Citation Impact on Authorship Pattern

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Abstract

This study examines the Citation Impact on Authorship Pattern on Spacecrafts Research outputs. The study analyzed the Citation Impact on Single authored and Coauthored publications over a period of 40 years from 1975-2014. The data for the study was downloaded from the Scopus database. The study found that there are numerous number of 3,89,196 publications during the study period out of which 20.74% are single authored contribution and the remaining were from coauthored one. The average number of authors per publications is 3.67 and the average number of publication per author is 0.27. The average number of authors per publications is directly proportional to the increase of literature over the period of time. Collaborated publications outnumbered single authored one. There seems to be a better collaboration among the authors of the published literature, since the value of CC during the study period stood at 0.54. More number of coauthored publications attracts more number of citations than the single authored one. The Relative Citation Impact (RCI) of the single authored publications is 0.51 whereas it is 1.13 for the coauthored publications. The Related Uncitedness Index (RUI) values for the single and coauthored publications are 1.42 and 0.89 respectively.

Keywords Authorship Pattern, Citation Analysis, Relative Citation Impact, Relative Uncitedness Index, Spacecrafts, Scopus Database.

Introduction

A spacecraft 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. Authorship pattern is one of the important aspects of Bibliometric / Scientometric analysis. The duration of the study has been divided into four block periods with each block covers a period of ten years. It is necessary to examine the authorship pattern to assess the research contributions. In this study

analysis were carried out to identify the author productivity and authorship pattern with the help of authorship indicators such as Authors frequency (single and multiple), Degree of Collaboration (DC), Collaboration Index (CI) and Collaboration Coefficient, Average Authors per paper, Average paper per authors. The main aim of the study is to examine how far the citation impact on publications varies with the authorship pattern on research works on the area of study. In general, more credits were considered for single authored publications in academic as well as in research and development environments. Whereas most of the researchers across the globe prefers collaborated research works rather than a solo one. From the earlier studies on Scientometrics / Bibliometrics on different disciplines by various researchers, the authors noted that coauthored publications attract more citations than the single authored one. To examine how far the citation impact varies with authorship pattern on Spacecraft research outputs is analyzed in the study. For this purpose, Citation Analysis on Single and coauthored contributions has been studied and elaborated with common indicators like Citations per paper (CPP) and special indicators like Relative Citation Impact (RCI) and Relative Uncitedness Index (RUI) to ascertain the uncited articles on the literature.

Objective of the Study

- To study the Authorship pattern by using the parameters like Degree of Collaboration (DC), Collaboration Index (CI) and Collaborative Coefficient (CC).
- To find the number of authors contributed to the literature during the study period.
- To examine the citation impact on authorship pattern using Relative Citation Impact (RCI) and Relative Uncitedness Index (RUI).

Methodology

The data for the study has been downloaded from the Scopus database. The study covered a period of 40 years from 1975 to 2014. The search includes the synonymous terms of Spacecrafts to cover the area to the maximum possible extent on related literature. The collected data has been classified by using Excel software and the same has been loaded in to SPSS (Statistical Package for Social Sciences) for analytical purpose. Statistical analysis techniques such as

frequency distribution and percentage analysis have been employed depending on the nature of the data collected.

Review of Literature

Citation is perceived to be one of the important measures of research impact, serving as an indicator (Didegah and Thelwall 2013; Onodera and Yoshikane 2015). Bibliometric analysis is a preferred method to study the citation impact of research (Thompson 2002). Van Leeuwen (2006) provided evidence for the use of bibliometric techniques for the evaluation of research, culture of publications and patterns of citations. The impact of a publication is subjected to several determining factors. Collaboration is one such determinant. Citations, as Gazni and Thelwall (2014) noted, reflect knowledge flows between collaborators associated with collaboration. Didegah and Thelwall (2013) have also investigated the relationship between citation and other variables such as the number of authors and countries involved in the production of research publications. Collaboration has strong influence in Science and there are different reasons for collaboration such as increased publication visibility, sharing costs and exchanging ideas (Padial, Nabout, Siqueria, Bini, & Diniz-Filho, 2010; Vermeulen, Parker, and Panders, 2013). Uncitedness is an important aspect of citation analysis and needs a separate investigation (Carg and Kumar, 2014). Smart and Bayer (1986) found that multi-authored articles have usually higher citation frequencies than single authored ones. Elango (2017) examined the citation impact on coauthored publications in tribology research outputs. Sooryamoorthy (2017) studied the citation impact on collaborative works of Social Science outputs.

