ISSN (Print): 0972-2467
ISSN (Online): 0976-2477
SRELS Journal of Information Management, Vol 53(3), June 2016, p. 229-235 DOI: 10.17821/srels/2016/v53i3/70496

Research Output of PSG College of Technology, Coimbatore: A Scientometric Study

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Abstract

Bibliometric and scientometric techniques have been applied to present a quantitative and qualitative analysis of the publication output of PSG College of Technology (PSGCT), Coimbatore. Data for the study have been collected from the Scopus database for the period 1971 to 2014. Among the 2357 papers published in the span of 44 years, highest number of 319 papers was published in 2012. 2112 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 PSGCT has largely contributed to research in science, engineering and technology and the publication output of faculty has increased considerably during the last 10 years.

Keywords: Bibliometrics, PSG College of Technology (PSGCT), Publication Output, Research Publication, Scientometrics, Scopus

1. Introduction

Scientometrics, a term coined by 'Vasily Nalimov' is concerned with measuring and analysing science, technology and innovation. Analysis of quantitative data such as number of publications based on author, institution, country, year, type, subject and number of citations, etc., yields valuable information about the quality and quantity of research output. Major issues include the measurement of impact, reference sets of articles to investigate the impact of journals and institutes and understanding of scientific citations for use in policy and management contexts[1]. In this study, an attempt has been made to study the research output of the faculty of PSG College of Technology (PSGCT), Coimbatore.

1.1 PSG College of Technology

PSG College of Technology (PSGCT), Coimbatore is one of the foremost institutions in the country and was established in 1951. The college was conferred the Autonomous 'status' in the academic year 1978-79. It has student strength of more than 8500 with 15 engineering and technology departments besides departments in computer applications, management sciences, basic sciences and humanities. More than 505 research scholars are pursuing their research programmes leading to PhD, MS and M. Tech degrees and it is a recognized Quality Improvement Programme (QIP) centre for PG and PhD programmes. It maintains close interaction with several R&D Institutions, institutions of higher learning in India and abroad and many industries are connected through institutional network programmes, collaborative research programmes and Memorandum of Understanding (MoU) to promote technology, training of students, curriculum and state-of-art centres[2].

2. Review of Literature

Several studies have analysed research output of universities and institutions in India. Sevugan and Sharma[3] have reported the publication output in biotechnology of some Indian universities between 1997 and 2006 and found a steady growth of publication output. Vasistha[4] has analysed the research publication output of PEC University of Technology, Chandigarh and reported that the output increased by 131.85% between 1996 and 2009. Savanur and Konnur[5] have studied the research output of Bangalore University between 1970 and 2010 and found

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that the growth rate of publications was highest during 1996 and 2000 and gradual decrease found after 2001. Maharana and Sethi[6] have studied the publication output of Sambalpur University during 2007-2011. Meera and Sahu[7] have studied the research output of University College of Medical Science (UCMS), University of Delhi Mandhirasalam[8] analysed the publication output of Coimbatore Institute of Technology (CIT) and found that significant contribution (86.38%) (639 papers) was from the year 2006 onwards.

3. Objectives

The objectives of the study include:

- To find out the year-wise research publication output of PSGCT.
- To know the types of publication.
- To identify the most productive authors and authorship pattern.
- To identify research collaboration of PSGCT with other countries and institutions.
- To identify the journal-wise output.
- To examine the major areas and subjects of publication output.
- To examine the citations received by publications of PSGCT.

4. Methodology

Data on publication output of PSGCT were collected from the Scopus database for all the years from 1971 to 2014. Scopus, a product of Elsevier is covers nearly 22,000 titles from over 5,000 publishers and is the largest abstract and citation database of peer-reviewed literature covering science, technology, medicine, social sciences, and arts and humanities. It also provides author profiles which cover affiliations, number of publications and their bibliographic data, references, and details on the number of citations each published document has received. It has a facility to calculate h-index of authors and institutions[9]. The query: [AFFILORG (PSG College of Technology) and PUBYEAR < 2015] was used to retrieve details of research publications emanating from PSGCT[10].

