SCIENTOMETRIC ANALYSIS OF CONTRIBUTIONS TO JOURNAL OF SCIENTIFIC AND INDUSTRIAL RESEARCH

Dr. P. Rajendran
University Librarian, SRM University,
SRM Nagar, Kattangulathur – 603 203. TN
librarian@srmuniv.ac.in

Dr. R.Jeyshankar
Assistant Professor
Department of Library and Information Science
Alagappa University, Karaikudi, Tamil Nadu
Jeyshankar71@gmail.com

B. Elango
Librarian,
IFET College of Engineering,
IFET Nagar, Gangarampalayam
Villupuram – 605 108. TN.
elangokb@yahoo.com

ABSTRACT

Scientometric analysis of 633 research articles published in **Journal of Scientific and Industrial Research** has been carried out. Five Volumes of the journal containing 60 issues from 2005 – 2009 have been taken into consideration for the present study. The number of contributions, authorship pattern & author productivity, average citations, average length of articles, average keywords and collaborative papers has been analyzed. Out of 633 contributions, only 51 are single authored and rest by multi authored with degree of collaboration 0.92 and week collaboration among the authors. Pattern of Co-Authorship revealed that the improving trend of co-authored papers. The study revealed that the author productivity is 0.34 and dominated by the Indian authors.

KEYWORDS: Scientometrics, Bibliometrics, Journal of scientific and Industrial Research, Publication, Author Productivity, Collaboration pattern

INTRODUCTION

Scientometrics is a discipline which analyses scientific publications to explore the structure and growth of science. The bibliometric / scientometric / informetric techniques used to analyze various quantitative or qualitative aspects of a publication. It is a scientific field that studies the evolution of science through some quantitative measures of scientific information, as the number of scientific articles published in a given period of time, their citation impact, etc. The history of science and technology, philosophy of science and sociology of scientific knowledge are the related fields of Scientometrics.

The term scientometrics is often used with the meaning as the bibliometrics, originated in Russia. The application of quantitative methods to the history of science, Scientometrics is the science of measuring the science, which involves counting artifacts to the production & use of information and arriving conclusions from the counts.

Bibliometrics / Scientometrics research includes studies related to the scattering & growth of literature, author productivity, obsolescence of documents, distribution of scientific

literature by country, by language, etc, which helps to monitor the growth & pattern of research.

Pritchard (1969) [1] described the Bibliometrics as the application of mathematics and statistical methods to books and other media.

Scientometric research is devoted to quantitative studies of science and technology – according to A.F.J.Van Raan [2].

Scientometrics applies the bibliometric techniques to science and examines the development of the sciences [3].

Main areas of Scientometrics are individual scientific documents, authors, scientific institutions, academic journals and regional aspects of science [4].

In this paper, an attempt has been made to analyze the contributions to *Journal of Scientific and Industrial Research* published during the year 2005 – 2009, in order to explore the author pattern, collaborative research, keywords and length of the papers among the contributions. This study covers the 633 articles of 60 issues published.

SOURCE

Journal of Scientific and Industrial Research was selected as the source journal for the present research study. The Journal was started in 1942 and published **monthly**, by National Institute of Science communication and Information Resources (**NISCAIR**), a premier institution of **CSIR**, New Delhi. It serves as an information link between generators and users of technologies and addresses to entrepreneurs, technologists, engineers, technocrats and scientists on one hand and planners, administrators and managers on the other [5]. Original research articles of interest to industry, reviews on frontiers of science and technology, articles on management and policies relating to science, technology and industrial applications are the major coverage of publications.

The journal publishes articles in the following broad subject headings.

- Scientific Research (Application-based)
- Industrial Research (R & D)
- Industrial Research (Utilization)
- Industrial Development
- S & T Management and
- Industrial Management

LITERATURE REVIEW

Scientometric / Bibliometric / Citation studies have done earlier by different authors on the different individual journal publications and literature on specific subject areas. The following studies related to the objectives of this study have been reviewed.

Srimurugan A & Nattar S [6] analyzed the D-LIB magazine published during 2000 – 2007 which revealed that highest number of paper was published in 2005 and the lowest in 2007.