Limitations of the Study

The Study limited to the publications indexed in Scopus Database and confines to the literature published between the years1975-2014.

Analysis and Discussions

TABLE 1 - AUTHORSHIP PATTERN

S.No.	Number of Authors	Publications	Percentage (%)
1	Single Author	80703	20.74
2	Two Authors	83429	21.44

3	Three Authors	76147	19.57
4	Four Authors	55862	14.35
5	Five ≤ Authors	93055	23.91
	Total	**389196**	**100.00**

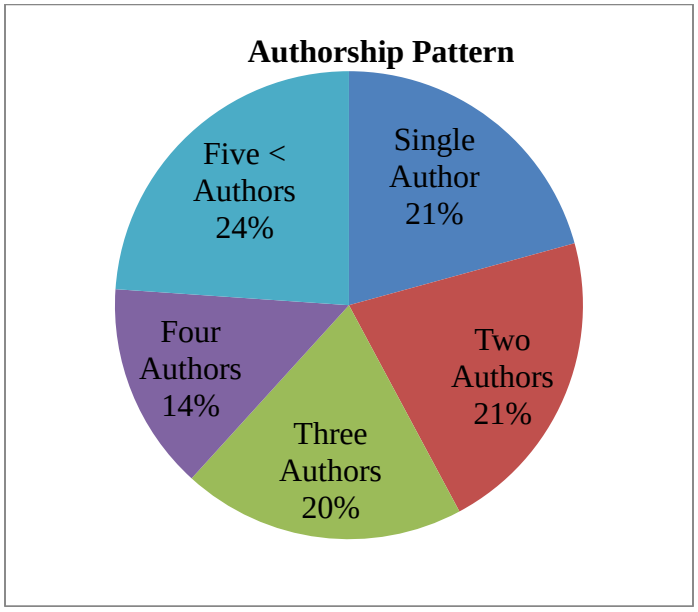

Figure 1- Authorship Pattern

It is observed from the above table that single authored contribution occupies (20.74%) of the total research outputs and the remaining publications are of collaborated nature. In the collaborated works five and above authored contributions occupies a maximum share of 23.91% of the total publications followed by two authored contributions with 21.44% and three authored contributions with 15.37% share of publications. The table further reveals that coauthored contributions outnumbered single authored contributions in the Spacecrafts research outputs during the period of study. Figure - 1 shows the authorship pattern of Spacecrafts literature.

The study period is equally divided into four block periods viz. 1975-1984, 1985-1994, 1995-2004 and 2005-2014. In the bibliometric study, the authorship collaboration in publications during a specific time period can be calculated using the Degree of Collaboration indicator (Subramaniyam, 1983). The Degree of Collaboration (DC) among authors is the ratio of the number of collaborative publications versus the total number of publications published in a discipline during certain period of time and the same can be calculated using the formula DC = $N_m/(N_m+N_s)$; where, N_m = Number of multiple authors publications during a specific period in a discipline and N_s= Number of single authored publications in the discipline during the given

period of time. The Collaborative Index (CI) (Lawani, 1980) is interpreted as mean number of authors per paper. Collaboration Co-efficient (CC) suggested by Ajiferuke (1988) has been used to assess the strength of collaboration. In this each paper carries a credit which has to be shared between all the authors of the paper. If j authors contributing one paper then 1/j credit goes to each author. Always the value of Collaboration Coefficient will between 0 and 1. If the value of CC is above 0.5, then it indicates a better collaboration among the authors when it nears the value of one then it indicates a strong collaboration among them. If the value of CC is below 0.5, indicates weak collaboration among the authors.

