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Bibliometric Analysis of the *Journal of Propulsion and Power* (1985-2013)

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ABSTRACT

Journal of Propulsion and Power (JPP) is a bi-monthly peer reviewed journal published by American Institute of Aeronautics and Astronautics (AIAA). The present bibliometric analysis is based on 4047 articles published from 1985 to 2013. The study is aimed to assess the growth pattern of research output, authorship pattern, institutional productivity, and geographical distribution of output. The highest number (194) articles were published in year 1992 and lowest (81) in 1987. Out of total articles, 1330 were produced by two authors and 1098 by three authors. It is found that 1205 different institutions were involved in publication of articles. 'Purdue University' contributed highest number of 163 articles. Out of ranked list of 21 affiliations which produced more than 50 articles, 18 institutions were from USA, 2 from Japan, and 1 from Germany, etc. It is observed that highest numbers of 2672 articles were contributed by USA. Country-wise collaborative research productivity of articles reveals that maximum number of articles, i.e., 3760 were produced by one country. International collaboration was involved in producing 287 articles. Out of 287 articles, 171 articles were produced by USA in collaboration with other countries. From top 27 ranked list of authors who have contributed alone or co-authored along with other authors, it is found that Fleeter, S. from Purdue University, USA has authored and co-authored highest number of 54 articles.

Keywords: *Journal of Propulsion and Power,* bibliometric analysis, aeronautics, AIAA

1. INTRODUCTION

Journal of Propulsion and Power (JPP) was introduced to the family of American Institute of Aeronautics and Astronautics (AIAA) journals by Dr Gordon C. Oates, as Editor-in-Chief who is the Professor of Aeronautics and Astronautics at the University of Washington, USA. The goal of the journal is to provide the readership of practicing professionals with up-to-date and original contributions to the literature of high-technology propulsion and power, covering fundamental research through development to applications of propulsion and power generation systems.

The journal is devoted to the dissemination of original research contributing to advancements in air breathing, electric, and advanced propulsion; solid and liquid rockets; fuels and propellants; power generation and conversion for aerospace vehicles; and the application of aerospace science and technology to terrestrial energy devices and systems. It is a bimonthly journal published under the guidance of Douglas G. Talley, Editor-in-Chief, US Air Force Research Laboratory, USA.

2. OBJECTIVES OF STUDY

The aim is to study the following aspects of the source journal:

(i) Publication output
(ii) Authorship productivity
(iii) Productivity of highly prolific organisations
(iv) Country-wise distribution of articles
(v) Organisation-wise collaborative research productivity
(vi) Country-wise collaborative research productivity, and
(vii) Ranked list of authors

3. REVIEW OF LITERATURE

There are several bibliometric studies available in the literature which includes bibliometric studies on single journals, citation studies and subject studies. Studies on single journals presented different types of bibliometric measures. Common measures are article productivity of authors, author's gender, profession, rank, author's institutional names & types. Another bibliometric measure used is co-authorship pattern and degree of collaboration among authors, affiliations and countries. Another measure is the analysis of subject content based on analysis of subject areas of articles published in the journal using various classification schemes, thesaurus, keyword analysis, keyword co-occurrences, article

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title analysis, word frequency in title, types of research methodology used, etc. Citation analysis is also frequently used in single journal studies based on analysis of number and distribution of citations referenced per article over a number of years; authorship pattern of citations; most referenced author; types of cited documents; the age of cited documents; cited documents half-life; and ranked list of core journals. A good number of bibliometric studies on single journals were published in the literature which includes studies undertaken by Tiew[1] on 102 works up to 1997 and by Anyi[2], *et al.* on 82 works from 1997 to 2008. The scope of the literature reviewed is limited to bibliometric studies on single journals in the field of science, technology and engineering by the Indian authors.

A study by Das & Sen[3] on *Journal of Biosciences* in 2000 showed that 18.68 % articles were single-authored, 52.71 % were double- and triple-authored, and the remaining 28.61 % were joint contributions of four or more authors. Of the citations, journal articles comprised 85.89 % and monographs 10.1 %. Indian contributions comprised 5.53 % of the citations. Of the citing articles, 30 were by Indian authors, 3 by foreign authors and 1 (2.94 %) jointly by Indian and foreign authors. Of the total citations, 10.87 % were author self citations and 0.57 % were journal self citations.