Vijay K R & Raghavan I [7] analyzed the Journal of Food Science & Technology published during 2000 – 2004 and found that above 93% of contributions were by multiple authors.

A Scientimetric Analysis on Indian Journal of Physics was made by Nattar S [8] during 2004 – 2008 which revealed that the year 2004 records the highest % of contributions regarding single, two and three authored.

Kannappanavar B U, Swamy C & Vijay Kumar M [9] analyzed the publishing trends of Indian Chemical Scientists during 1996 – 2000, which revealed average number of authors per paper has increased from 7.52 to 8.39.

An attempt was made by Tilak Hazarika, Kusuma Goswami & Pritimoni Das [10] to analyze the contributions of Indian Forestor which found Degree of Collaboration was 0.64 among the authors.

Guan & Ma [11] examined the China's Semiconductor Literature and found mega authored papers records the higher value for Co-Authorship Index.

Senthamilselvi & Srinivasa Raghavan [12] analyzed the issues of IEEE Trans on Power Electronics published during 2006 – 2008 which revealed that maximum number of papers was published between 6 – 10 pages category.

A bibliometric study has been carried out by Kalyane V L and Sen B K [13] on the Journal of Oilseeds Research published during 1984 – 1992 which revealed that the keyword "Groundnut" tops the list with 53 records.

Sanni S A and Zainab A N [14] examined the contributions published in Medical Journal of Malaysia during 2004 – 2008 and found 4.82% (28) of contributions were published by Malaysian authors with foreign collaboration.

OBJECTIVES OF THE STUDY

The objectives of this study are

- to map the year wise distribution of papers
- to examine the authorship pattern & author productivity
- to determine the degree of collaboration
- to assess the pattern of Co-Authorship
- to identify collaborative pattern
- to find the average length of papers
- to find the average keywords

SCOPE AND METHODOLOGY

The present study tries to find out the literature growth, authorship and collaboration pattern, average length of articles and average keywords in the source journal. Five volumes (Vol. No.110 to No.119) of *Journal of Scientific and Industrial Research*, published between 2005 and 2009 containing 60 issues have been taken into consideration to the present study. A datasheet was prepared in MS-Excel to record the data and then the data was entered manually into it from the journal itself. The details regarding number of papers, nature of author, keywords and length of papers are collected to fulfill the objectives of the present study. The collected data was analyzed with the following bibliometric indicators.

- ❖ Extent of Authorship Pattern (Single vs. Multiple)
- ❖ Degree of Collaboration
- ❖ Co-Authorship Index

LIMITATIONS

- Since the journal publishes Reviews, Research Papers, Research Reports and Book Reviews, this study is based only on the **Research Papers**.
- This study is limited to research papers published between 2005 and 2009 only.

RESULTS AND DISCUSSION

Year wise distribution of papers

Table 1 shows the distribution of research articles published in Journal of Scientific and Industrial Research during 2005 – 2009. The total of 633 research articles was published with an average of 126.6 articles per year. Out of 633 articles, the highest number of research articles were published in the year 2007 with 138 research articles (11.50 articles per issue) followed by the 2009 ; 132 articles, 2008 ; 131 articles, 2006 ; 117 articles and the lowest number of articles were published in the year 2005 with 115 articles (9.58 articles per issue).

The average number of papers per year is 126 during the study period and the similar type of result has been drawn by Umamaheswari S [15] in the Indian Journal of Agronomy.

Table 1 – Year wise distribution of Papers

Year	Vol. No.	No. of Issues	Total Papers	Research Papers	% of Research Papers
2005	64	12	127	115	90.55
2006	65	12	121	117	96.69
2007	66	12	149	138	92.62
2008	67	12	137	131	95.62
2009	68	12	144	132	91.67
Total		60	678	633	93.36

Authorship Pattern

It is observed from the Table 2, about 90% of papers were contributed by multi authors. Similarly, Nattar S (2011) [16] found 96% of papers were contributed by multi authors in the Indian Journal of Chemistry. Out of 633 papers, the highest number of papers was published by double authors and it accounts for 203 with 32.07% followed by three authored articles account for 198 with 31.28%. 17.38% of articles were published by four authors. 8.06 % of articles were published by single authors. 7.90% of articles were published by five authors. Only 3.32% of articles were published by more than five authors. But the trend of the author pattern in the journal shows that the team size was two to four.