TABLE 2 - AUTHORSHIP PATTEN Vs BLOCK YEARS

S. No.	Block Years	Single Author	Two Authors	Three Authors	Four Authors	Five ≤ Authors	Total	DC	CI	CC
1	1975-1984	16205	10668	5962	2869	2455	38159	0.58	2.07	0.35
2	1985-1994	16763	14064	9319	5397	6667	52210	0.68	2.45	0.43
3	1995-2004	21411	21320	19106	13044	22902	97783	0.78	2.95	0.53
4	2005-2014	26324	37377	41760	34552	61031	201044	0.87	3.33	0.60
	Total	**80703**	**83429**	**76147**	**55862**	**93055**	**389196**	**0.79**	**2.99**	**0.54**

(DC- Degree of Collaboration, CI- Coefficient Index, CC- Collaboration Coefficient)

The study period equally divided into four block periods viz. 1975-1984, 1985-1994, 1995-2004 and 2005-2014. The above table represents the authorship pattern of spacecraft research outputs in block periods. It shows a substantial presence of single authored publications in all the block years even though the collaborated work dominates the publication trend throughout the study period. In the coauthored publications, more number of two authored publications were recorded in the first two block periods (1975-1984 & 1985-1994) and whereas five and above authored works dominates the published literature in the last two block periods of the study (1995-2004 & 2005-2014). The Degree of Collaboration (DC) is ranged between 0.58 and 0.87 with an average value of 0.79 during the study period. It is observed from the table that the value of Degree of Collaboration is found to be increasing over the period of time shows that the collaborative works on the rise in the field of Spacecrafts literature. The Collaboration Index

(CI) ranged between 2.07 and 3.33. The average value of CI is 2.99. It is observed that the CI value also increases over the period of time which shows that the increase in publication trend is directly proportional to the increase in involvement of authors in collaborated works. The above table shows the Collaborative Coefficient value for the first two block periods (0.35 and 0.43) is less than 0.5 which indicates weak collaboration among the authors. Whereas the value of CC for the last two block periods (0.53 and 0.60) indicates a better collaboration among them. Overall the collaboration among the authors (CC value is 0.54) of spacecrafts literature looks better during the study period. Figure 2 represents the authorship pattern in block years.

