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A Scientometric Study of the Productivity of the Literature in the Engineering and Materials Sciences

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Abstract
This report examines the research output of the journal "Indian Journal of Engineering and Materials Sciences (IJEMS)" between the years 2001 and 2018, focusing on a subset of the total 1215 papers published in the magazine. The year 2014 saw the greatest volume of published works. Researchers most often used journal articles as references in their work. There were 10,952 papers published with two or more authors and just 120 published with a single author. The Relative Growth pace of academic communication is 1.99, which means it is growing at an average pace. This study indicates that IJEMS's research output and growth rate of scholarly communication are on the decline, and it also looks at the authorship pattern of this communication using the collaborative index, which is the collaborative coefficient.
Keywords: Science, technology, engineering, and mathematics (STEM), and scientometrics

Introduction

Scientometrics is a field that uses the analysis of scientific papers to learn more about how science works and how it develops over time. The quantitative and qualitative features of a publication are dissected using bibliometric, scientometric, and informetric methods. Quantitative measures of scientific information, such as the number of scientific articles published in a given time period, the citation impact of those articles, etc., are used to examine the development of science in this discipline (Rajendran, 2011)."Scientometrics" is the "application of those quantitative methods dealing with the analysis of science viewed as information processes," as stated by Patra et al. (2006). The Indian Journal of Materials Science and Engineering Launched in 1994, the journal features articles from a wide range of engineering disciplines, including aerospace, mechanical, metallurgical, electrical/electronic, civil, fluid mechanics, instrumentation, and materials science. As of the year 2018, the IF of IJEMS was 0.794 (JCR). (http://op.niscair.res.in/index.php/IJEMS/index) The mission of the Indian Journal of Engineering & Materials Sciences is to disseminate significant new findings in the theory and application of all branches of engineering and materials science. Aerospace, mechanical, metallurgical, electrical, electronic, civil, and materials engineering are all subfields of engineering. (https://www.niscair.res.in/jinfo/IJEMS/ijems_inst_auth.pdf).

The objective of the Study

- To study the growth of research productivity on during 2001-2018.
- To examine the Relative growth rate of articles.
- To find out the Doubling time of the articles.

- To analyses the Author pattern and collaboration like CI, CC, DC, etc.,
- To know the ranking of the author.

Scope and Methodology

The paper represents the scientometric analysis of IJEMS publications in the field of engineering during the period 2001 to 2018. The data is confined to articles on IJEMS. A total number of 1215 articles have been found and the same has been analyzed by using the spreadsheet application. Computed growth rate and collaborative measures using a set of formula Relative growth rate (RGR) and Doubling time (Dt).

Analysis of the data based on the publishing chronological order from the year 2001 to 2018. Using worldwide set of formulas i.e. Log formula and mean value the study analyzing the Author collaboration i.e Collaborative index (CI), Collaborative coefficient (CC), Degree of collaboration (DC) also Average Author per publication (AAPP) and Average publication per author (APPA) etc., also examines the Growth rate of scholarly communication through

Analysis and Interpretation of Data

Growth rate of research publications

Table 1: Growth rate of research publications

Year	No. of Publications	Cumulative No. of Publications	Log(p)1	Log(P)2	RGR(P)	Mean RGR	Dt(p)	Mean Dt
2001	63	63	4.14	4.14		1.27		0.63
2002	74	137	4.30	4.92	0.62		1.13	
2003	76	213	4.33	5.36	1.03		0.67	
2004	80	293	4.38	5.68	1.30		0.53	
2005	77	370	4.34	5.91	1.57		0.44	
2006	72	442	4.28	6.09	1.81		0.38	
2007	60	502	4.09	6.22	2.12	2.38	0.33	0.29
2008	74	576	4.30	6.36	2.05		0.34	
2009	67	643	4.20	6.47	2.26		0.31	
2010	63	706	4.14	6.56	2.42		0.29	
2011	53	759	3.97	6.63	2.66		0.26	
2012	50	809	3.91	6.70	2.78		0.25	
2013	71	880	4.26	6.78	2.52	2.77	0.28	0.25
2014	87	967	4.47	6.87	2.41		0.29	
2015	82	1049	4.41	6.96	2.55		0.27	
2016	47	1096	3.85	7.00	3.15		0.22	
2017	60	1156	4.09	7.05	2.96		0.23	
2018	59	1215	4.08	7.10	3.02		0.23	

