

Highly Cited Paper from Indian Institute of Science, Bengaluru, India during 2001-14: A Scientometrics Analysis Case Study

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Abstract

Over the past six decades the web of science database maintaining the core collections Science Citation Index Expanded, and past three decades Conference Proceedings Citation Index- Science and past one and half decades SciLEO Citation Index, Journal citation reports. This research paper analyses the results of a scientometric analytical case study of the research activities of highly cited papers from 2001 to 2014. The study evaluates the growth of publications, citations, average citations per publication and H- index of top scientists or researchers, at Indian Institute of Science, Bengaluru, India. Besides that the paper presents a citation-based mapping of data on global scientific activities from Indian Institute of Science, Bengaluru, India research publications using Web of Science Database. Using different scientometric approaches, a continuous increase of both quantitative and qualitative parameters such as h-index and Global Citation Scores. Researchers have published 20063 publications during the time period 2001-2014 and cited at least 47 times by end of 2014 are analysed. Authors have been able to place their papers in high impact journals such as Physics, Engineering, Chemistry, Materials Science, Science & Technology, Computer Science, Biochemistry Molecular Biology, Mechanics, Mathematics, Telecommunications, and Crystallography. The study reveals that the output of Indian Institute of Science research Publications has greatly increased over period.

Keywords: Web of Science, Scientometrics, Citation Map, Indian Institute of Science, Global Citation Scores, Highly Cited Paper.

1. Introduction

Scientometrics is a branch of library and information science. Its tools can be used to measure and compare the scientific activities at various levels of aggregation including distribution of publications such as year wise, document type-wise, subject wise, source/ journal wise, countries-wise, authors wise and highly cited papers with citation map. It is concerned with the quantitative features and characteristics of science and scientific research. They can also be used to measure research collaborations, to map scientific networks and to monitor the evolution of scientific fields.

2. About Indian Institute of Science

Indian Institute of Science, Bangalore, has been at the forefront of research and education in science and engineering. Today the institute has a very high international reputation in the academic world, in view of the fact; it has expertise both in conventional and emerging areas of science and engineering and provides facilities for the post graduate research and course work. The institute has more than 65 departments and centers staffed by high caliber scientists. The institute offers an opportunity for young researchers to pursue doctoral and post doctoral studies in science and engineering. The institute also offers basic science undergraduate program by providing an opportunity for young scientist.



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3. Objectives of the Study

1. To analyze the year-wise growth of publications and citations.
2. To analyze the document type-wise distribution of publications.
3. To know the top subject-wise publications.
4. To know the top country-wise publications.
5. To know the top source/journal-wise publications.
6. To identify the prolific authors wise distributions of Publications.
7. To identify the author's wise h-index and Global Citations Scores.
8. To identify the highly cited papers with Citation Map from Indian Institute of Science, Bangalore.

4. Methodology

The required data was collected from Web of Science database for the period 2001-2014. It can be seen that nearly 20063 bibliographic records of contribution by Indian Institute of Science Bengaluru, India researchers over the period of 14 years. The researcher applied a search strings "Indian Inst Sci" that has used for data extraction from the

database of Science Citation Index total 14 years to download the records based on the above strings. A total of 20063 records were downloaded and analyzed by using Web of Science inbuilt software applications as per the objectives of the study. Further based on citation per paper with Citation map, number of high quality papers are also applied to find out the quality of the research output. The study aims to analyze the thrust areas of research concentration.

5. Results and Discussion

5.1 Analysis and Interpretations Year wise Distribution of Publications

Table 1 Views clearly that during the period 2001-2014 a total of 20063 publications were published at Global level. The highest publication is 1812 in 2013 followed by 1658 papers in 2014 and 1655 papers in 2009. The lowest number 987 of publication from 2001. It shows that even minimum numbers of records were scored higher global citations. The study also reveals all these 217155 publications have TGCS it shows that there is a maximum trend in citation is found among the Scientists from Indian Institute of Science, Bengaluru.