5. Data Analysis and Results

Table 1 shows significant increase in publication started from 2005 with 115 publications and 2012 is the most productive year with 319 (13.53%) publications followed by 2014 and 2013 with 301 (12.77%) and 279 (11.84%) publications respectively. The publication output of last ten years, i.e. from 2005 to 2014 contributes 2112 (89.6%) publications of the total of 2357 in 44 years (1971 to 2014).

Table 1. Year-wise Output of Publications, Relative Growth Rate and Doubling Time

Year	Papers	Percent	W_1	W_2	R(a) (W_2-W_1)	D_t(a) [0.693/R(a)]
1971 to 2004	245	10.39	-	-	-	-
2005	115	4.88	-	4.74	-	-
2006	143	6.07	4.74	4.96	0.22	3.15
2007	176	7.47	4.96	5.17	0.21	3.30
2008	157	6.66	5.17	5.06	-0.11	0.58
2009	191	8.10	5.06	5.25	0.19	3.65
2010	185	7.85	5.25	5.22	-0.03	0.66
2011	246	10.44	5.22	5.51	0.29	2.39
2012	319	13.53	5.51	5.77	0.26	2.67
2013	279	11.84	5.77	5.63	-0.14	0.55
2014	301	12.77	5.63	5.71	0.08	8.66
Total	**2357**	**100**			**0.97 (0.11)**	**25.61 (2.85)**

R(a) - Relative Growth Rate *D_t(a) - Doubling Time*

5.1 Relative Growth Rate [R(a)]

The relative growth rate is the increase in the number of publications per unit of time i.e. one year. The mean relative growth rate R(1-2) over a specified period of interval can be calculated from the following equation suggested by Mahapatra[11]

$$R(1-2) = \frac{W_2 - W_1}{T_2 - T_1}$$

where,

R(1-2) = Mean relative growth rate over a specific period of interval;

W_1 = Log W_1 (Natural log of initial number of publications);

W_2 = Log W_2 (Natural log of initial number of publications);

T_2-T_1 = Unit difference between the initial time and final time.

Therefore,

R(a) = Relative growth rate per unit of publications per unit of time (year).

The Relative Growth Rate R(a) and Doubling Time D(t) of publication output of PSGCT are derived and presented in Table 1 and the results show that till 2004 there was not enough number publications when compare with the last 10 years. The relative growth rate ranges between 0.19 to 0.29 from 2006 onwards except in 2014 (0.08) and declined in 2008 (-0.11), 2010 (-0.03) and 2013 (-0.14). The mean relative growth rate is 0.11.

5.2 Doubling Time (D_t)

A direct equivalence exists between the relative growth rate and doubling time. The doubling time for publication can be calculated by the following formula suggested by Mahapatra[11]

$$\text{Doubling time } (D_t) = \frac{0.693}{R}$$

Therefore,

$$\text{Doubling time for publications } Dt(a) = \frac{0.693}{R(a)}$$

The doubling time for publication output of PSGCT increased from 3.15 from 2006 to 3.65 in 2009 but decreased during 2008 (0.58), 2010 (0.66) and 2013 The The doubling time for publications at the aggregate level has been computed as 2.85 years. There is a progressive growth in the number of publications of research output of PSGCT but its Doubling time is showing a declining trend, since the rate of increase is low.

Table 2 (a). Type of Publications

Publication Type	Papers	Percent
Journal Articles	1787	75.82
Conference Papers	439	18.63
Reviews	80	3.39
Book Chapters	15	0.64
Articles in Press	14	0.59
Notes	7	0.30
Editorials	6	0.25
Others	9	0.38
Total	**2357**	**100**

Table 2 (b). Type of Sources

Source Type	Papers	Percent
Journals	1633	69.28
Conference Proceedings	328	13.92
Trade Publications	220	9.33
Book Series	157	6.66
Books	19	0.81
Total	**2357**	**100**

It is found from Tables 2 (a) and 2 (b) that the faculty of PSGCT mostly published their research findings in the form of journal articles (1787 with 75.82%) and selected journal (1633 with 69.28%) as the preferred channel for their publications. They have also presented their papers in 328 (13.92%) conferences and contributed 439 papers (18.63%). They have published 80 (3.39%) review papers as well. Other types like trade publications (220 of 9.33%) and books (176 of 7.47%) are also the source of publications. Remaining forms like book chapters, editorial account for a small proportion (51 with 2.16%).

