas Doubling time (Dt) used to indicate the period required for a quantity to double in size or value. To know the Dt, the researchers applied formula for $Doubling\ Time = \frac{D(t)0.693}{RGR}$ for calculating Doubling Time. However, the Doubling Time (DT) has found a periodical growth over the years from 0 to 4.54. It is evident from the table that AGR & RGR, and Dt are inversely proportional to the engineering science and technology field at NIT Rourkela.

Table 3. Average Growth rate, Relative Growth rate and Doubling times

Year	TP	AGR	CT	W1	W2	RGR	Dt
2000	53	0.00	53	0	3.97	0	0
2001	40	-24.53	93	3.97	4.53	0.56	1.23
2002	47	17.50	140	4.53	4.94	0.41	1.69
2003	36	-23.40	176	4.94	5.17	0.23	3.03
2004	45	25.00	221	5.17	5.40	0.23	3.04
2005	59	31.11	280	5.40	5.63	0.24	2.93
2006	80	35.59	360	5.63	5.89	0.25	2.76
2007	116	45.00	476	5.89	6.17	0.28	2.48
2008	200	72.41	676	6.17	6.52	0.35	1.98
2009	301	50.50	977	6.52	6.88	0.37	1.88
2010	366	21.59	1343	6.88	7.20	0.32	2.18
2011	431	17.76	1774	7.20	7.48	0.28	2.49
2012	507	17.63	2281	7.48	7.73	0.25	2.76
2013	594	17.16	2875	7.73	7.96	0.23	2.99
2014	693	16.67	3568	7.96	8.18	0.22	3.21
2015	831	19.91	4399	8.18	8.39	0.21	3.31
2016	1029	23.83	5428	8.39	8.60	0.21	3.30
2017	1160	12.73	6588	8.60	8.79	0.19	3.58
2018	1339	15.43	7927	8.79	8.98	0.19	3.75
2019	1306	-2.46	9233	8.98	9.13	0.15	4.54
Total	9233	606.97	18466	9.13	9.82	5.16	53.13

* TP=Total publication, AGR=Annual growth rate, CT=Cumulative Total, RGR=Relative growth rate, DT=Doubling times

5.5 Top ten Highly Cited Publications

Table 4 listed the top 10 highly cited publications. Citation received for each publication year is varied from highest 2045 to lowest 294. The Average Citation per Paper of the total publications is 11.12. Among the top 10 highly cited papers, the first two articles have received more than 1000 citations, i.e., Core/shell nanoparticles: classes, properties, synthesis mechanism, characterization and applications by Ghosh Chaudhuri R., and Paria S. published in Chemical Review (2012) & A comparative study on maximum power point tracking techniques for photovoltaic power systems by Subudhi G., and Pradhan R. published in IEEE Transactions on Sustainable Energy (2013), The remaining publications as indicated in the table have received average citations between highest 997 to lowest 230.

Table 4. Top ten Highly Cited Publications

Sl. No.	Authors	Title	Year	Source title	Citation
1	Ghosh Chaudhuri R., Paria S.	Core/shell nanoparticles: classes, properties, synthesis mechanisms, characterization, and applications	2012	Chemical Reviews	2045
2	Subudhi, B., Pradhan, R.	A comparative study on maximum power point tracking techniques for photovoltaic power systems	2013	IEEE Transactions on Sustainable Energy	1016
3	Sahu et al.	Simple one-step synthesis of highly luminescent carbon dots from orange juice: application as excellent bio-imaging agents	2012	Chemical Communications	957
4	Sood A.K., Ohdar R.K., Mahapatra S.S.	Parametric appraisal of mechanical property of fused deposition modelling processed parts	2010	Materials and Design	479
5	Dash P.K., Panigrahi B.K., Panda G.	Power quality analysis using S-transform	2003	IEEE Transactions on Power Delivery	377
6	Panda A.K.,	Thermolysis of waste plastics to liquid fuel. A suitable method for	2010	Renewable and Sustainable	330

