Scientometric analysis of IEEE Transaction on Pattern analysis and Machine Intelligence (2006-2015)

[1]N.Ramasabareswari, [2]Dr.J.Santhi

[1]Research Scholar (Bharathiar University), Librarian, Akshaya college of Engineering & Technology, Kinathukadavu, Coimbatore – 642109, Tamilnadu

[2]Librarian, Arumugam Pillai Seethai Ammal College, (Government Aided College), Thirupathur Sivagangai Dt

ABSTRACT

The present study deals the scientometric analysis of 1557 articles from IEEE Transaction on Pattern analysis and Machine Intelligence for the period of 2006-2015. The results show that the highest number of 204 (13.10%) articles has been appeared in the year of 2013. A significant note of the study is that the majority of articles are contributed by three authors 496(31.9 %).It is found that out of 1557 articles, only 74 articles were contributed by single authors; remaining 1483articles were contributed by multiple authors. The average degree of collaboration is 0.95.The total average author per paper is 3.16and average productivity per paper is 0.32.It is noted that the average citation per article is 45.

Keywords: Scientometric, IEEE Transactions on Pattern Analysis & Machine Intelligence , Authorship pattern, Collaborative Research, Relative Growth Rate, Doubling Time.

I.   INTRODUCTION

The *IEEE Transactions on Pattern S*cientometric*Analysis and Machine Intelligence* (TPAMI) is published monthly. The Journal publishes articles on computer vision and image understanding, pattern analysis and recognition, and some areas of machine intelligence, with a particular emphasis on machine learning for pattern analysis. ISSN: 0162-8828. The journal published by IEEE Computer society of India. The impact factor of journal is 6.07. The present study deals the Scientometricanalysis of 1557 articles from IEEE Transaction on Pattern analysis and Machine Intelligence for the period of 2006-2015.

According to Sengupta,Bibliometrics defined as "Organization, classification and quantitative evaluation of publication patterns along with their authorships by mathematical and statistical calculus". According to Pritchard "The Application of mathematics and statistical methods to all media of communication; Methodology of the information transfer process and its purpose is analysis and control of the process. According to Tague, "Scientometrics is the study of quantitative aspects of science as a discipline or economic activity. It is part of the sociology of science and has application to science policymaking. It involves quantitative studies of scientific activities, including among others, publication, and so overlaps bibliometrics to some extent". It is clear from the basic definition that the scope of scientometrics is limited to studies of science. The info metrics studies are spread over all fields of knowledge.

II.   REVIEW OF LITERATURE

Velmurugan C ,(2013) analyzed the journal "Annals of Library and Information Studies " for the period between 2007-2012. This covers mainly the authorship patter, articles, average number of reference per article etc.,the results shows that thehighest number of contributions i.e., 43 (21.19 %) were published in the year2010. The minimum number of 27 (13.31 %) was published in the year 2012. A total of 72contributions (35.46 %) out of 203 have been contributed by single author. The highest number of i.e. 167 articles (82.26 %) contributed by authors affiliated to Academic Institutes whereas the lowest number i.e.12 (5.92%) from Special Institution.

Rajendran.P, Jeyshankar R, Elango(2011)analyzedthe Journal of Scientific and Industrial Research from 2005-2009. 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.

PriyaA.Suradkar, Khaparde V (2012) examines the authorship pattern of the Journal of documentation during 2007-2011. The results show the mean of relative growth rate of 0.278 whereas the mean of Doubling Time for the five years was only 1.813. The value of group co-efficient for citations was 0.42. The average rate of citation per articles was 10.37.

ChandaArya, Superna Sharma (2012) highlights the collaboration in research and authorship trend in the area of veterinary sciences all over the world with special reference to India. Average degree of collaboration was found 0.84, which also indicates dominance of collaborative research over solo research. The study of literature growth worldwide indicates that Indian has contributed a good portion to the veterinary sciences research.

Krishnamoorthy G, Ramakrishnan J, Devi S(2009) analyzed the Bibiliometrics analysis of literature on diabetes during 1995-2004. The results indicated the Relative Growth Rate was found to be decreasing and doubling time increasing every year.