Table-1 Year wise Distributions of Publications

Years	Total Publications (TP)	Percentage	Total Citations (TC)	Average Citation Per Publications (ACP)	H-Index
2001	987	4.92	20818	21.09	64
2002	1063	5.30	18413	17.32	59
2003	1178	5.87	19536	16.58	60
2004	1185	5.91	20502	17.3	59
2005	1301	6.49	19903	15.3	58
2006	1372	6.84	18886	13.77	53
2007	1438	7.17	19162	13.33	53
2008	1502	7.49	19402	12.92	59
2009	1655	8.25	20953	12.66	52
2010	1586	7.91	14198	8.95	43
2011	1578	7.87	12061	7.64	40
2012	1748	8.71	7845	4.49	28
2013	1812	9.03	4584	2.53	20
2014	1658	8.26	892	0.54	7
Total	20063	100.00	217155	11.74	655

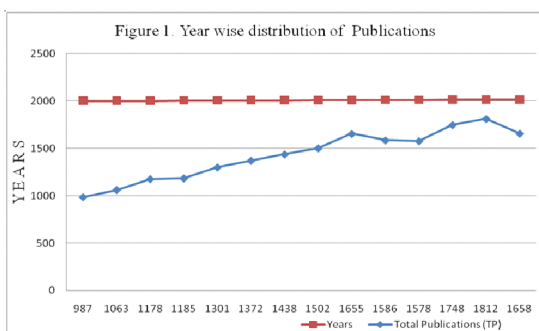


Figure 1: Shows the highest publication is 1812 in 2013 and lowest publication is 987 in 2001

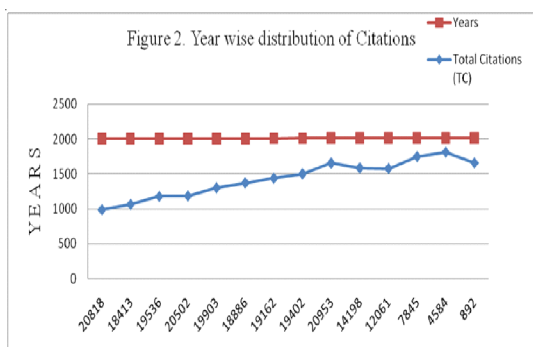


Figure 2: Shows the highest Citations is 20818 in 2001 and lowest publication is 892 in 2014

5.2 Document wise Distribution of Publications

The table 2 depicts the top 10 document wise distribution of articles published in the journal during 2001 to 2014. The productivity of scientists spreads over variety of publication media, such that journal articles; article, proceedings paper; Meeting abstract, review; letter; editorial materials; correction; meeting abstracts; article, book chapters; correction, Item about an individual and other news items. It is clear from bellow table 2 analysis that the share of journal articles is the most prominent bibliographic form of publication and it occupies 16807 (83.77%) of total publications. Proceedings paper with 2881

(14.36%) contributions, Review papers with 436 (2.17%) contributions, Editorial materials with 342 (1.71%), Meeting abstract with 209 (1.04%) and followed by remaining Letter, Correction, bibliographic Item. Remaining document types like News item, Book Chapter, Software Review are scored the lowest total number 3 (0.02%) of publications for communication among the scientists.

Table 2: Document Wise Distributions of Publications

Document Types	TP	Percentage
Article	16807	83.77
Proceedings Paper	2881	14.36
Review	436	2.17
Editorial Material	342	1.71
Meeting Abstract	209	1.04
Letter	141	0.70
Correction	67	0.33
Biographical Item	45	0.22
News Item	22	0.11
Book Chapter	21	0.11
Software Review	3	0.02

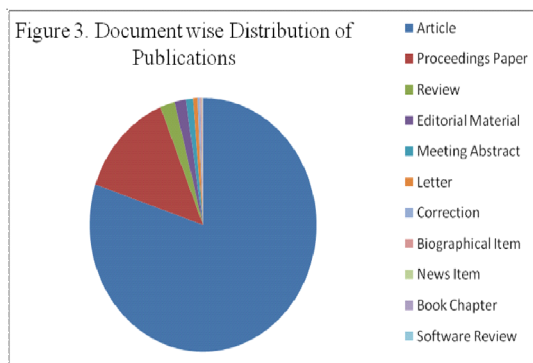


Figure 3: Shows journal articles is top ranked with 16807 (83.77%) and Software Review is lowest rank with 3 (0.02%)

5.3 Subject Wise Distributions of publications

The table 3 depicts the top 10 subject-wise distribution of articles published in the journal during 2001 to 2014. Physics subject is top ranked with 4285 (19.01%) publications, followed by Engineering subjects with 3966 (17.59%) publications, while

Chemistry subject ranked third with 3845 (17.06%) publications and followed by remaining subjects. Remaining document types like Mechanics, Mathematics and Crystallography are lowest numbers 805(3.57), 790(3.50) and 733 (3.25%) respectively for subject wise distributions of publications.