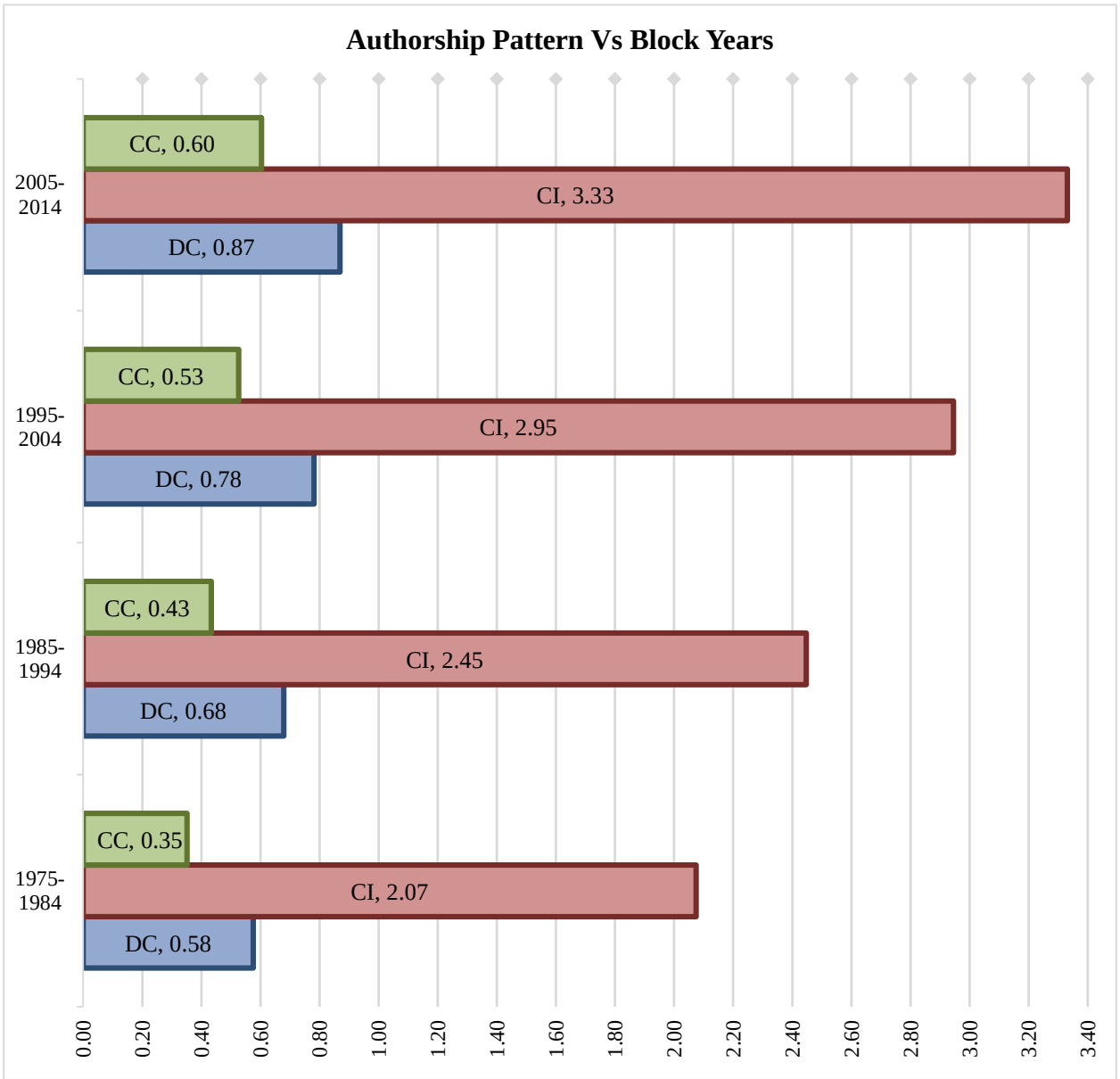

Figure 2 – Authorship Pattern Vs Block Years

TABLE 3 - AUTHOR PRODUCTIVITY Vs BLOCK YEARS

S.No	Block Year	Total Publications	Number of Authors	Average Number of Authors
1	1975-1984	38159	82933	2.17
2	1985-1994	52210	140514	2.69
3	1995-2004	97783	347098	3.55
4	2005-2014	201044	858253	4.27
	Total	**389196**	**1428798**	**3.67**
Average Number of publications per author = 0.27				

The above table depicts the overall published literature during the study period which was contributed by 1428798 authors. The average number of authors per publications was reported low in the first block period with 2.17 authors per publications and it gradually rose over a period of time and it was 4.27 authors per publications in the fourth block period. The overall average number of authors per publications is 3.67 and the average number of publications per author is 0.27.

TABLE 4 - CITATIONS Vs BLOCK YEARS

S.No.	Block Year	TP	TP %	CTP	Cited TP %	Citation	Citation %	CPP
1	1975-1984	38159	9.80	13214	6.38	182006	5.22	4.77
2	1985-1994	52210	13.42	26094	12.60	519862	14.92	9.96
3	1995-2004	97783	25.12	62278	30.08	1539430	44.17	15.74
4	2005-2014	201044	51.66	105451	50.94	1243587	35.69	6.19
	Total	**389196**	**100.00**	**207037**	**100.00**	**3484885**	**100.00**	**8.95**

(TP- Total Publications, CTP-Cited Total Publications, CPP- Citations per Paper)