Table-1 show that the growth rate of research publication on IJEMS between 2001 and 2018 in terms of

Relative growth rate (RGR) and
Doubling Time (DT). Mean

value of Relative growth rate and doubling time is 2.14 and 0.39 respectively. It is evidenced that the Relative growth rate increased whereas the Doubling Time (DT) slightly decreased.

Collaborative index (CI)

Table 2: Collaborative index (CI)

Year	Total Publications	Total Author Publications	Total Authors	Mono	Multi-Author Publication	CI
2018	59	59	203	0	59	3.34
2017	60	60	206	1	59	3.39
2016	47	47	153	4	43	3.30
2015	82	82	278	6	76	3.46
2014	87	87	283	4	83	3.35
2013	71	71	187	10	61	3.28
2012	50	50	155	6	44	3.41
2011	53	53	152	4	49	3.06
2010	63	63	198	8	55	3.45
2009	67	67	222	7	60	3.55
2008	74	74	233	8	66	3.41
2007	60	60	173	12	48	3.38
2006	72	72	201	6	66	2.97
2005	77	77	213	10	67	3.12
2004	80	80	245	7	73	3.14
2003	76	76	199	11	65	3.02
2002	74	74	204	10	64	3.03
2001	63	63	172	6	57	3.00
Total	**1215**	**1215**	**3677**	**120**	**1095**	**3.26**

Table-2 depicts the number of authors known as Collaborative index (CI). Collaborative index in the year 2009 was the highest viz. 3.55, followed by 2015 as 3.46; least collaborative index was 2.97 recorded in the year 2006. Therefore, the overall average collaborative index is 3.26. It means on an average of three authors collaboratively worked for an article.

Collaborative Coefficients (CC)

Table 3: Collaborative Coefficients (CC)

Year	Total Publications	Total Author Publications	Total Authors	Mono	Multi-Author Publication	CC
2018	59	59	203	0	59	0.67
2017	60	60	206	1	59	0.66
2016	47	47	153	4	43	0.59
2015	82	82	278	6	76	0.62
2014	87	87	283	4	83	0.63
2013	71	71	187	10	61	0.55

2012	50	50	155	6	44	0.58
2011	53	53	152	4	49	0.57
2010	63	63	198	8	55	0.57
2009	67	67	222	7	60	0.60
2008	74	74	233	8	66	0.59
2007	60	60	173	12	48	0.51
2006	72	72	201	6	66	0.56
2005	77	77	213	10	67	0.55
2004	80	80	245	7	73	0.58
2003	76	76	199	11	65	0.52
2002	74	74	204	10	64	0.54
2001	63	63	172	6	57	0.56
Total	**1215**	**1215**	**3677**	**120**	**1095**	**0.58**

Table-3 shows the author Collaborative coefficient which measures both Collaborative index and Degree of collaboration in one pattern. The highest author Collaborative coefficient is 0.67 in the year 2018 and followed by 0.66 Collaborative coefficient recorded in 2017. The least collaborative coefficient is 0.51 in the year 2007.