	Singh R.K., Mishra D.K.	plastic waste management and manufacture of value-added products-A world perspective		Energy Reviews	
7	Sen T.K., Khilar K.C.	Review on subsurface colloids and colloid-associated contaminant transport in saturated porous media	2006	Advances in Colloid and Interface Science	326
8	Paria S.	Surfactant-enhanced remediation of organic contaminated soil and water	2008	Advances in Colloid and Interface Science	324
9	Sood A.K., Ohdar R.K., Mahapatra SS.	Improving dimensional accuracy of Fused Deposition Modelling processed part using grey Taguchi method	2009	Materials and Design	311
10	Ray B.C.	Temperature effect during humid ageing on interfaces of glass and carbon fibers reinforced epoxy composites	2006	Journal of Colloid and Interface Science	294

5.6 Top ten Preferred Source for Publications

Table 5 shows the top ten preferred sources which published most of the articles contributed by the authors of NIT Rourkela. The observation of a specific table, the IOP Conference Series materials science and Engineering, is the top-ranked selected source for publication of 141 articles with 31 h-index. Followed by Advances in Intelligent Systems and Computing with 128 articles and Materials Today Proceedings with 122 articles, AIP Conference Proceedings with 106 articles and stood in the fourth position.

It is also observed that the top ten publications were published in the conference proceedings except one, 'Journal of Alloys and Compounds.' The finding revealed that academicians and researchers prefer to publish their research work with high impact conference volume.

It is also clear from the study that among the top ten most preferred sources for publication impact factors (IF) ranging from 0.53 to 4.65. Further, country-wise distribution of the top ten preferred sources shows that the UK has published 385 articles in 4 sources followed by Germany (190) articles and USA (157) articles each in 2 sources each, Malaysia with 86

publications in one source, and Netherlands 49 articles in one source. It is concluded that the researchers have preferred to publish their research articles in international conference proceedings and journals.

Table 5. Top ten most Preferred Source for Publications

Sl. No	Source	Country	TP	h-index	Cite Score	SJR	SNIP	IF
1	IOP Conference Series Materials Science and Engineering	UK	141	31	0.6	0.198	0.543	0.53
2	Advances in Intelligent Systems and Computing	Germany	128	34	0.9	0.184	0.429	0.57
3	Materials Today Proceedings	UK	122	27	1.3	0.304	0.576	0.97
4	AIP Conference Proceedings	USA	106	64	0.6	0.190	0.373	0.40
5	IEEE Region 10 Annual International Conference Proceedings TENCON	Malaysia	86	36	1.0	0.169	0.393	0.38
6	Ceramics International	UK	68	100	6.1	0.891	1.310	3.64
7	Lecture Notes in Computer Science	Germany	62	356	1.9	0.427	0.776	1.17
8	RSC Advances	UK	54	128	6.5	0.736	0.827	3.07
9	ACM International Conference Proceeding Series	USA	51	109	0.8	0.200	0.333	0.87
10	Journal of Alloys and Compounds	Netherlands	49	160	7.6	1.055	1.468	4.65

5.7 Top ten Highly Collaborative Institutions

Figure 3 discloses the top ten highly collaborative institutions that have involved collaborative research with NIT, Rourkela. It is observed from the figure 3 that, out of 9233 publications, 364 of publications were collaborated with IIT Kharagpur, followed by 257 of publications with KIIT Bhubaneswar, 154 VSS University of Technology, 135 of publications Siksha O Anusandhan Deemed to be University, 110 with Jadavpur University, 105 of publications with Indian Institute of Technology Bhubaneswar and 95 to 32 of publications were come from other collaborative institutions.