Table 3 reveals that Devadasan, S.R. is the most productive author with 113 (4.79%) publications followed by Sivanandam, S.N. with 95 (4.03%) publications. Interestingly Chandramohan, G. and Jayakumar, S. are ranked in the top two positions based on average number of citations per publication. Sivanandam, S.N. and Ramachandran, T. have more publications but received less citations. Some of the authors from other institutions are also shown in the table since they are co-authors.

It is clear from the Table 4 that 2256 papers (95.71%) are collaborative publications. Two author papers (961 with 40.77%) are more among collaborative papers fol-

Table 3. Ranking of Authors based on Publications/Citations (Top 15 Ranked Authors)

Author	Papers	Percent	Total Citations	'H' Index	Average Citation per paper	Rank*	Rank**
Devadasan, S.R.	113	4.79	664	14	5.88	1	5
Sivanandam, S.N.	95	4.03	283	6	2.98	2	13
Thilagavathi, G.	73	3.10	266	10	3.64	3	9
Ramachandran, T.	71	3.01	243	7	3.42	4	10
Rajasekaran, S.	68	2.89	335	11	4.93	5	8
Sumathi, S.	67	2.84	212	5	3.16	6	12
Jerome, J.	54	2.29	132	6	2.44	7	14
Nadarajan, R.	51	2.16	116	5	2.27	8	15
Muthukumarasamy, N.	45	1.91	332	9	7.38	9	3
Balasundaraprabhu, R.	45	1.91	331	11	7.36	9	4
Kandaswamy, A.	44	1.87	88	5	2.00	10	16
Rudramoorthy, R.	39	1.65	201	8	5.15	11	7
Anbumani, N.	38	1.61	64	4	1.68	12	17
Subramanian, R.	37	1.57	211	7	5.70	13	6
Chandramohan, G.	35	1.48	582	14	16.63	14	1
Krishnaraj, V.	34	1.44	115	4	3.38	15	11
Gunavathi, K.	34	1.44	43	3	1.26	15	18
Jayakumar, S.	34	1.44	271	11	7.97	15	2

**Rank based publications* ***Rank based on average citations per publication*

Table 4. Authorship Pattern

No. of Authors	No. of Papers	Percent
Single	101	4.29
Two	961	40.77
Three	639	27.11
Four	346	14.68
Five	179	7.59
Six	87	3.69
Seven	25	1.06
Eight and Above	19	0.81
Total	**2357**	**100**

lowed by three (639 with 27.11%). 101 papers (4.29%) were contributed by single authors.

6. Degree of Collaboration of Publications

Collaborative co-efficient is used to measure the extent of collaboration. The measure of the degree of collaboration in a discipline lies between 0 and 1 according to the formula of Subramanyam[12] C = Nm/Nm+Ns.

C: Degree of Collaboration
Nm: Number of multi-authored publications
Ns: Number of single authored publications
Hence C = 2256/2256+101 = 0.957

Hence, it is found that the degree of collaboration of publications of PSGCT faculty is 0.957.

Table 5 shows that the faculty of PSGCT collaborated most with researchers of USA and South Korea for 38 publications each.

It is found from the Table 6 that researchers from 12 institutions collaborated with the faculty of PSGCT for more than 20 publications each. Among them, Coimbatore Institute of Technology stands first with 116 publications.

Table 7 shows that the distribution of journals ion which the papers appeared indicates a high degree of scatter in terms of number of journals. The top 10 journals accounted for less than 20% of all publications output.

It is evident from the Table 8 that 1205 papers were published in the broad area of 'Engineering' followed by Materials Science (712) and Computer Science (658).