MahendrakumarShah(2016) deals the Bibliometric Analysis of International Journal of Agriculture Sciences (2009-2014). The results show that the majority of the articles are an outcome of the collaborative research, the degree of collaboration is 0.8765 which clearly indicates the dominance of collaborative research upon individual contributions.

III.   OBJECTIVES OF THE STUDY

1. To find and study the year wise distribution of articles
2. To study the authorship pattern by year and volume
3. To study the authors productivity and degree of collaboration
4. To identify single vs. multiple author publications
5. To identify the Relative growth rate (RGR) and Doubling Time (DT)
6. To analyzed year wise distribution of citations

IV.   METHODOLOGY

Methodology applied in the present *Scientometric* study is analysis which is used to study in detail the bibliographic features of the articles and citation analysis of reference appended at the end of each article, published in IEEE Transactions on Pattern Analysis & Machine Intelligence from 2016-2015. The data is pertaining to IEEE Transactions on Pattern Analysis & Machine Intelligence regarding 1557 articles. These data were organized, calculated, tabulated and presented by using simple arithmetic and statistical methods for its results.

V.   ANALYSIS OF THE DATA

Table 1: Year-wise distribution of articles

Table 1: Yearwise distribution of articles					
Year	Vol. No.	No. of issues	Total	percentage	Cumulative percentage
2006	28	12	126	8.09	8.09
2007	29	12	137	8.80	16.89
2008	30	12	143	9.18	26.07
2009	31	12	135	8.67	34.74
2010	32	12	140	8.99	43.74
2011	33	12	160	10.28	54.01
2012	34	12	162	10.40	64.42
2013	35	12	204	13.10	77.52
2014	36	12	173	11.11	88.63
2015	37	12	177	11.37	100.00
Total		**120**	**1557**	**100.00**	

5.1 Year-wise distribution of articles

Table 1 indicates the year wise distribution of articles published in the Journal of IEEE Transactions on Pattern Analysis & Machine Intelligence. It is observed that the highest number of articles 204 (13.10%) in 2013, followed by 177 (11.37%) articles in 2015. The less number of articles 126 (8.09%) have been published in 2006.
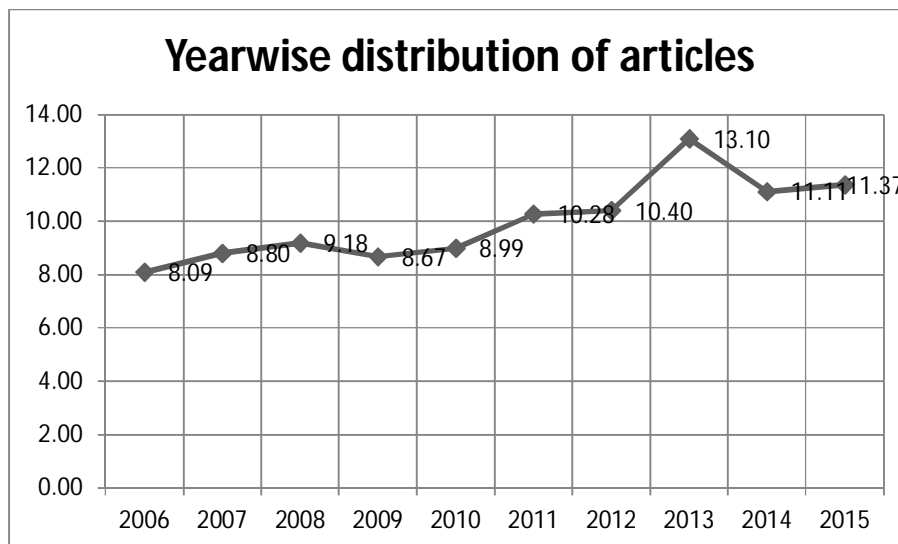

Fig-1 **Year-wise distribution of articles**

Table 2: Authorship pattern of contribution

Table 2 : Authorship pattern of contribution		
Author	Total	Percentage
Single	74	4.8
Two	469	30.1
Three	496	31.9
Four	318	20.4
Five and above	200	12.8
Total	1557	100