Table 2 – Authorship Pattern		
# Authors	No. of Papers	%
Single	51	8.06
Two	203	32.07
Three	198	31.28
Four	110	17.38
Five	50	7.90
>Five	21	3.32
Total	633	100

Authorship Pattern year wise

The data pertaining to authorship pattern year wise have been given in the Table No.3. Regarding single authored contributions, the years 2005, 2006 & 2007 have the highest contributions with 11 and the lowest in 2009. Regarding double authored contributions, the year 2009 has the highest contributions with 55. The year 2007 has the highest contributions regarding three, four & five authored contributions with 47, 28 & 14 respectively. The year 2008 has the highest contributions of multi authored (more than five authors) with 7.

Table 3 – Authorship Pattern year wise						
Year	# Authors					
	1	2	3	4	5	>5
2005	11	40	31	19	9	5
2006	11	29	45	22	5	5
2007	11	36	47	28	14	2
2008	10	43	39	23	9	7
2009	8	55	36	18	13	2
Total	51	203	198	110	50	21

Author Productivity

The data pertaining to author productivity has presented in the Table 4. The table shows that the total average number of authors per paper is 2.95 for the 633 articles. The years 2005 & 2006 has the relatively equal average number of authors per article when compared the total average number of authors per article.

The average productivity per author is 0.34 during the year 2005 - 2009. The years 2005 & 2006 has the relatively equal productivity per author when compared to the average productivity. Productivity has been calculated with the following formula [18].

Average Authors per Paper = No. of Authors / No. of Papers
Productivity per Author = No. of Papers / No. of Authors

Table 4 – Author Productivity

Year	Total Number of Papers	Total Number of Authors	AAPP	Productivity per Author
2005	115	338	2.94	0.34
2006	117	340	2.91	0.34
2007	138	418	3.03	0.33
2008	131	395	3.02	0.33
2009	132	375	2.84	0.35
Total	633	1866	2.95	0.34

Degree of Collaboration

In order to determine the strenth of Collaboration (DC), the following formula suggested by Subramanyam K [19] has been employed.

$$DC = \frac{N_m}{N_m + N_s}$$

Where, DC = Degree of Collaboration
N_m = Number of Multiple Authored Papers
N_s = Number of Single Authored Papers

The Degree of Collaboration of authors by year wise is presented in the Table 5. The degree of collaboration ranges from 0.90 to 0.94. The average degree of collaboration is 0.92 during the period 2005 – 2009 and it brings out clearly that there exists a higher level of collaboration in the journal. The similar type of result has been drawn by Rajinikanth, et al [20] in the Journal of Surveying Engineering.

Table 5 : Degree of Collaboration

Year	Single	Multiple	DC
2005	11	104	0.94
2006	11	106	0.90
2007	11	127	0.92
2008	10	121	0.92
2009	8	124	0.94
Total	51	582	0.92

Pattern of Co-Authorship

In order to assess the Pattern of Co-Authorship (CAI), the following formula suggested by Garg and Padhi [21] has been employed.

$$CAI = \frac{N_{ij}/N_{io}}{N_{oj}/N_{oo}} X100$$

Where,

N_{ij} = Number of papers having authors in block i

N_{io} = Total output of block i

N_{oj} = Number of papers having j authors for all blocks

N_{oo} = Total number of papers for all authors and all blocks

CAI = 100 implies that a country's co-authorship effort for a particular type of authorship corresponds to the world average, CAI > 100 reflects higher than average co-authorship effort, and CAI < 100 lower than average co-authorship effort by that country for a given type of authorship pattern.

For calculating the co-authorship index for authors, countries have been replaced by block. For this study, the authors have been classified into four blocks, vz Single, Two, Three and more than three authors and the results of Co-authorship index as per the formula have been presented in the Table No.6.