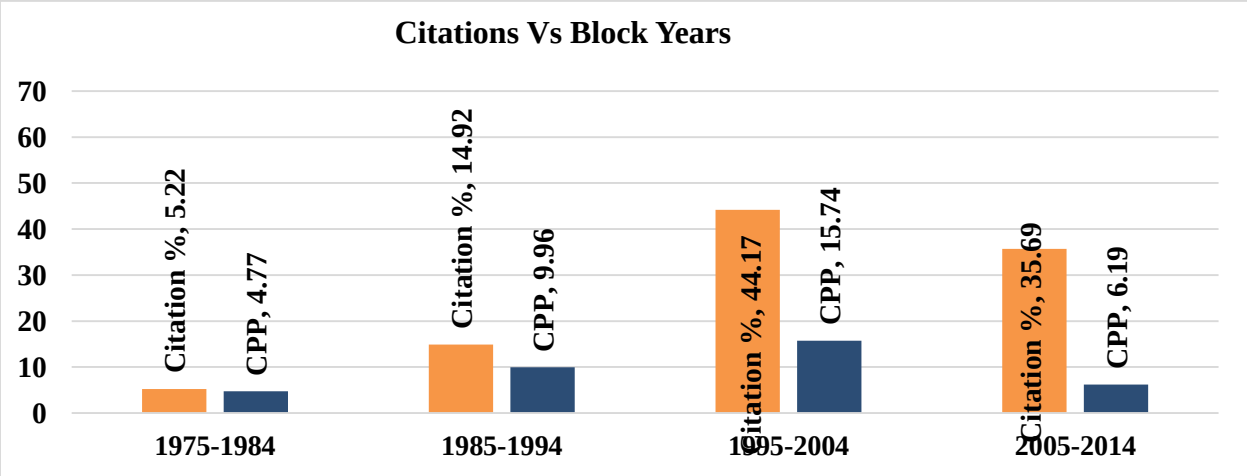

Figure 3 – Citations Vs Block Years

The above table shows that 207037 (53.20%) out of a total 389196 publications has been cited and yielded 3484885 citations with an average of 8.95 citations per paper. The published literature in the third block period attracted more citations than the rest with a higher value of 15.74 Citations per paper. Even though more than half of the published literature in the fourth block period got cited, the lower CPP value (6.19) may be due to less age of the published literature. The table 3 represents the citation analysis during the block years.

Relative Citation Index (RCI) (Kumari, 2009), is an indicator of influence and visibility of research in global perspective, is defined as the proportion of an entity's share of world citations to that entity's share of world publications (RCI = C%/P%). An entity's citation rate is equal to the world's citation rate if, RCI value is equal to one. If, RCI >1 indicates that an entity's citation rate is higher than the world's citation rate and RCI<1 indicates that that entity's citation rate is less than the world's citation rate. In this study, we have applied the same on Authorship pattern.

TABLE 5 - AUTHORSHIP PATTERN Vs CITATIONS

Authorship Pattern	TP	TP (%)	TCP	TCP (%)	TC	TC (%)	CPP	RCI
Single Authored Publications	80703	20.74	27144	33.63	366298	10.51	4.54	0.51
Co-authored Publications	308493	79.26	179893	58.31	3118587	89.49	10.11	1.13
Total	**389196**	**100**	**207037**	**53.20**	**3484885**	**100**	**8.95**	**1.00**

(TP- Total Publications, TCP – Total Cited Publications, TC-Total Citations, CPP – Citations per Paper, RCI – Relative Citation Index))

The above table reveals that 33.63% of the single authored contributions got cited and yielded 366298 citations at an average of 4.54 citations per paper. At the same time, 58.31% of the coauthored publications got cited and received 3118587 citations with an average of 10.11 citations per paper. It shows that more number of coauthored publications attracts citations than the single authored one. It is further evident from the fact that the Relative Citation Index value of single authored publications is 0.51 whereas it is 1.13 for the coauthored publications which shows that the coauthored publication has supremacy over the single authored one in attracting citations.

TABLE 6 - AUTHORSHIP PATTERN Vs CITATION ANALYSIS IN BLOCK YEARS

Authorship Pattern on Publications	Total Number of Publications and Cited Publications								TP (1975-2014)	TCP (1975-2014)
	1975-1984		1985-1994		1995-2004		2005-2014			
	TP	TCP	TP	TCP	TP	TCP	TP	TCP		
Single Author Publications	16205	3774 (23.29)	16763	5784 (34.50)	21411	9402 (43.91)	26324	8184 (31.09)	80703	27144 (33.63)
Co-authored Publications	21954	9440 (43.00)	35447	20310 (57.30)	76372	52876 (69.23)	174720	97267 (55.67)	308493	179893 (58.31)
Total Publications	**38159**	**13214 (34.63)**	**52210**	**26094 (49.98)**	**97783**	**62278 (63.69)**	**201044**	**105451 (52.45)**	**389196**	**207037 (53.20)**
Ratio of cited publications on Authorship		**1:1.85**		**1:1.66**		**1:1.58**		**1:1.79**		**1:1.73**

(TP- Total Publications, TCP – Total Cited Publications)

The above table shows the cited publications against total publications of single and co-authored publications during the four block periods. The percentage of cited publications against the total publications has been shown in parenthesis. It is clear from the above table that the cited single authored publications has not touched the half way mark (50%) even once in the four block periods and by overall, only 33.63% of the total publications got cited. Whereas, cited publications of co-authored publications crossed the half way mark (50%) thrice in the block periods except in the first block period (1975-1984). Overall 58.31% of the co-authored publications got citations during study period. The ratio of cited publications on all the block periods shows co-authored publications leads over single authored one in attracting citations in the area of study. The study also reveals that more number of publications in the third block period attracted more citations than the rest irrespective of whether it is solo or collaborative work in nature.

