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Authorship Pattern in Spacecraft Research Publication in India

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Abstract **- This paper investigates research papers published during 2012-2016 about spacecraft as reflected through its publication productivity in different years. This study highlights a quantitative analysis on the authorship pattern and collaborative trends during the past five years in the newly emerged ever growing field of spacecraft in Engineering. Ever since India sent a spacecraft to mars in 2014, India has earned its place in the top ranking space-faring nations which include the USA, Europe Russia, China and Japan. The study reveals almost a constant trend of inflow of papers with increasing trend of multi authored papers year by year. Highest share of Papers are being contributed by authors from India, written in English.**
Keywords: **Spacecraft, Bibliometric, Collaboration Trends, Authorship pattern**

I. INTRODUCTION

Bibliometric research methodologies of library and information science have always been used to provide tools for understanding the dynamics of disciplines, developing policy, and justifying research funding. It is a branch of library and information science makes quantitative analysis of 'library and library use patterns' Pritchard (1969)[1] defined Bibliometric as "the application of mathematical and statistical methods to books and other media of communication", while Nalimov and Mulchenko (1969)[2] defined Scientometrics as "the application of those quantitative methods which are dealing with the analysis of science viewed as an information process". A spacecraft[3] is a vehicle, or machine designed to fly in outer space. Spacecraft are used for a variety of purposes, including communications, earth observation, meteorology, navigation, space colonization, planetary exploration, and transportation of humans and cargo. On a sub-orbital spaceflight, a spacecraft enters space and then returns to the surface, without having gone into an orbit. For orbital spaceflights, spacecraft enter closed orbits around the Earth or around other celestial bodies. Spacecraft used for human spaceflight carry people on board as crew or passengers from start or on orbit (space stations) only, whereas those used for robotic space missions operate either autonomously or telerobotically. Robotic spacecraft used to support scientific research are space probes. Robotic spacecraft that remain in orbit around a planetary body are artificial satellites. Orbital spacecraft may be recoverable or not. By method of reentry to Earth they may be divided in non-winged space capsules and winged spaceplanes. Humanity has achieved space flight but only a few nations have the technology for orbital launches, including: Russia (RSA or "Roscosmos"), the United States (NASA), the member states of the European Space Agency (ESA), Japan (JAXA), Iran (ISA), India (ISRO), and China (CNSA).This research analyzed spacecraft publication output or a period from 2012-2016.Records for the analysis have been extracted from SCOPUS database with a sample of 1601 records.

II. REVIEW OF LITERATURE

Gupta and Adarsh Bala (2010)[4] analyzed Indian Science and Technology publications of 1996-2010. This study conducted on the basis of Scopus database and examined several quantitative measures including India's global publication share, rank and growth rate, its publication share in various subjects in terms of national and global context. The study found that India contributed 538609 papers in science and technology during 1996 to 2010 with an annual average growth rate of 9.32 per cent. The study found that top 100 most productive Indian organizations contributed 54.92 per cent share (295827 papers). The study shows that among the India's contribution to global research output in broad 20 subjects during 1996-2010, the largest publications share (5.49 per cent) comes from veterinary science.

Khatun and Ahmed (2011)[5] have carried out the quantitative analysis to identify the literature growth, authorship pattern, collaboration and journal distribution on diarrheal disease research in Bangladesh based on the data obtained from PubMed, Web of Science and Scopus databases. The result showed increasing R&D activities on diarrheal research in Bangladesh. The h-index count indicates that Bangladesh tops in the diarrheal research output list in South Asia region.

Elango and Rajendran (2012)[6], have examined the authorship trend and collaborative pattern in Marine Science literature during 2001-2010. The study reveals that the co-authored papers were dominated and the author productivity follows the Lotka's law. The mean number of authors per co-authored papers is 3.4 and the average collaboration rate is 0.57. 58% of papers were collaborated within the same institution, only 7.31% of the papers were collaborated with the international level institutions. Out of 23 authors with 5+ papers only 5 authors attained the dominance factor value with above 0.5 (DF is the proportion of number of multi authored publications of an author at first author to total number of multi authored publications of author).