Table 6 : Pattern of Co-Authorship

Year	Single Author		Two Authors		Three Authors		>Three Authors		Total
	No	CAI	No	CAI	No	CAI	No	CAI	
2005	11	118	40	108	31	86	33	100	115
2006	11	116	29	77	45	122	32	95	117
2007	11	98	36	81	47	108	44	111	138
2008	10	94	43	102	39	95	39	104	131
2009	8	75	55	129	36	87	33	87	132
Total	51		203		198		181		633

It is observed from the Table 6, the CAI for single authors is declined from 118 in the year 2005 to 75 in the year 2009. On the other hand, the CAI for double authors is enhanced from 108 in the year 2005 to 129 in the year 2009, which indicates the pattern of cu-authorship is increasing among the contributions of the journal. On the other hand, there is a fluctuation trend of CAI for multi authored contributions. The similar type of result has been drawn by Jeyshankar R, et al [22] in the Current Science.

Distribution of Pages

Table 7 shows that 633 papers published with a total page of 3968 (average 6.27 pages per article) during the year 2005 – 2009. It is observed that the average length of the

articles varied from a minimum of 5.96 pages to a maximum of 6.92 pages. The similar type of result has been drawn by Kamal Lochan Jena [23] in the Indian Journal of Fibre and Textile Research. The year 2008 has highest average page per paper with 6.92 pages while the year 2009 has the lowest average page per paper with 5.96.

Table 7 – Distribution of Pages

Year	No. of Articles	Total Pages	Average pages per Article
2005	115	747	6.50
2006	117	699	5.97
2007	138	828	6.00
2008	131	907	6.92
2009	132	787	5.96
Total	633	3968	6.27

Average Keywords per Article

Table 8 – Average Keywords per Article

Year	No. of Articles	Total Keywords	Average keywords per paper
2005	115	558	4.85
2006	117	526	4.50
2007	138	597	4.33
2008	131	614	4.69
2009	132	582	4.41
Total	633	2877	4.55

Table 8 reveals that 2877 keywords have been appended to 633 papers. It is observed that the average keyword of the paper varied from a minimum of 4.33 to a maximum of 4.85 during the year 2005 – 2009. The year 2005 has the highest average keyword per paper with 4.85 keywords per paper while the year 2007 has the lowest average keywords per paper with 4.33. The overall average keywords per article are 4.55.

Distribution of Indian and Foreign Contributions

Table 9 shows that out of 633 articles, 462 (72.98%) articles published by Indian Authors followed by International Authors with 159 Articles (25.12%). Only 12 (1.89%) articles published by Indian Authors collaborated with international Authors and similar type

of study has been conducted by Zainab A N, et al (2009) [24]. It seems that there was poor collaboration of Indian Authors with Foreign Authors. It is observed from the data that out of 60 issues, 6 issues having the contributions only by Indian Authors.

Table 9 - Distribution of Indian and Foreign Contributions		
Form	Contributions	%
Indian Authors	462	72.99
Indian Authors with Foreign Collaboration	12	1.89
Foreign Authors	159	25.12
Total	633	

FINDINGS

The analysis revealed the following conclusions.

- The maximum number of papers published in 2009 and minimum in 2005.
- The highest number of research papers contributed by multiple authors during the study period.
- The degree of collaboration was 0.92.
- It is found that the average value for CAI was around 100 during the study period and it reflects the world average.
- The author productivity is 0.34 and the average number of authors per paper is 2.95.
- The average pages per paper are 6.27.
- The average keywords per paper are 4.55.
- The majority of the contributions are by Indian Authors (72.99%).
- Papers by Indian Authors with Foreign Collaboration are minimal (1.89% of articles).

CONCLUSION

The analysis explores that the majority of papers by multi authors and Indian authors. There was poor international collaboration by Indian authors. The average page is 6.27 and it is the ideal for research papers. The Degree of collaboration (using Subramanyam‘s formula) indicates that there exists a high degree of collaboration. The average Co-Authorship Index for all the authors reflects the world average in the journal and improving trend of co-authored papers. The study revealed that the journal seems to be popular among the international research community with around 25% of papers.

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