The Relative Uncitedness Index (RUI) (Carg K C & Kumar S 2014) which is going to be used I this study to compare the uncitedness between single and multi authored publications. RUI is the ratio of the share of uncited articles to the share of total articles. The value of RUI can be zero or more. Higher RUI value indicates less citation impact and zero RUI value indicates that there is no uncited article for the calculating unit.

TABLE 7 - AUTHORSHIP PATTERN Vs UNCITEDNESS IN BLOCK YEARS

Authorship Pattern	Total Number of Publications and Cited Publications								TP (1975-2014)	TUCP (1975-2014)	RUI
	1975-1984		1985-1994		1995-2004		2005-2014				
	TP	TUCP	TP	TUCP	TP	TUCP	TP	TUCP			
Single Authored Publications	16205	12431 (76.71)	16763	10979 (65.50)	21411	12009 (56.09)	26324	18140 (68.91)	80703	53559 (66.37)	1.42
Co-authored Publications	21954	12514 (57.00)	35447	15137 (42.70)	76372	23496 (30.77)	174720	77453 (44.33)	308493	128600 (41.69)	0.89
Total Publications	**38159**	**24945 (65.37)**	**52210**	**26116 (50.02)**	**97783**	**35505 (36.31)**	**201044**	**95593 (47.55)**	**389196**	**182159 (46.80)**	
Ratio of Uncited Publications on Authorship		**1:0.74**		**1:0.65**		**1:0.55**		**1:0.64**		**1:0.63**	

(TP- Total Publications, TUCP – Total Uncited Publications, RUI –Relative Uncitedness Index)

The above table shows the quantum of uncited publications on authorship pattern in block periods. Uncitedness on single authorship touched its peak value (76.71%) in the first block period. Nearly two third (66.37%) of the total single authored publications went uncited in the 40 years study period. Whereas, in the case of co-authored publications, during the third block period only 30.77% of the total publications went uncited and 41.69% of the total co-authored publications went uncited during the study period. Overall, 46.80% of the total published literature is yet to receive its first citations. The ratio of uncited publications between the single authored and co-authored publications shows that single authored publications lacks in attracting citations when compares to the co-authored ones. Here the RUI value for the single authored publications is 1.42 and for the co-authored publications it is 0.89.

Findings

Single authored publications contribute 20.74% to the Spacecrafts literature during the study period. The rest of the published literature contributed by coauthored publications.

The single authored publications occupied a substantial presence in all the block periods. In the coauthored works, presence of two authored publications seems more in the first two block periods whereas the last two block periods were dominated by works of five and above authors.

The Degree of Collaboration is 0.79 shows the researchers prefers coauthored work rather than go for a solo one in Spacecraft Literature research. The Collaborative Index for the published literature is 2.99 and Collaborative Coefficient is 0.54 during the study period shows that there seems to be a better collaboration among the authors in this area of literature.

The average number of authors per publications in the first block period is 2.17 and shows an increasing trend in the subsequent periods and it is end up with 4.27 in the last block period. It indicates that increase in number of publications is directly proportional to the increase in number of authors contributing the literature.

The average number of authors per publications is 3.67 and the average number of article per author is 0.27 during the study period.

The study finds that 53.2% of the total publications got cited with an average of 8.95 citations per paper. The published literature in the third block period attracted more number of citations than the rest with an average of 15.74 Citations per paper.

During the study period only 33.63% of the single authored publications got cited with an average of 4.54 citations per paper. Whereas 58.31% of the total coauthored publications received citations with an average of 10.11 citations per paper which is double the amount of citations received by the single authored publications. It shows large number of coauthored publications attracts more number of citations than the single authored one. It is further evident from the study of Relative Citation Index on authorship publications.

In all the block periods more number of coauthored publications received citations than the single authored publications. The cited single authored publications have recorded less than 50% of the total publications in all the block periods whereas the cited coauthored publications have crossed the milestone thrice in the block periods as well as to the duration of the study. The ratio of the cited publications shows supremacy of the coauthored publications over the single authored publications in attracting citations.

The study on uncited publications indicates that large number of single authored publications went uncited during the study period when compares to coauthored publications. It is further evident from the values of Relative uncitedness Index for the single authored publications.