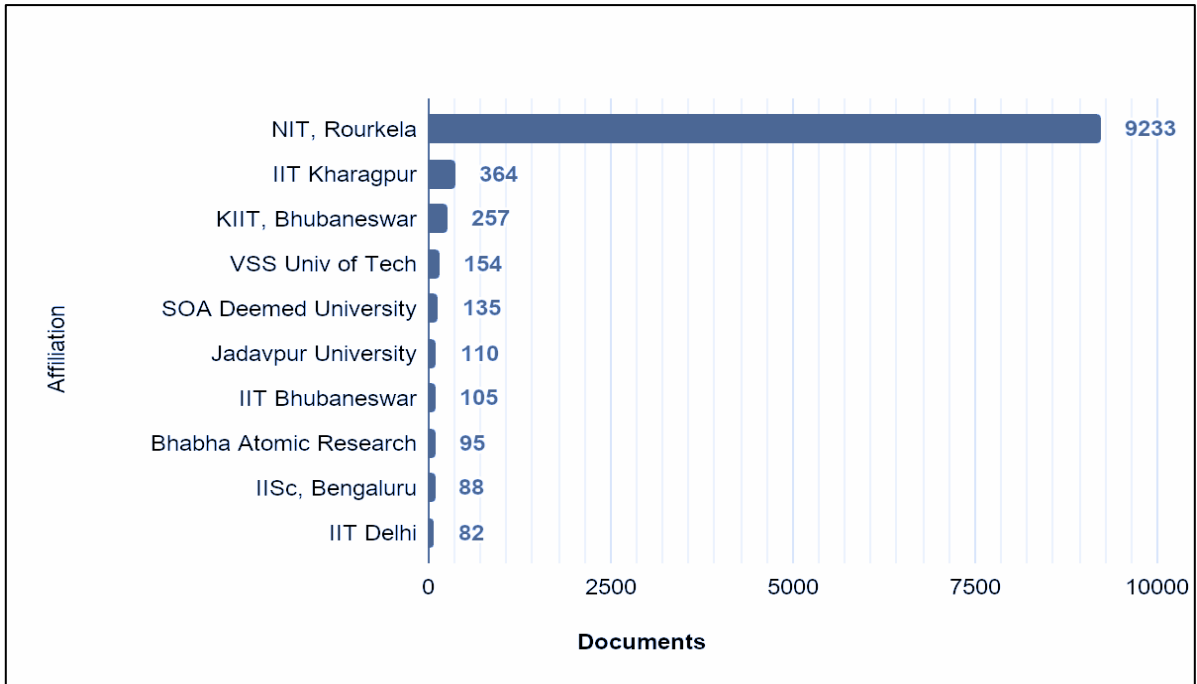


Fig.3: Top ten highly collaborative Institutions

5.8 Top ten Highly Collaborative Countries

The international collaboration of research output has been shown in figure 4. The United States (287) has the largest share with NIT Rourkela, followed by South Korea (102) and UK (95), Saudi Arabia (80) Australia (70), Canada (64), Singapore (60), China (53). Out of these 15 countries, four countries are Asian countries.