5.2 Authorship pattern of contribution

The table 2 shows the information about the authorship pattern of articles published in the journal of IEEE Transaction on pattern analysis and machine Intelligence Out of 1557 articles, the majority of the research articles written by a three authors 496 (31.9%), followed by two authors 469 (31.9%), four authors 318 (20.4%) and five and above authors 200 (12.8). The lowest number of contributions was made by single author 74 (4.8%).
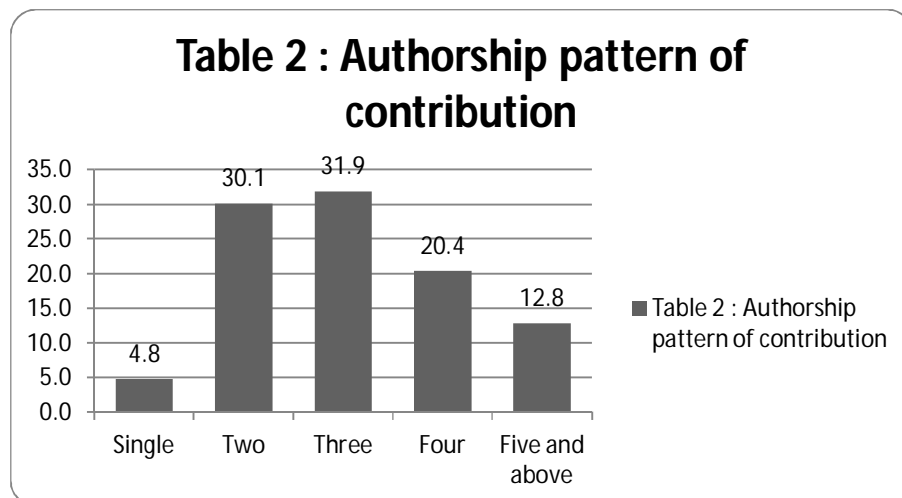
Fig-2 **Authorship pattern of contribution**

Table 3 : Authorship pattern of contribution by year

| Table 3 : Authorship pattern of contribution by year | | | | | | | | |
Year	Volume	Single	Two	Three	Four	Five & above	Total contributions	Percentage
2006	28	12	43	31	15	10	111	7.13
2007	29	11	51	41	25	13	141	9.06
2008	30	9	47	48	27	11	142	9.12
2009	31	3	53	44	26	13	139	8.93
2010	32	11	41	48	27	13	140	8.99
2011	33	5	56	52	37	14	164	10.53
2012	34	7	43	54	27	32	163	10.47
2013	35	7	51	68	42	39	207	13.29
2014	36	3	43	61	47	19	173	11.11
2015	37	6	41	49	45	36	177	11.37
Total		**74**	**469**	**496**	**318**	**200**	**1557**	**100.00**

5.3 Authorship pattern of contribution by year

The above table 3 indicates volume and year wise authorship pattern of contributions. It shows that out of 74 contributions by single authors, volume28 has highest i.e., 12 whereas the volume 31,36 has the lowest number i.e., 3contributions. Out of 469 articles by two authors, volume 33 has highest 56 and volume 32 and 37 has the lowest number i.e., 41 of publications. Out of 496 contributions by three authors, volume 35 indicates highest number i.e.,68 and volume 28 is the lowest number i.e.,31of contributions. Out of 318 contributions by four authors, volume 36 indicates highest number i.e.,47 and volume 28 is the lowest number i.e., 15 of contributions. It shows that out of 200 contributions by five and above authors, volume 35 has highest i.e., 39 whereas the volume 28 has the lowest number i.e., 10contributions.