The Authorship pattern of Digital Architecture Research output was analysed by Ranganathan, and Balasubramani (2013)[7], with the records collected from Web of Science database for the period of 15 years from 1999 to 2013. 2012 was the most productive year; the authorship trend showed that 89% of the publications published under the joint author and also observed that the author productivity was not in agreement with Lotka's law, but productivity distribution partially fits the law when the value of Chi-square to 727.37.

III. OBJECTIVES

The major objectives are framed with the exclusive notion of the present study as mentioned below:

1. To classify the most productive authors and authorship patterns and author productivity an
2. To identify the nature of collaborator and co-authorship patterns and determine the degree of collaboration in spacecraft research.

IV. METHODOLOGY

The present study observed the authorship pattern in publications from all over world researchers in the concept of Space craft research during the period of 2012-2016. Data was collected from SCOPUS databases covering all aspects of spacecraft. A total of 1601 records were downloaded and analyzed by using spreadsheet application as per the objective of the study.

Collaborative Coefficient (CC):

The degree of collaboration is defined as the ratio of the number of collaborative research papers to the total number of research papers in the discipline during a certain period of time. The formula suggested by Subramanian (1983)[8] is used. It is expressed as

$$C = \frac{Nm}{N_m \square N_s}$$

Where,

C is the degree of collaboration in a discipline.

N_m is the number of multi-authored research papers in the discipline published during a year.

N_s is the number of single authored papers in the discipline published during the same year. Using this formula, the degree of collaboration is determined.

Based on this study, the result of degree of collaboration **C = 0.91** of collaborative authors' articles is published in this study.

V. RESULTS AND DISCUSSIONS

A total of 1601 records are downloaded and analysed during the period of 2012-2016, the search yield a result of 1601 articles published by Indian researchers. It is to be noted that the distributing the data with respect to authorship pattern. It is evident that from the Table 1(Figure 1), that the single authorship pattern is on decline. The collaborative papers produced by group of authors, number ranging from 2 to 11, giving 92.6% of the total publications. The multiple authorship papers of the collaborative author group number 3 and above contribute to a maximum of 76.14% of the total papers whereas, 16.5% of the papers are of joint collaboration.

TABLE 1 COLLABORATION TRENDS

S.No.	Authorship	No. of Papers	%
1	Single	118	7.37
2	Joint	264	16.49
3	Multiple	1219	76.14
Total		1601	100.00

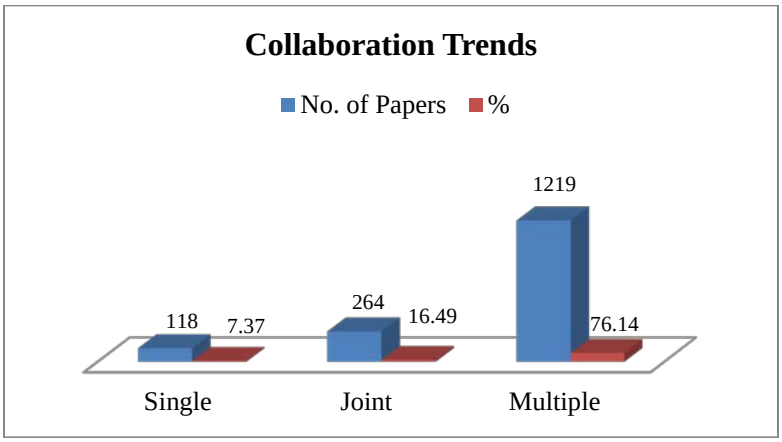

Fig.1 Collaboration trends

TABLE 2 AUTHORSHIP PATTERNS

S.No.	Authorship	No. of Papers	%	Total Authorship Credits
1	1	118	7.37	118
2	2	264	16.48	528
3	3	219	13.67	657
4	4	200	12.48	800
5	5	97	6.05	485
6	6	75	4.68	450
7	7	30	1.94	210
8	8	32	1.99	256
9	9	20	1.25	180
10	10	41	2.56	369
11	11 & above	505	31.54	5555
Total		1601	100.00	9608

Table 2 explains that the authorship pattern on Spacecraft research publications in India.