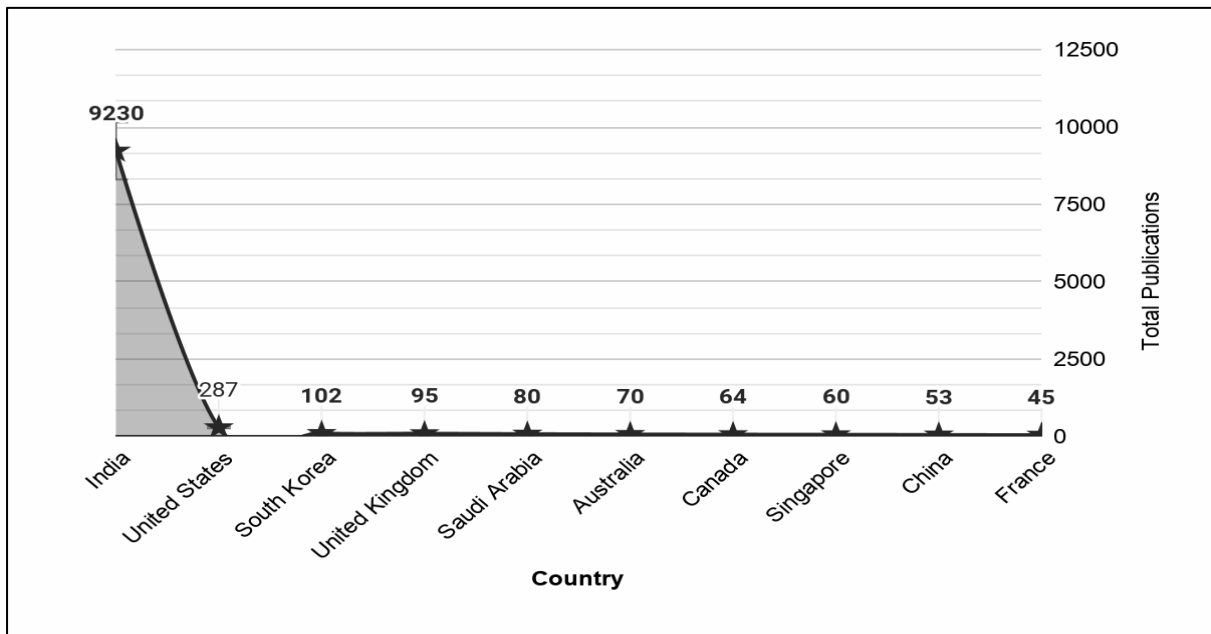


Fig.4: Top Ten Highly Collaborative Countries

5. 9 Subject-wise Distributions

Figure 5 shows the subject-wise distribution of research output produced from 2000 to 2019. This investigation helps to identify authors' interest and involvement in producing a publication on their specialization. It shows that most of the subjects are overlapped with each other. The study's findings reveal that the highest number of 4463 (48.34%) of scholarly publications have come on the subject of Engineering, Computer Science, Material Science, Physics and Astronomy-Mathematics, and Chemical Engineering.

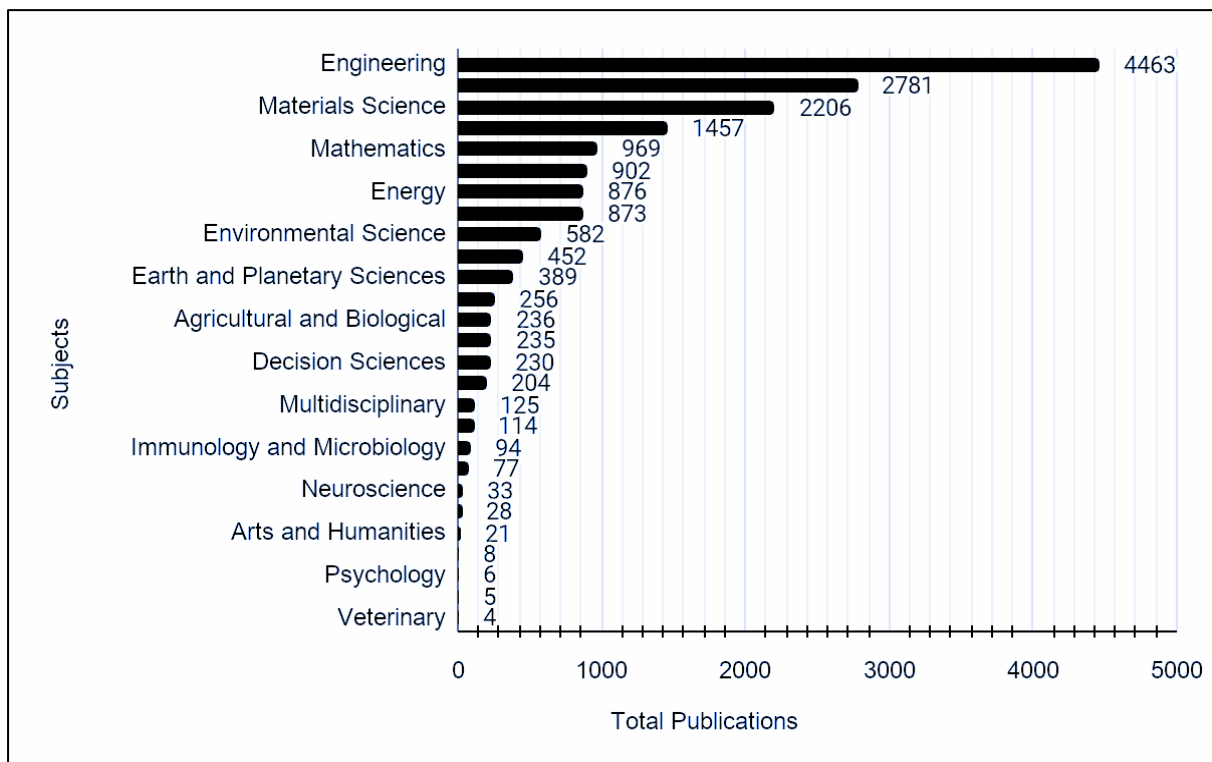


Fig.5: Subject-wise Distributions

5. 10 Top ten Highly Funding Agency

Figure 6 shows the rank of the top ten research funding agencies/institutions. It is inferred that the department of Science and Technology, Government of Kerala, is the top funding agency funded 292 publications. The Science and Engineering Research Board stood the second rank in the top ten most funding agencies by funding 232 publications. Followed by the department of Science and Technology, Govt.of India stood in third place, funded for 177 publications. As listed in figure 6, the remaining funding agencies support the scientists of NIT Rourkela to carry out research publications.