Table 9 indicates some of the major areas of research being carried out in OPSGCT: Algorithms' 'Scanning electron microscopy'. 'Mathematical models', 'Optimization',

Table 5. Country wise Collaboration (Top 5 Ranked Countries)

Rank	Country	Papers
1	United States	38
1	South Korea	38
2	France	19
3	Norway	18
4	China	13
5	Australia	11
5	Singapore	11
5	Portugal	11

Table 6. Ranking of Collaborative Institutions (Top 10 Ranked Institutions)

Rank	Institution	Papers
1	Coimbatore Institute of Technology	116
2	Anna University	89
3	PSG College of Arts and Science	87
4	Kumaraguru College of Technology	77
5	Bannari Amman Institute of Technology	63
6	National Institute of Technology, Tiruchirappalli	43
7	Bharathiar University	39
8	Avinashilingam University for Women	30
8	Karpagam College of Engineering	29
9	Government College of Technology, Coimbatore	24
10	Sri Krishna College of Engineering and Technology	22

'Neural networks', 'Cotton', and 'Computer simulation' are the major topics of research and publications by PSGCT faculty.

It is evident from Table 10 that 6 papers have received more than 100 citations and 20 papers have received between 50 and 99 citations. 902 papers have received less than 9 citations and 1214 papers have not received a single citation. Among the 1214 uncited papers, 258 (21.25%) and 167 (13.76%) papers are published in 2014 and 2013 respectively. 343 (28.25%) papers were published during 2010 to 2012.

Table 7. Ranking of Journals based on Publications (Top 10 Ranked Journals)

Rank	Journal	Papers	Percent
1	Asian Textile Journal	56	2.38
2	European Journal of Scientific Research	55	2.33
3	Indian Journal of Fibre and Textile Research	51	2.16
4	Studies in Computational Intelligence	48	2.04
5	Applied Mechanics and Materials	34	1.44
6	Journal of Scientific and Industrial Research	32	1.36
7	Man Made Textiles in India	31	1.32
7	Journal of the IEI Part TX Textile Engineering	31	1.32
8	Procedia Engineering	28	1.19
9	Melliand International	27	1.15
10	International Journal of Advanced Manufacturing Technology	25	1.06
10	Journal of the Textile Association	25	1.06
10	Indian Journal of Engineering and Materials Sciences	25	1.06

7. Scimago Institutions Rankings (SIR)

The SCImago Institutions Rankings (SIR) characterizes research outcomes of institutions to provide useful information to institutions, policymakers and research managers for the analysis, evaluation and improvement of their research. The Global SIR takes into account those organizations from any country, with at least 100 documents published (articles etc.) in the last year of the five year period as collected by Scopus[13].

It is evident from Figure 1 (a) and 1 (b), PSGCT has occupied the 2164th rank among the 4844 listed global institutions in the output of publications as per SIR 2014. It holds 80th rank among the 222 Indian Institutions listed. Its global output score of 2014 is 0.4812 out of 100. More rankings of publications of PSGCT from 2009 to 2014 such as Scientific Talent Pool, Excellence, Leadership, and Excellence with Leadership, International Collaboration, Normalized Impact, Specialization, Q1,

Table 8. Broad Areas of Publication (Top 15 Ranked Areas)

Rank	Subject	Papers
1	Engineering	1205
2	Materials Science	712
3	Computer Science	658
4	Business, Management and Accounting	380
5	Mathematics	242
6	Chemistry	203
7	Physics and Astronomy	179
8	Environmental Science	169
9	Chemical Engineering	164
10	Agricultural and Biological Sciences	157
11	Earth and Planetary Sciences	100
12	Decision Sciences	90
13	Multidisciplinary	75
14	Biochemistry, Genetics and Molecular Biology	68
15	Medicine	66

Table 9. Topics of Research (Top 10 Ranked Topics)

Rank	Keywords	Papers
1	Algorithms	124
2	Scanning electron microscopy	103
3	Mathematical models	77
4	Optimization	75
5	Neural networks	69
6	Cotton	65
6	Computer simulation	65
7	X ray diffraction	57
8	Genetic algorithms	52
8	Adsorption	52
9	Textile industry	40
9	Aluminum	40
10	Artificial intelligence	39

Innovative Knowledge and Technological Impact can be accessed from: http://www.scimagoir.com/institution.php?idp=10274[14].