Table 4 : Author Productivity

<table>
<tr><td colspan="6">Table 4 : AUTHOR'S PRODUCTIVITY</td></tr>
<tr><th>Sl.No</th><th>year</th><th>Total no. of contributions</th><th>Total No. of Authors</th><th>AAPP*</th><th>Productivity per year**</th></tr>
<tr><td>1</td><td>2006</td><td>126</td><td>345</td><td>2.74</td><td>0.37</td></tr>
<tr><td>2</td><td>2007</td><td>137</td><td>385</td><td>2.81</td><td>0.36</td></tr>
<tr><td>3</td><td>2008</td><td>143</td><td>415</td><td>2.90</td><td>0.34</td></tr>
<tr><td>4</td><td>2009</td><td>135</td><td>429</td><td>3.18</td><td>0.31</td></tr>
<tr><td>5</td><td>2010</td><td>140</td><td>441</td><td>3.15</td><td>0.32</td></tr>
<tr><td>6</td><td>2011</td><td>160</td><td>501</td><td>3.13</td><td>0.32</td></tr>
<tr><td>7</td><td>2012</td><td>162</td><td>556</td><td>3.43</td><td>0.29</td></tr>
<tr><td>8</td><td>2013</td><td>204</td><td>708</td><td>3.47</td><td>0.29</td></tr>
<tr><td>9</td><td>2014</td><td>173</td><td>573</td><td>3.31</td><td>0.30</td></tr>
<tr><td>10</td><td>2015</td><td>177</td><td>617</td><td>3.49</td><td>0.29</td></tr>
<tr><td></td><td>**Total**</td><td>**1557**</td><td>**4970**</td><td>**3.16**</td><td>**0.32**</td></tr>
<tr><td colspan="6">*Average author per paper (AAPP) = Number of authors/Number of contributions</td></tr>
<tr><td colspan="6">**Productivity per year = Number of papers /Number of Authors</td></tr>
</table>

5.4 Author Productivity

Table 4 shows the data related to author productivity, which shows that the total average number of authors per paper is 3.16 and the average productivity per author is 0.32. The highest number of author productivity i.e., 3.49 % was published in the year 2015.
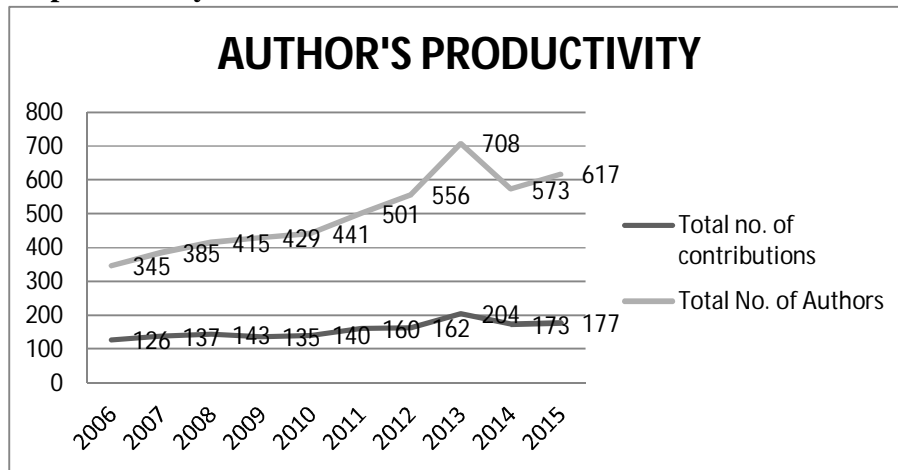
Fig – 4 Author productivity

Table 5 : Degree of collaboration

TABLE 5 : DEGREE OF COLLABORATION						
year	single author	%	multiple author	%	Total	Degree of Collaboration
2006	12	16.22	99	6.68	111	0.89
2007	11	14.86	130	8.77	141	0.92
2008	9	12.16	133	8.97	142	0.94
2009	3	4.05	136	9.17	139	0.98
2010	11	14.86	129	8.70	140	0.92
2011	5	6.76	159	10.72	164	0.97
2012	7	9.46	156	10.52	163	0.96
2013	7	9.46	200	13.49	207	0.97
2014	3	4.05	170	11.46	173	0.98
2015	6	8.11	171	11.53	177	0.97
Total	**74**	100.00	**1483**	100.00	**1557**	**0.95**

5.5 Degree of collaboration

The above table shows that the Degree of author collaboration of IEEE Transactions on Pattern Analysis & Machine Intelligence. During the study period, multi authored papers dominate with the highest 1483 articles out of 1557. The single author papers (74) are less, which shows the fact the group activity in research in the field of engineering and technology is high.

To analysis the nature of researcher's participation in research activity, the author productivity is tested. The formula given by K.Subramanium(1983) is useful for determining the degree of collaboration in quantitative terms.

$$C = \frac{NM}{NM + NS}$$

Where C-Degree of collaboration,

NM-Number of multi author papers,

NS- Number of single author papers.

In the study NM=1483, NS=74

$$C = \frac{1483}{1483+74} = 0.95$$

Thus, the degree of collaboration in IEEE Transactions on Pattern Analysis & Machine Intelligence is 0.95. This brings out clearly the high level of prevalence of collaborative research in the field of engineering and technology.