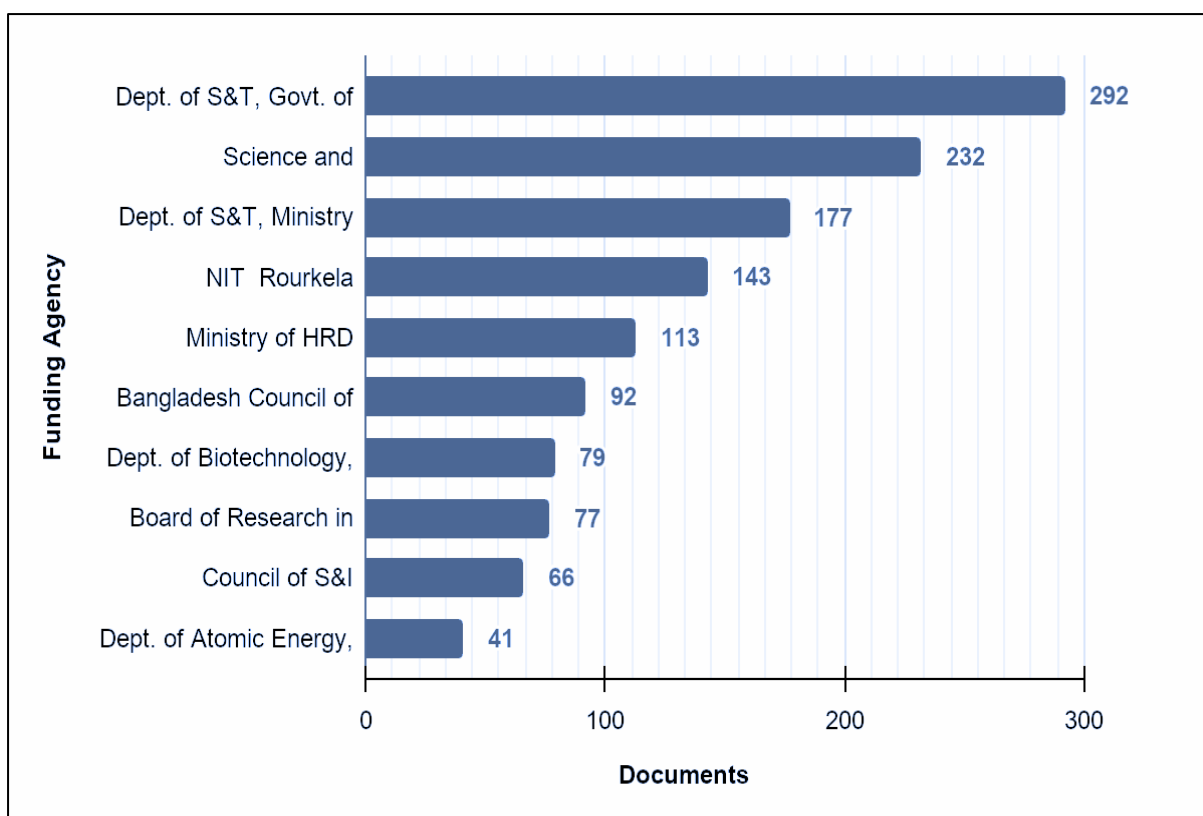


Fig.6: Funding Agency

5.11 Types of Documents

It is estimated from the analysis that all 9233 published records were acknowledged in the 11 different source items, as indicated in figure 7. The majority, i.e., 5733 of the documents, accounted for 62.09% of the total records, demonstrating that these are the primary approach for scientific communication on information visualization followed by Conference Proceedings with 3000 taking up 32.49% of the total records. whereas the remaining 4.2% of publication records were other significant ways to publish academic research achievements in the form of Review, Book Chapter, Editorial, erratum, Book, Letter, note Short Survey and data paper, etc.,