Dutta & Sen[4] studied citation analysis of *Indian Journal of Chemistry* Section A during 2000 and found that two-authored citations were 34.03 %, three-authored citations were 22.01 %, and one-authored citations were 17.51 % of total citations. Overall ratio of Indian to foreign citations was 1:36 and 1:47 for journals. The percentage of journal and author self citation was found to 0.50 % and 15.43 % respectively. Study by Narang[5] on *Indian Journal of Pure and Applied Mathematics* revealed that highest number of 174 articles were published in 2001 out of 737 articles during 1998-2002. Authorship pattern showed that two authored articles 352 (47.76 %) topped in five years followed by single authored articles 259 (35.14 %), three authored articles 113 (15.33) and four authored articles 13 (1.77 %). Out of 8396 citations, maximum number of citations 2047 appeared in 2002, followed by 2016 in 2001. With respect to types of documents cited, 6255 citations were journals and 465 were books. Out of 737 articles, 372 (50.47 %) were Indian contributions and 365 (49.52 %) were foreign contributions. Bibliometric studies conducted on the *Indian Journal of Environmental Protection* by Biradar[6] for the years 1994, 1999, and 2004 revealed that average number of references per article during 1994, 1999 and 2004 were 10.6, 11.0 and 13.2 respectively. Among cited references, 56.6 % were journals, 29.8 % were books, and 5.1 % were reports. Out of 370 articles, two authored articles were 144 (38.9 %) followed by three authored articles 96 (25.9 %) and single authored articles 57 (15.4 %). Organisation-wise contribution showed that universities were major contributors with 31.6 % followed by colleges with 24 %, and research institutions with 23.7 %.

Nattar[7] studies on *Indian Journal of Physics* during 2004 to 2008 revealed that 238 articles were contributed in 2004, followed by 200 articles in 2005 out of total 829 articles. Authorship pattern showed that two-authored articles were 275, followed by 221 three-authored articles, 136 four-authored articles, etc. Geographical distribution showed that 91.64 % of contributions were India; 1.5 % contributions were from Bangladesh, etc. Out of 13481 citations, 8851 were journals and 3303 were books. Hadimani & Rajgoli[8] studies on Applied Engineering in Agriculture showed that highest number of 128 articles were published in 2007 and minimum number of 98 articles were published 2007. The authorship pattern showed that the number of three-authored articles account for 27.88 %, followed by 23.79 % of four-authored articles, and 20.26 % of two-authored articles. Year-wise appearance of 10553 citations from 538 articles showed that highest number of 21.44 % of citations appeared in 2006 followed by 21.14 % of citations in 2005. Among cited references, 55.04 % were journals and 26.11 % were books.

Studies conducted by Mandapur, Govanakoppa & Rajgoli[9] on Baltic Astronomy during 2000 to 2008 found that highest number of 113 articles were published in 2004 and lowest of 18 were published in 2001. Authorship pattern revealed that single-authored articles were 132, two-authored articles were 135, three-authored articles were 83, etc. Year-wise distribution of 8489 references from 552 articles showed that highest number of 1521 citations appeared in 2004, followed by 1239 in 2006. Also found that 82.53 % were journals and 7.13 % were books. With respect to country-wise contributions, 16.10 % contributors were from USA, followed by Lithuania with 13.67 %. The *Astronomical Journal* topped the ranked list with 24.17 % citations followed by *Astronomy and Astrophysics* with 17.67 % citations. Studies by Singh[10] on *Indian Journal of Pure and Applied Physics* out of 657 articles during 2006 to 2010 revealed that highest number of 144 articles were published in 2007, followed by 143 articles in 2006, 131 articles in 2008. Authorship pattern showed that 174 were two-authored articles, followed by 162 by three-authored articles, 145 were four-authored articles, etc. Institution-wise contributions showed that Council of Scientific Industrial Research CSIR topped with 54 articles followed by IIT with 50 articles. Out of 1229 citations, articles published in 2007 received the highest number of 291 citations, followed by 282 citations in 2006. The most prolific author was R. Kumar who topped with 21 papers followed by A. Kumar with 20 papers.

4. METHODOLOGY

All journal issues were examined and research articles, review articles, and technical notes published in the source journal were included during 1985-2013 in the present study. Rest of the materials such as technical comments, editorial, announcements and acknowledgments, reviewers, ethical standards, manuscript review process, erratum, subject index, author index, chronological index, reply by authors, preface, scope and summary were excluded. A database is designed and developed using MS-Access to store collected data.