Relative Growth Rate (RGR) and Doubling Time(DT)

The relative growth rate and doubling time model developed by Mahapatra(1985) was applied to calculate the growth rate of research publications. By the way of Mahapatra,therelative growth rate is increased in the number of publications or pages per unit of time. The specified period of interval can be calculated by the following equations,

$$\bar{R}(1 - 2) = \frac{W2 - W1}{T2 - T1}$$

Where $\bar{R}$(1-2)= is mean relative growth rate over the specified period of interval

W2 = log W2 Natural log of final number of publications

W1 = log W1 Natural log of initial number of publications

T2-T1 = The unit difference between the initial time and final time

Doubling Time

There is a direct equivalence existing between the relative growth rate and doubling time. If the number of publications of a subject doubles during a given period, then the difference between the logarithm of the numbers at the beginning and at the end of the period must be the logarithms of the number 2. The logarithms value of 2 is 0.693. From the value the doubling time can be calculated as showing below,

$$Doubling\ Time\ (DT) = \frac{0.693}{\bar{R}}$$

Table 6: Relative Growth Rate (RGR) And Doubling Time (DT)

Table 6: RELATIVE GROWTH RATE AND DOUBLING TIME					
Year	Total Publications	cumulative total	W 1	W 2	RGR (W2-W1)	DT (0.693/RGR)
2006	126	126	-	4.84	-	-
2007	137	263	4.84	5.57	0.73	0.17
2008	143	406	5.57	6.00	0.43	1.61
2009	135	541	6.00	6.29	0.29	2.39
2010	140	681	6.29	6.52	0.23	3.01
2011	164	845	6.52	6.74	0.22	3.15
2012	163	1008	6.74	6.91	0.17	4.08
2013	207	1215	6.91	7.10	0.19	3.65
2014	173	1388	7.10	7.24	0.14	4.95
2015	177	1565	7.24	7.36	0.12	5.78

5.6 Relative Growth Rate (RGR) and Doubling Time (DT)

Table 6 shows the Relative Growth Rate (RGR) and Doubling Time(DT) of IEEE Transaction on Pattern analysis and Machine Intelligence for the period of 2006-2015. The relative growth rate is decreasing every year, whereas Doubling Time is increasing every year.The highest RGR in the year 2007 (0.73) and the lowest value in the year 2015 (0.12). Doubling Time is highest in the year 2015 (5.78) and lowest in the year 2007 (0.17).

Table 7: Yearwise distribution of cited references

TABLE 7: YEARWISE DISTRIBUTION OF CITED REFERENCES				
Year	No. of articles	No. of cited references per year	%	Average citation per articles
2006	126	4866	6.80	38.6
2007	137	5388	7.53	39.3
2008	143	5679	7.94	39.7
2009	135	6438	9.00	47.7
2010	140	6345	8.87	45.3
2011	160	7244	10.12	45.3
2012	162	7523	10.51	46.4
2013	204	9705	13.56	47.6
2014	173	9014	12.60	52.1
2015	177	9345	13.06	52.8
Total	**1557**	**71547**	**100.00**	**45.5**

5.7. Year wise distribution of cited references

Table 7 shows the year wise distribution of citations from the period of 2006-2015. The relative distribution of references is increasing every year. The highest number of cited reference is in the year 2015 (13.06) and the lowest value in the year 2006 (6.80). It is found that the average citation per article is 45.

VI. CONCLUSION

An IEEE Transactions on Pattern Analysis & Machine Intelligence is the highly preferred journal in the field of engineering and technology. It is observed that the highest number of articles i.e., 204 (13.10%) have been appeared in the year 2013.The minimum number of contributions 126 (8.09%) was published in the year 2006.A total of 1557 articles, the majority of the research articles written by three authors i.e., 496 (31.9%). The lowest number of contribution was made by single author i.e., 74 (4.8%). It is found that the highest number of author productivity i.e., 3.49% was published in the year 2015.The study shows that the Degree of collaboration is 0.95. The study revealed that the highest relative growth rate in the year 2007 and the lowest value in the year 2015. Doubling time is highest in the year 2015 and lowest in the year 2007. It is found that the average citation per article is 45.

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