8. Summary of Findings

- 2357 papers were published by the faculty of PSGCT in the span of 44 years from 1971 to 2014.

Table 10. Cited and Uncited Papers

Citations (Received by Papers)	No. of Papers	Percent
More than 100 citations	6	0.25
50 to 99 citations	20	0.85
25 to 49 citations	55	2.33
10 to 24 citations	160	6.79
9 citations and less	902	38.27
Uncited Papers	1214	51.51
Total	**2357**	**100**

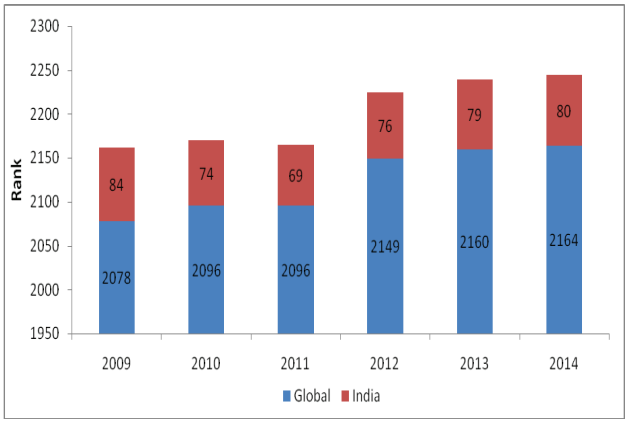

Figure 1 (a). Global and National Output Ranking of PSGCT from 2009 to 2014.

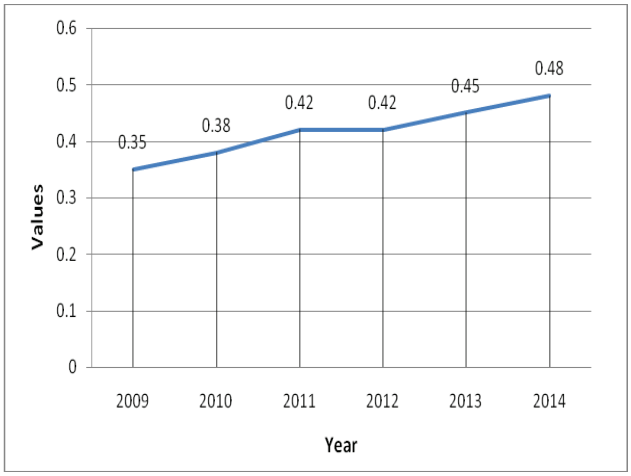

Figure 1 (b). Global Output Value of PSGCT from 2009 to 2014.

- Journals are the most preferred channels followed by conference proceedings.
- The relative growth rate ranges between 0.19 to 0.29 from 2006 to 2013 and declined in the years 2008 (-0.11), 2010 (-0.03) and 2013 (-0.14).
- The paper entitled 'Adsorption of methylene blue onto jute fiber carbon: Kinetics and equilibrium studies' by Senthil Kumar, S. et al., in the 'Journal of Colloid and Interface Science' in 2005 is the most cited paper of PSGCT and has received 242 citations as of now;
- Six papers have received more than 100 citations and 20 papers have received 50 to 99 citations. 1214 (51.5%) papers have not received a single citation.
- 'H' Index of PSGCT is 41. This means 41 papers have got atleast 41 citations each.
- As per SIR, PSGCT stands at 2164th rank among the 4844 global institutions listed. It stands at 80th rank among the 222 Indian Institutions listed.

9. Conclusion

The reputation of any institution can be measured on the basis of its R&D and publication output. The quality of R&D and publications should be measured by means of quantitative (papers) as well as qualitative (citations) analysis. It is the responsibility of the LIS community to study and notify the faculty, scientists and scholars of a particular institution to make known the research trend of their organization and the subject areas of research through bibliometric/scientometric analysis and help them to do further research in their field.

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