Degree of Collaboration

Table 4: Degree of Collaboration

Year	Total Publications	Total Author Publications	Total Authors	Mono	Multi-Author Publication	DC
2018	59	59	203	0	59	1.00
2017	60	60	206	1	59	0.98
2016	47	47	153	4	43	0.91
2015	82	82	278	6	76	0.93
2014	87	87	283	4	83	0.95
2013	71	71	187	10	61	0.86
2012	50	50	155	6	44	0.88
2011	53	53	152	4	49	0.92
2010	63	63	198	8	55	0.87
2009	67	67	222	7	60	0.90
2008	74	74	233	8	66	0.89
2007	60	60	173	12	48	0.80
2006	72	72	201	6	66	0.92
2005	77	77	213	10	67	0.87
2004	80	80	245	7	73	0.91
2003	76	76	199	11	65	0.86
2002	74	74	204	10	64	0.86
2001	63	63	172	6	57	0.90
Total	**1215**	**1215**	**3677**	**120**	**1095**	**0.90**

Table-4 shows collaborative research pattern known as Degree of collaboration.

Highest Degree of collaboration (DC) was 1.0 in the year 2018 and followed by 0.98 recorded in 2017. Average Degree of collaboration (DC) was 0.90.

Average Author per Productivity & Average Publication per Author

Table 5: Average Author per Productivity & Average Publication per Author

Year	Total Publications	Total Author Publications	Total Authors	AAPP	APPA
2018	59	59	203	3.44	0.29
2017	60	60	206	3.43	0.29
2016	47	47	153	3.26	0.31
2015	82	82	278	3.39	0.29
2014	87	87	283	3.25	0.31
2013	71	71	187	2.63	0.38
2012	50	50	155	3.10	0.32
2011	53	53	152	2.87	0.35
2010	63	63	198	3.14	0.32
2009	67	67	222	3.31	0.30
2008	74	74	233	3.15	0.32
2007	60	60	173	2.88	0.35
2006	72	72	201	2.79	0.36
2005	77	77	213	2.77	0.36
2004	80	80	245	3.06	0.33
2003	76	76	199	2.62	0.38
2002	74	74	204	2.76	0.36
2001	63	63	172	2.73	0.37
Total	**1215**	**1215**	**3677**	**3.03**	**0.33**

Table-5 depicts that Average author per productivity (AAPP) and Average publication per author (APPA). Highest AAPP in the year 2018 was 3.44; lowest AAPP is 2.62 in the year 2003. Average AAPP is 3.03 in the year 2001 to 2018. least APPA is 0.38 2013 and 2003, Lowest APPA is 0.29 in the year 2018, 2017 and 2015. And average APPA is 0.33.

Ranking of the author(s)

Table 6: Ranking of the author(s)

Rank	Author Name	No. of articles contributed	Percentage of articles contributed
1	Rao, G Venkateswara	13	1.1
2	Keshavarz, M H	12	1.0
3	Choudhary, R N P	11	0.9
4	Ganesan, V	8	0.7
5	Singh, S N	8	0.7
6	Horng, Jiun-Wei	7	0.6
7	Seshadri, V	6	0.5
8	Sivanandam, S N	6	0.5

9	Prasad, K	6	0.5
10	Kuo, Chil-Chyuan	6	0.5

It is observed from the above Table-6 that there is Rao, G Venkateswara Contributed highest number of articles he is occupied first place with 13 articles followed by Keshavarz, M H ranked second with 12 articles, Choudhary, R N P ranked third with 11 articles.

Findings and Conclusion

The Relative growth rate (RGR) has an increasing trend whereas the Doubling time (Dt) has increasing trend. Average doubling time was 0.37 years. The Mean number of authors (CI) was 3.5 Highest author collaborative coefficient is 0.67 in the year 2018. The average Degree of Collaboration (DC) was 0.90. Average author per publication (AAPP) is high i.e. 3.03, Average publication per author (APPA) is very less that is 0.33. There is collaborative research trend in IJEMS.

Scientometrics analysis of a subject field helps in identifying the research status. It can be seen whether it is conducting more or fewer research works in a particular field.

Through this analysis, one can found subject areas in which research trend is high and theareas where research trend is low; and subject areas where no significant change in research is seen world-wide.

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