A least proportions 7.4% of the papers is produced by single authors. Based on the survey Chemical Abstract, Price (1963)[8] observed "a steady increase in the multiple authorship trends and stated that…. If it continues at the Present rate, by 1980, the single authored papers will be extent". It is obvious from the table that the single authorship trend is on decline.

Due to the complex nature of the subject Spacecraft Research publication, collaborating research contributions, only 7.37% (with 118 credits) of the papers are independently produced by single authorship credits.16.5% (with 528 credits) of the papers are produced by joint authorship collaboration 13.7% (with 657 credits) are produced by 3 authorship collaboration. There exist 505(with 5555 credits articles of 11 and above authors.

Table 3 (Figure 2) gives the authorship productivity of the present study. From Table 3, it is learnt that, altogether 9608 authorship credits produced 1601 papers. Among 6781 distinct authors, 4212 authors produced only one article each. Rest of them, are produced more than one article.

TABLE 3 AUTHORSHIP PRODUCTIVITY

S.No	No. of Authors	Productivity	Total Authorship Credits
1	129	4	516
2	774	3	1548
3	1666	2	3332
4	4212	1	4212
Total	6781	Total Credits	9608

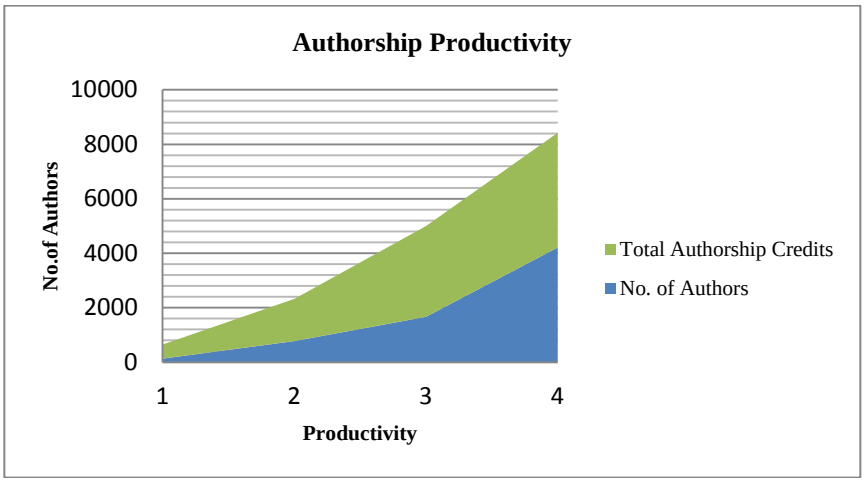

Fig. 2 Authorship Productivity

TABLE 4 YEAR WISE DISTRIBUTION

S.No	Year	Single	Double	Multiple	Total	DC
1	2012	17	47	168	232	0.91
2	2013	29	41	202	272	0.87
3	2014	29	61	344	344	0.89
4	2015	18	77	365	365	0.94
5	2016	25	38	388	388	0.93
Total		118	264	1219	1601	0.91

Table 4 reveals that the year wise distribution of authorship patterns.

To study the extent of collaboration, Degree of Collaboration, is calculated using Subamaniyam's formula. The ratio of multi- authored papers to that of the total number of papers. The mean degree of Collaboration is 0.91.

VI. CONCLUSION

Collaboration trends are very high in Spacecraft Research Publication "Multi author grouped contributions are more productivity than others. The highest productivity in Spacecraft is yielded by the collaborations of two and multi authorship groups. Price's prediction about becoming extent nature of single authorship publications is proved to be true. The investigations in these authorship patterns would be, very useful in understanding the patterns in Research and Communication in the field of Spacecraft Research Publication in India.

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