Suitable queries were executed to retrieve results and analysed for making observations to achieve the objectives. A total number of 174 issues from 29 volumes starting from 1985 to 2013 were examined by recording bibliographic data. The details of each published article such as title of the article, name of authors, author affiliation, country of origin, length of article in terms of number of pages were recorded for making observations.

5. RESULTS AND DISCUSSIONS

5.1 Publication Output and Length of Articles

There were 4047 articles published in *Journal of Propulsion and Power* during 1985-2013. Table 1 represents year-wise distribution, average number of articles per volume, length of articles and average number of pages per article. Out of 4047 articles, the highest numbers of article were published in the year 1992, contributing 194 (4.8 %) to the total number of articles. The lowest numbers of articles were published in 1987, contributing 81

Table 1. Year-wise distribution and length of articles

Year	No. of articles	Average No. of articles per volume	Length (Pages)	Average No. of pages per article
1985	88	14.6	508	5.8
1986	90	15.0	565	6.3
1987	81	13.5	565	6.9
1988	84	14.0	593	7.1
1989	113	18.8	750	6.6
1990	111	18.5	788	7.1
1991	149	24.8	1083	7.3
1992	194	32.3	1309	6.7
1993	124	20.6	901	7.3
1994	128	21.3	899	7.1
1995	178	29.6	1371	7.7
1996	179	29.8	1197	6.7
1997	117	19.5	803	6.9
1998	132	22.0	1058	8.0
1999	128	21.3	923	7.2
2000	164	27.3	1177	7.2
2001	186	31.0	1370	7.4
2002	172	28.6	1302	7.9
2003	123	20.5	1196	9.7
2004	132	22.0	1115	8.5
2005	138	23.0	1130	8.2
2006	159	26.5	1415	8.9
2007	163	27.2	1305	8.0
2008	166	27.7	1409	8.5
2009	148	24.7	1351	9.1
2010	149	24.8	1320	8.9
2011	148	24.7	1320	8.9
2012	146	24.3	1546	10.6
2013	157	26.2	1460	9.3
Total	**4047**	**23.3**	**31729**	**7.84**

(2 %) to the total number of articles. On average 23.3 articles were published per issue and 139.5 articles per volume approximately. In the first block from 1985-1994, the number of articles published were 1162; in the second block from 1995-2004, the number of articles published were 1511; and in the third block from 2005-2013 the number of articles published were 1374. It is observed that number of articles published during the first block was less than the average number of articles and the number of articles published in second and third block was more than the average number of articles.

The length of articles varied from 2 to 37 pages and average length of articles during the period 1985-2013 is 7.84 pages. It is observed from the Fig. 1 that, 717 articles have eight pages length, 698 articles have seven pages length, 513 articles have nine pages length and so on.

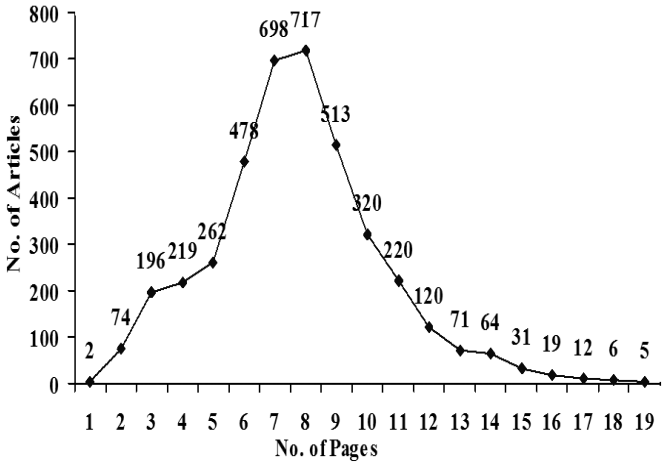

Figure 1. Articles with number of pages during 1985-2013.

5.2 Authorship Productivity

Table 2 shows the authorship productivity of articles published in *Journal of Propulsion and Power* during 1985-2013. It is observed that 7641 authors have contributed 4047 articles with an average of 0.53 articles per author. 523 (12.9 %) articles were produced by one author, 1330 (32.8 %) were produced by two authors, 1708 (42.2 %) articles by multi authors (3 & 4), and 486 (12 %) articles were produced by mega authors (more than 4 authors). The production of one authored articles decreased to almost one third from 1985 to 2013, two authored articles with constant phase, multi authored articles have increased to almost twice, and mega authored articles have increased to almost six times. This indicates a rising collaboration trend in the field of study.