Table 3 : Subject Wise Distributions of Publications

Sl. No.	Subjects	TP	Percentage	TC	ACP	H-Index
1	Physics	4285	19.01	48375	11.29	78
2	Engineering	3966	17.59	27136	6.84	58
3	Chemistry	3845	17.06	69614	18.11	96
4	Materials Science	3268	14.50	41809	12.79	74
5	Science & Technology	1767	7.84	20116	11.38	62
6	Computer Science	1577	7.00	7129	4.52	35
7	Biochemistry Molecular Biology	1507	6.69	20861	13.84	53
8	Mechanics	805	3.57	6729	8.36	34
9	Mathematics	790	3.50	3150	3.99	22
10	Crystallography	733	3.25	5135	7.01	33

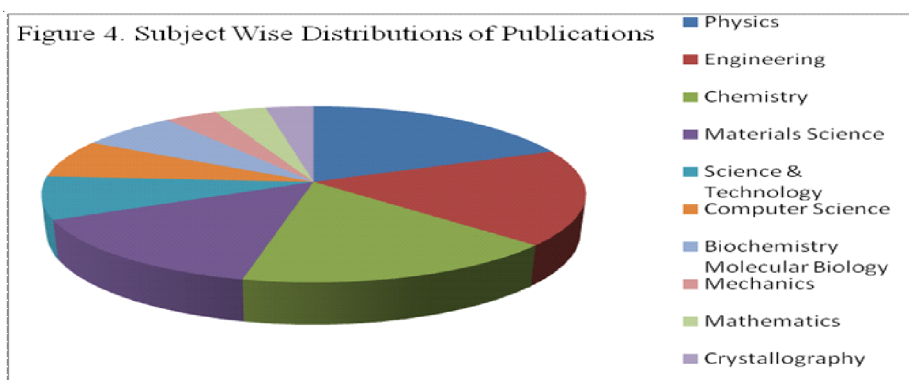


Figure 4: Shows subject physics is top rank with 4285 (19.01%) and Subject Crystallography is lowest rank with 733 (3.25%).

5.4 Top country-wise Distribution of Publication

The table 4 depicts the top 10 country-wise distribution of articles published in the journal during

2001 to 2014 from Indian Institute of Science scientists/ authors. USA is top ranked with 1783 (41.35%) publications, followed by France with 547 (12.69%) publications, while Germany ranked third with 491

(11.39%) publications and followed by England, Japan etc. Remaining country wise distribution of publications like Italy, South Korea, Canada,

Singapore and Australia are lowest numbers 179(4.15%), 166(3.85%), 140 (3.25%), 134(3.11%) and 132 (3.06%) respectively.

Table 4: Country Wise Distribution of Publications

Sl. No.	Counties	TP	Percentage	TC	ACP	H-Index
1	USA	1783	41.35	31923	17.9	74
2	France	547	12.69	9243	16.9	46
3	Germany	491	11.39	7647	15.57	39
4	England	391	9.07	7467	19.1	40
5	Japan	349	8.09	6867	19.68	44
6	Italy	179	4.15	4377	24.45	37
7	South Korea	166	3.85	2033	12.25	24
8	Canada	140	3.25	3250	23.21	27
9	Singapore	134	3.11	2269	16.93	22
10	Australia	132	3.06	1395	10.57	18

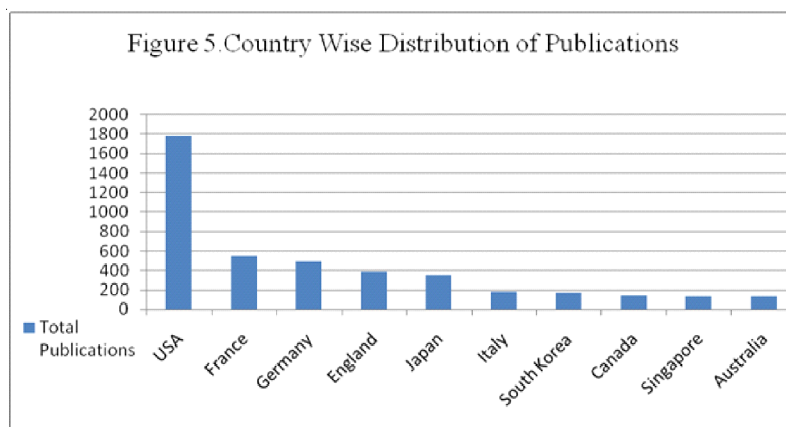


Figure 5: Shows country wise USA is top rank with 1783 (41.35%) and Australia is lowest rank with 132 (3.06%).