Conclusion

The study has been conducted with a vast number of 389196 records which was published over a period of 40 years. The study carried out a thorough examination on the relationship between the authorship pattern and citation analysis of the published literature in the field of Spacecrafts. From the study it is found that coauthored publication attracts more citations than the single authored one in Spacecrafts research outputs. Similar studies on other disciplines also came to a conclusion that in general, coauthored publications receive more citations than the single authored one. This study proves that Spacecraft literature is no exemption to other similar literatures.

References

Ajiferuke, I., Burrel, Q., and Tauge J. (1998). Collaborative coefficient: A single measure of the degree collaborations in research in research. *Scientometrics*, 14: 421-433.

Burrell, Q, L. (2012). Alternative thoughts on uncitedness, *Journal of the American Society for Information Science and Technology*, 63(7):1466-1470.

Burrell, Q, L. (2013). A stochastic approach to the relation between the impact factor and the uncitedness factor. *Journal of Informetrics*, 7(3):676-682.

Didegah, F., & Thelwall, M. (2013). Which factors help authors produce the highest impact research? Collaboration, journal and document properties. *Journal of Informetrics*, 7, 861–873.

Dutt, B & Nikam, K. (2016). Scientometric Analysis of Global Solar Cell Research. *Annals of Library and Information Studies,* 63(1): 31-41.

Egghe, L (2010). The distribution of the uncitedness factor and its functional relation with the impact factor. *Scientometrics*, 83(3):689-695.

Egghe, L, Guns, R & Rousseau R (2011). Thoughts on uncitedness: Nobel laureates and Fields medalists as case studies. *Journal of the American Society for Information Science and Technology*, 62(8):1637-1644.

Elango, B. (2017). Does co-authored articles receives more citations? *International Journal of Information Studies and Libraries*, 2(1): 1-4.

Garg, K. C., & Kumar, S. (2014). Uncitedness of Indian scientific output. *Current Science*, 107(6), 965-970.

Gazni, A., & Thelwall, M. (2014). The long-term influence of collaboration on citation patterns. *Research Evaluation*, 23, 261–271.

Heneberg, P (2013). Supposedly uncited articles of Nobel laureates and Fields medalists can be prevalently attributed to the errors of omission and commission. *Journal of the American Society for Information Science and Technology*, 64(3,): 448-454.

Hsu, J, W., Huang, D, W. (2012). A scaling between impact factor and uncitedness. *Physica A*, 391(5): 2129-2134.

Kumari, G. L. (2009). Synthetic Organic Chemistry Research: Analysis by Scientometric Indicators. *Scientometrics*, 80(3): 559-570.

Lawani S M (1980). Collaboration and the Quality of Research Productivity. *ITTA Research Briefs*, 13: 6-8.

Onodera, N., & Yoshikane, F. (2015). Factors affecting citation rates of research articles. *Journal of the American Society for Information Science and Technology*, 66(4), 739–764.

Padial, A. A., et al. (2010). Weak evidence for determinants of citation frequency in ecological articles. *Scientometrics*, 85(1), 1-12.

Schwartz, C, A. (1997). The rise and fall of uncitedness. *College Research Libraries*, 58, 19–29.

Sinha, B. & Joshi, K. (2012). Analysis of India's solar photovoltaic's research output. *Annals of Library and Information Studies*, 59 (2): 106-121.

Smart, J. C., & Bayer, A. E. (1986). Author collaboration and impact: A note on citation rates of single and multiple authored articles. *Scientometrics*, 10(5), 297-305.

Sooryamoorthy, R. (2017). Do types of Collaboration change citation? A Scientometric Analysis of Social Science Publications in South Africa. *Scientometrics*, 111(1), 79-400.

Spacecrafts, http://www.braeunig.us/space/systems.htm, [16 August 2017].

Subramanyam, K (1983). Bibliometric study of Research Collaboration: A Review. *Journal of Information Science*, 6(1): 33-38.

Thompson, J. W. (2002). The death of the scholarly monograph in the humanities? Citation patterns in literary scholarship. *Libri*, 52, 121–136.

Van Leeuwen, T. (2006). The application of bibliometric analyses in the evaluation of social science research. Who benefits from it, and why it is still feasible. *Scientometrics*, 66(1), 133–154.

Vermeulen, N., Parker, J. N., & Penders, B. (2013). Understanding life together: A brief history of collaboration in biology. *Endeavour*, 37(3), 162-171.