5.3 Highly Prolific Organisations

Table 3 shows highly prolific organisations contributing more than 50 articles. Larger divisions in various organisations were considered as different research institute for the purpose of this study and for drawing inferences. Due to the involvement of multiple authors for producing articles from same organisation, it is observed that 1205 organisations involved in 11690 times for publishing 4047 articles. From Table 3, it is evident that 'Purdue University' contributed highest articles, i.e., 163 contributing (4.03 %) to the total 4047 articles, followed by 161 articles by 'NASA Lewis Research Center' contributing (3.98 %) and 132 articles by 'Pennsylvania State University' contributing to (3.26 %) and so on.

Table 2. Authorship productivity of articles

Year	No. of authors				
	One	Two	Multi (3 & 4)	Mega (> 4)	Total
1985	21	31	34	2	88
1986	19	32	34	5	90
1987	22	29	27	3	81
1988	20	28	34	2	84
1989	17	47	45	4	113
1990	19	43	41	8	111
1991	25	57	57	10	149
1992	30	65	91	8	194
1993	22	44	46	12	124
1994	14	46	57	11	128
1995	38	60	70	10	178
1996	24	73	70	12	179
1997	20	36	47	14	117
1998	15	44	62	11	132
1999	20	49	40	19	128
2000	24	56	70	14	164
2001	18	53	89	26	186
2002	22	60	68	24	172
2003	15	35	59	14	123
2004	21	33	65	13	132
2005	7	47	69	15	138
2006	24	48	59	28	159
2007	12	39	78	34	163
2008	12	43	80	31	166
2009	10	49	60	29	148
2010	11	44	61	33	149
2011	6	50	59	33	148
2012	9	38	65	34	146
2013	6	51	71	29	157
Total (%)	**523 (12.9 %)**	**1330 (32.8 %)**	**1708 (42.2 %)**	**486 (12 %)**	**4047 (100 %)**

5.4 Country-wise Distribution of Articles

Table 4 shows that all countries multiple participation, i.e., 11690 times in producing 4047 articles. It is considered to count the same article under contributing countries, if contributors are from

Table 3. Ranked list of organisations which contributed more than 50 articles

S. No.	Organisation/affiliation	Country	No. of articles	No. of contributors
1.	Purdue University	USA	163	377
2.	NASA Lewis Research Center	USA	161	236
3.	Pennsylvania State University	USA	132	361
4.	U.S Air Force Research Laboratory	USA	128	222
5.	University of Illinois	USA	109	252
6.	NASA John H. Glenn Research Center	USA	87	142
7.	University of Michigan	USA	84	188
8.	University of California	USA	81	166
9.	Georgia Institute of Technology	USA	69	175
10.	United Technologies Research Center	USA	69	115
11.	California Institute of Technology	USA	66	148
12.	Massachusetts Institute of Technology	USA	65	137
13.	National Aerospace Laboratory	Japan	64	203
14.	German Aerospace Center	Germany	62	133
15.	NASA Marshall Space Flight Center	USA	61	102
16.	NASA Langley Research Center	USA	61	93
17.	Japan Aerospace Exploration Agency	Japan	57	127
18.	University of Maryland	USA	56	102
19.	University of Alabama	USA	55	97
20.	Virginia Polytechnic Institute and State University	USA	54	117
21.	Stanford University	USA	50	125

Table 4. Country-wise distribution of articles during 1985-2013

S. No.	Country	No. of articles	No. of contributors	% of article contribution
1.	USA	2672	7100	61.24
2.	Japan	302	1027	6.92
3.	China	166	513	3.80
4.	Germany	142	362	3.25
5.	UK	132	304	3.03
6.	India	116	304	2.66
7.	France	111	277	2.54
8.	Italy	109	267	2.49

Table 5. Year-wise distribution of articles by countries that produced more than 100 articles

S. No.	Country	1985 -89	1990 -94	1995 -99	2000 -04	2005 -09	2010 -13
1.	USA	355	561	514	512	441	289
2.	Japan	38	40	40	65	72	47
3.	China	10	20	34	23	27	52
4.	Germany	5	15	18	32	27	40
5.	UK	8	17	15	27	38	27
6.	India	8	12	15	25	30	26
7.	France	10	6	19	31	26	19
8.	Italy	4	7	24	14	32	28

different countries. Hence, It is observed that 'USA' contributed 2672 articles contributing (61.24 %) to the total contributions, followed by 302 articles by 'Japan' contributing (6.92 %), 166 articles by 'Republic of China' contributing (3.8 %), 142 articles by 'Germany' contributing (3.25 %), and 132 articles by 'United Kingdom' contributing (3.03 %), 116 articles by 'India' contributing (2.66 %), 109 articles by 'France' contributing (2.54 %), and so on. Year-wise distribution of articles produced by seven countries which produced more than 100 articles is shown in Table 5.