5.5 Source Wise Distribution of Publications

The table 5 depicts the source wise distribution of publications published in the journal during 2001 to 2014 from Indian Institute of Science scientists/authors. Current Science is top ranked with 538 (22.34%) publications, followed by Physical Review B with 318 (13.21%) publications, while Acta

Crystallographica Section E Structure Reports Online ranked third with 251 (10.42%) publications and followed by other Journal titles. Remaining source wise distribution of publications like Lecture Notes in Computer Science, Journal of Physical Chemistry B, Applied Physics Letters and Physical Review Letters are low numbers of publications i.e. below on percentage.

Table 5: Source Wise Distribution of Publications

Sl. No.	Journal Title	TP	Percentage	TC	ACP	H-Index
1	Current Science	538	22.34	2724	5.06	23
2	Physical Review B	318	13.21	6125	19.26	39
3	Acta Crystallographica Section E Structure Reports Online	251	10.42	501	2	8
4	Journal of Chemical Physics	221	9.18	2687	12.16	26
5	Journal of Applied Physics	210	8.72	1815	8.64	23
6	Lecture Notes In Computer Science	196	8.14	285	1.45	8
7	Journal of Physical Chemistry B	195	8.10	5045	25.87	36
8	Applied Physics Letters	163	6.77	1790	10.98	22
9	Physical Review Letters	159	6.60	4950	31.13	38
10	Plos One	157	6.52	828	5.27	14

5.6 Prolific authors wise distributions of publications

In this analytical period, scientists have produced 20063 paper contributions scattered over 500 journals. In accordance to this the researcher has given the ranks according to their highest publication at up to top 100 published authors. The first 100 of authors are identified as per the highest contributors of research output. The table 6 depicts the Authors wise distributions of Publications published in the journal during 2001 to 2014 from Indian Institute of Science scientists/authors. The research shows the total global citation score and h-index. The analysis depicts the productivity of authors during the period of study. Madras G is the most productive author who published 351 papers with 6267 Total Global Citation Scores with first place and the below table shows only top 10 authors with citation and h-index.

Row TNG with 281 papers with 2852 Total Global Citation Scores articles comes second place and followed by other scientists.

Table 6: Authors wise distributions of Publications

Sl. No.	Authors	TP	Percentage	TC	ACP	H-Index
1	Madras G	351	14.10	6267	17.85	39
2	Row T N G	281	11.29	2852	10.15	27
3	Kumar A	274	11.00	2535	9.25	26
4	Rao C N R	261	10.48	12657	48.49	57
5	Krupanidhi S B	249	10.00	1784	7.16	22
6	Nethaji M	243	9.76	3916	16.12	35
7	Sood A K	229	9.20	3916	25.59	28
8	Bhattacharya S	204	8.19	3481	17.06	31
9	Bagchi B	204	8.19	3905	19.14	31
10	Kumar S	194	7.79	1705	8.79	22