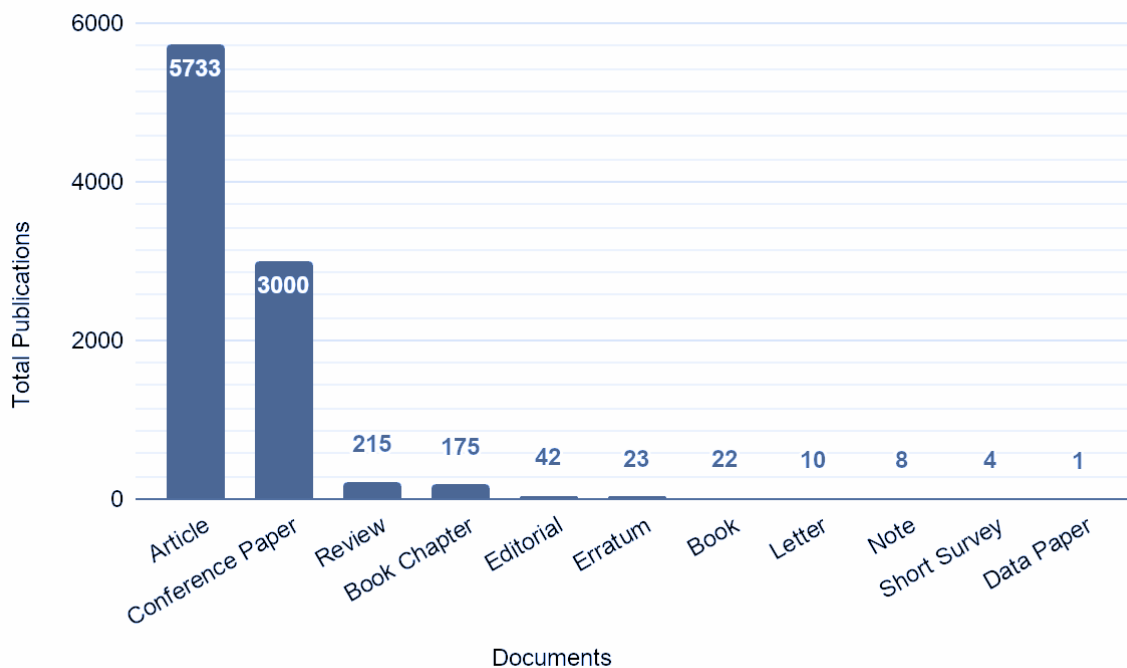


Fig.7: Types of Documents

6.FINDINGS

1. The analysis acknowledges that 2018 is the most productive year with 1339 research papers. Further to all 9233 publications, a total of 102692 citations were received, with an average of 11.12 citations per paper.
2. The authorship patterns reveal that double the author is the highest contribution with 3282 research papers during the study period. The degree of collaboration and collaborative co-efficient is apparent, with a total of 0.97 and 0.62, respectively.
3. It is apparent during the study period Mahapatra, S. S, was found to be the most productive author with 295 articles and 5727 citations with an average of 5.15 citations.
4. It is found that the total AGR is 606.97 and RGR 5.16 from 2000 to 2019. The DT has found a periodical growth over the years from 0 to 4.54. it shows the AGR & RGR and DT are inversely proportional in the medical literature at NIT Rourkela.
5. The "Core/shell nanoparticles: classes, properties, synthesis mechanisms, characterization, and applications" by Ghosh Chaudhuri R., Paria S., published in Chemical Reviews of 2012, is the most cited (2045) among the publications of NIT Rourkela.

6. In the top-10 journal ranking list, the IOP Conference series material science and engineering is the topmost preferred source of publication of the researchers of NIT Rourkela with 141 research papers.
7. The collaboration institution data analyzed above shows that IIT Kharagpur is the top collaborative organization of NIT Rourkela with 364 research papers in this session.
8. The United States is the top collaborating country of NIT Rourkela, with 287 research papers.
9. The highest number, i.e., 44463 (48.34%) of publications, has appeared in the Engineering discipline.

7. CONCLUSION

The present scientometric analysis identified two decades of research productivity of researchers of NIT Rourkela. The study revealed rapid and strong optimistic growth in research and received many citations that evinced the research quality. The research collaboration with more than one author is found significantly high. The scientists preferred to publish their research paper in journals as a source of publications, mainly in international journals. The United States of America is at the top of the collaborative research countries of NIT Rourkela. Further, the present study's implication would be facilitating various policy-making bodies and funding agencies such as UGC, NAAC, MHRD, and other foreign bodies to take appropriate steps to boost researchers to be involved in research activities. The study results may act as an incentive for enhancing the interest of individual faculty in specific and the organization in general for strengthening their research activities. Overall, this study would help researchers conduct better research that turns into more publications in their field.

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