It is clear from the Table 5 that USA is almost maintaining production of articles consistently, where as rest of the countries increased their production of articles to two to three fold.

5.5 Country and Organisation-wise Collaborative Research Productivity

A raw analysis of data for country-wise collaborative research productivity of articles in the field of propulsion and power was made and it was found that 3760 articles were produced by one country contributing (92.9 %), followed by 265 articles by two-countries contributing (6.55 %), 17 articles by three-countries contributing (0.42 %), 4 articles by four-countries contributing (0.09 %) and 1 article by six-countries contributing (0.02 %). Table 6 shows

Table 6. Organisation-wise collaborative research productivity of articles

S. No.	No. of participating organisations	No. of articles (%)
1.	One organisation	2614 (64.59 %)
2.	Two organisations	1081 (26.71 %)
3.	Three organisations	289 (7.14 %)
4.	Four organisations	56 (1.38 %)
5.	More than four organisations	7 (0.02 %)
	Total	**4047 (100 %)**

collaborative research productivity of 4047 articles by 7641 different organisations. It is observed that one organisation is involved in producing 2614 articles contributing (64.59 %) to the total 4047 articles, followed by two-organisations in producing 1081 (26.71 %) articles, three organisations in producing 289 (7.14 %) articles, four organisations in producing 56 (1.38 %) articles.

Detailed analysis of data showed that Purdue University has produced 43 articles in collaboration with 36 different organisations, NASA Lewis Research Centre has produced 111 articles in collaboration with 69 different organisations; Pennsylvania State University has produced 26 articles in collaboration with 31 different organisations; US Air Force Research Laboratory has produced 110 articles in collaboration with 82 different organisations and University of Illinois has produced 39 articles in collaboration with 43 different organisations.

International collaborative research was observed in 287 articles with 603 appearances by different countries. Out of 287 articles, 171 (59.58 %) articles were produced by USA in collaboration with other countries, 50 (17.42 %) articles by Japan, 43 (14.98 %) articles by Germany, 36 (12.54 %) articles by UK, 36 (12.54 %) articles by Russia, and so on (Table 7).

4.7 Ranked List of Authors

Table 8 shows top 27 authors who have contributed alone or co-authored along with their affiliations for producing articles in journal during 1985-2013. It is found that Fleeter, S., 'Purdue University, USA' has authored and co-authored highest number of articles, i.e., 54 followed by Kuo, K.K., 'Pennsylvania State University, USA' with 28 articles, and Gallimore, A.D., 'University of Michigan, USA' 28 articles, etc. Out of 27 authors, 20 authors were from USA; 6 authors were from Japan; and 1 author from Israel.

It is observed from the Table 9 that 54 articles authored or co-authored by Fleeter, S. from Purdue University, USA contained thirty eight different groups of authors for production of articles. It is also witnessed from the highest contributor that there were four cohorts with the degree of 2, 3, 4 and 5 who have shared the contributions.

Table 7. International collaborative research productivity of articles by participating countries

S. No.	Country	No. of articles in collaboration with other countries
1.	USA	171
2.	Japan	50
3.	Germany	43
4.	UK	36
5.	Russia	36
6.	Italy	33
7.	Republic of Korea	33
8.	France	31
9.	China	26
10.	Israel	18
11.	Canada	17
12.	Netherlands	15
13.	India	12
14.	Switzerland	9
15.	Australia	8
16.	Belgium	7
17.	Spain	7
18.	Portugal	6
19.	Brazil	5
20.	Singapore	5
21.	Austria	4
22.	Ukraine	3
23.	Greece	3
24.	Iran	3
25.	South Africa	2
26.	Jorgan	2
27.	Argentina	2
28.	Sweden	2
29.	Saudi Arabia	2
30.	Finland	2
31.	Turkey	2
32.	Poland	2
33.	Czech Republic	1
34.	New Zealand	1
35.	Nigeria	1
36.	Norway	1
37.	Pakistan	1
38.	Hong Kong	1