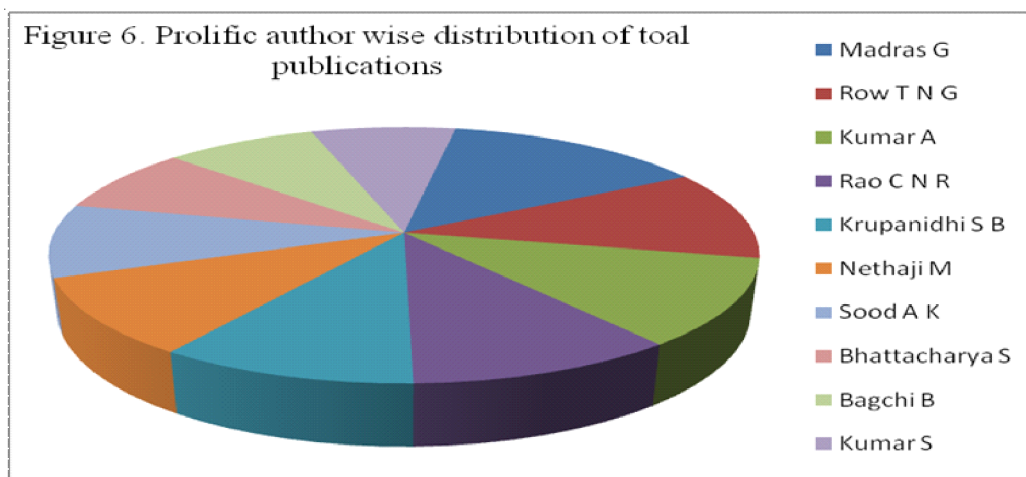


Figure 6: Shows prolific author wise publications Madras G are top rank with 351 (14.10%) and Kumar S is lowest rank with 194 (7.79%).

5.7 Citation Map of Highly Cited Authors

A Citation Map is a graphical representation that shows the citation relationships (cited references and citing articles) between a paper and other papers using various visualization tools and techniques. Citation mapping analysis can be applied as subject

similarity indicators. It is defined as “the frequencies with two documents are cited together”. (Source: Web of Science Database)

Table 7: Top 10 Highly Cited Papers from Indian Institute of Science, Bengaluru, India.

Sl. No.	Citations	Title	Authors	Source	Year
1	1403	Graphene: The New Two-Dimensional Nanomaterial	Rao, C. N. R.; Sood, A. K.; Subrahmanyam, K. S.; et al	Angewandte Chemie-International Edition	2009
2	997	Monitoring dopants by Raman scattering in an electrochemically top-gated graphene transistor	Das, A.; Pisana, S.; Chakraborty, B.; et al.	Nature Nanotechnology	2008
3	988	Overview No.144 - Mechanical behavior of amorphous alloys	Schuh, Christopher A.; Hufnagel, Todd C.; Ramamurty, Upadrasta	Acta Materialia	2007
4	911	Supramolecular gels: Functions and uses	Sangeetha, NM; Maitra, U	Chemical Society Reviews	2005
5	585	Inorganic nanowires	Rao, CNR; Deepak, FL; Gundiah, G; et al.	Progress in Solid State Chemistry	2003
6	568	Supramolecular Coordination: Self-Assembly of Finite Two- and Three-Dimensional Ensembles	Chakrabarty, Rajesh; Mukherjee, Partha Sarathi; Stang, Peter J.	Chemical Reviews	2011
7	507	Nanotubes	Rao, CNR; Satishkumar, BC; Govindaraj, A; et al.	Chemphyschem	2001
8	472	Synthesis, Structure, and Properties of Boron- and Nitrogen-Doped Graphene	Panchokarla, L. S.; Subrahmanyam, K. S.; Saha, S. K.; et al.	Advanced Materials	2009
9	471	Vortex-induced vibrations	Williamson, CHK; Govardhan, R	Annual Review of Fluid Mechanics	2004
10	449	Improvements to Platt's SMO algorithm for SVM classifier design	Keerthi, SS; Shevade, SK; Bhattacharyya, C; et al.	Neural Computation	2001

6. Conclusion

Based on the analysis undertaken the present study reveals the following findings. Total number of publications is 20063 and 217155 times cited by others scientist, its average citation value is 11.74. The overall years h – index value is 46.77. Document wise distributions of publications for the article is top ranked with 16807 (83.77%) and software review last ranked with 3 (0.02%). Subject wise distributions for the physics subject is top ranked with 4285 (19.01%) Publications and Crystallography subject is last rank with 733 (3.25%). Country-wise distribution of articles published in the journal USA is top ranked with 1783 (41.35%) publications and Australia is last rank with 132 (3.06%). Source wise distribution of publications published in the journal current science is top ranked with 538 (22.34%) and Plos One is last rank with 157(6.52%). Prolific author wise publications Madras G are top rank with 351 (14.10%) and Kumar S is lowest rank with 194 (7.79%). The group of citing papers includes a large number of highly cited papers we would describe as citation classics. The highest publication is 1790 in 2013 followed by 1731 papers in 2012 and 1655 papers in 2009. The lowest publication is less than 987 from 2001. This research paper results shows that there is considerable growth in the productivity of the journal during 2001-2014 in Indian Institute of Science researchers. Overall, at the global level single author publications should be encouraged. Citation Map help the researcher and scientist to know the growth, development and research impact of particular field of research to know citation, h-index and number of publications.

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