6. SUMMARY AND CONCLUSIONS

(i) The study reveals that 4047 articles were published in 174 issues of 29 volumes in the *Journal of Propulsion and Power* during 1985 to 2013. The highest numbers of articles were

Table 8. Core authors (Most productive authors)

S. No.	Author's name	Author's affiliation	No. of articles authored/co-authored
1.	Fleeter, S.	Purdue University, USA	54
2.	Kuo, K.K.	Pennsylvania State University, USA	28
3.	Gallimore, A.D.	University of Michigan, USA	28
4.	Yang, V.	Pennsylvania State University, USA	26
5.	Gupta, A.K.	University of Maryland, USA	25
6.	Burton, R.L.	University of Illinois, USA	20
7.	Schetz, J.A.	Virginia Polytechnic Institute & State University, USA	19
8.	Kanda, T.	National Aerospace Laboratory, Japan	19
9.	Krier, H.	University of Illinois, USA	18
10.	Lewis, M.J.	University of Maryland, USA	18
11.	Heister, S.D.	Purdue University, USA	17
12.	Lefebvre, A.H.	Purdue University, USA	17
13.	Masuya, G.	Tohoku University, Japan	16
14.	Segal, C.	University of Florida, USA	16
15.	Hanson, R.K	Stanford University, USA	15
16.	Hamed, A.	University of Cincinnati, USA	15
17.	Gany, A.	Technion Israel Institute of Technology, Israel	15
18.	Funaki, I.	National Aerospace Laboratory, Japan	14
19.	Brewster, M.Q.	University of Illinois, USA	14
20.	Arakawa, Y.	University of Tokyo, Japan	14
21.	Mitani, T.	National Aerospace Laboratory, Japan	14
22.	Tani, K.	National Aerospace Laboratory, Japan	14
23.	Dutton, J.C.	University of Illinois, USA	13
24.	Kudo, K.	Japan Aerospace Exploration Agency, Japan	13
25.	Lakshminarayana, B.	Pennsylvania State University, USA	13
26.	El-Genk, M.S.	University of New Mexico, USA	13
26.	Micci, M.M.	Pennsylvania State University, USA	13
27.	Carter, C.D.	US Air Force Research Laboratory, USA	13

published in year 1992, contributing 194 (4.49 %) and lowest numbers of articles were published in the year 1987, contributing 81 (2.00 %) to total number of articles. On average 23 articles were published per issue and 139 articles per volume approximately.

(ii) The length of articles varied from 2 to 37 pages and average length of articles during the period 1985-2013 is 7.84 pages. It is found from the data that 10 articles were having more than 25 pages in length. The lengthy article having 37 pages being the one contributed by 'Raymond E. Chupp' titled 'Sealing in Turbomachinery' which was published in 2006.

(iii) Maximum number of articles i.e. 1330 contributing (32.86 %) to the total number were produced by two authors, followed by 1098 contributing (27.13 %) were produced by three authors, 610 contributing (15.07 %) were produced by four authors, and 523 contributing (12.92 %) from one author. It is observed that 7641 authors have contributed 4047 articles for publication with an average of 0.53 articles per author.

(iv) Due to the involvement of multiple authors for producing articles from the same affiliation, it is observed that 1205 affiliations involved in 11690 times for publishing 4047 articles. 'Purdue University' contributed highest number of articles i.e. 163 contributing (4.03 %) to the total 4047 articles, followed by 161 articles by 'NASA Lewis Research Center' contributing (3.98 %) and 132 articles by 'Pennsylvania State University' contributing (3.26 %). Out of ranked list of 21 affiliations which produced more than

Table 9. Articles authored/co-authored by 'Fleeter, S.'

Group	Degree of cohort	Co-author's names (with Fleeter, S.)	No. of articles
1	Cohort: 2	Boyd, D.M.	1
2	Cohort: 2	Buffum, D.H.	1
3	Cohort: 2	Capece, V.R.	1
4	Cohort: 2	Ehrlich, D.A.	2
5	Cohort: 2	Fagan, J.R.	1
6	Cohort: 2	Frey, K.K.	2
7	Cohort: 2	Gottfried, D.A.	4
8	Cohort: 2	Henderson, G.H.	1
9	Cohort: 2	Hoyniak, D.	1
10	Cohort: 2	Johnston, D.A.	1
11	Cohort: 2	Johnston, R.T.	3
12	Cohort: 2	Kim, K.H.	2
13	Cohort: 2	Lawless, P.B.	1
14	Cohort: 2	Manwaring, S.R.	1
15	Cohort: 2	Myers, S.	1
16	Cohort: 2	Sanders, A.J.	5
17	Cohort: 2	Sawyer, S.	2
18	Cohort: 2	Spara, K.M.	1
19	Cohort: 2	Wolff, J.M.	1
20	Cohort: 3	Buhr, C.A. & Franchek, M.A.	1
21	Cohort: 3	Capece, V.R & Manwaring, S.R	1
22	Cohort: 3	Choi, Y.S & Gottfried, D.A.	2
23	Cohort: 3	Feiereisen, J.M. & Johnston, R.T.	1
24	Cohort: 3	Fulayter, R.D. & Lawless, P.B.	1
25	Cohort: 3	Hoyniak, D. & Topp, D.A.	1
26	Cohort: 3	Kenyon, J.A. & Rabe, D.C.	1
27	Cohort: 3	Key, N.L. & Lawless, P.B.	3
28	Cohort: 3	Kim, K.H. & Lawless, P.B.	1
29	Cohort: 3	Lawless, P.B. & Gallier, K.	1
30	Cohort: 3	Lawless, P.B. & Papalia, J.	1
31	Cohort: 3	Lawless, P.B. & Ramakrishnan, K.	1
32	Cohort: 3	Papalia, J. & Sanders, A.J.	1
33	Cohort: 3	Sawyer, S. & Simonich, J.	1
34	Cohort: 3	Choi, Y.S & Key, N.	1
35	Cohort: 3	Cukurel, B. & Lawless, P.B.	1
36	Cohort: 4	Lawless, P.B.; Oakes, W.C. & Fagan, J.R.	1
37	Cohort: 4	Gottfried, D.A.; Lawless, P.B. & Ramakrishnan, K.	1
38	Cohort: 5	Johnston, R.; Liu, T.; Sullivan, J. & Torgerson, S.	1

50 articles, eighteen institutions were from USA, two Japan, and one from Germany.

(v) It is observed that USA produced 2672 articles contributing (61.24 %) to the total articles, 'Japan' contributing 302 (6.92 %) articles, 'Republic of China' contributing 166 (3.8 %), 'Germany' contributing 142 (3.25 %) articles, and 'UK' contributing 132 (3.03 %) articles, 'India' contributing 116 articles (2.66 %), and so on.

(vi) From the collaborative research productivity of 4047 articles by 7641 different institutions, it is observed that one organisation is involved in producing 2614 (64.59 %) articles, followed by two-organisations in producing 1081 (26.71 %) articles, three-organisations in producing 289 (7.14 %) articles, four-organisations in producing 56 (1.38 %) articles, five-organisations in producing 1 (0.02 %) article, six-organisations in producing 4 (0.09 %) articles, seven organisations in producing 1 (0.02 %) article, and eleven-organisations in producing 1 (0.02 %) article.

(vii) Country-wise collaborative research productivity of articles reveals that 3760 articles were produced by one-country contributing (92.9 %), followed by 265 (6.55 %) articles by two-countries, 17 (0.42 %) articles by three-countries, 4 (0.09 %) articles by four-countries, and 1 (0.02 %) article by six-countries. It is also observed that international collaboration was involved in producing 287 articles. Out of 287 articles, 171 (59.58 %) articles were produced by USA in collaboration with other countries, 50 (17.42 %) articles by Japan, 43 (14.98 %) articles by Germany, 36 (12.54 %) articles by UK, 36 (12.54 %) articles by Russia, and so on.

(viii) From top 27 ranked list of authors who have contributed alone or co-authored along with their colleagues for producing articles, it is found that 'Fleeter, S.' from 'Purdue University, USA' has authored and co-authored highest number of articles, i.e., 54 followed by 'Kuo, K.K.' from 'Pennsylvania State University, USA' authored and co-authored 28 articles, and 'Gallimore, A.D.' from 'University of Michigan, USA' authored and co-authored 28 articles.

(ix) It is observed that 54 articles authored and co-authored by 'Fleeter, S.' from 'Purdue University, USA' and there were 38 different groups of authors contributed for the article production. It is also observed from the highest contributor, i.e., Fleeter, S. that there were four cohorts with the degree of 2, 3, 4 and 5 who have shared the contributions.

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