

University of Nebraska - Lincoln

DigitalCommons@University of Nebraska - Lincoln

Library Philosophy and Practice (e-journal)

Libraries at University of Nebraska-Lincoln

12-2018

Bibliometric Indicators for Assessing the Quality of Scholarly Communications: A Case Study on International Journal of Cooperative Information Systems

Basudev Mohanty

Institute of Physics, Bhubaneswar

Jyotshna Sahoo

Khallikote University, jyotshna_sahoo@rediffmail.com

Nrusingh Kumar Dash Librarian

Silicon Institute of Technology

Follow this and additional works at: <http://digitalcommons.unl.edu/libphilprac>



Part of the [Library and Information Science Commons](#), and the [Management Information Systems Commons](#)

Mohanty, Basudev; Sahoo, Jyotshna; and Dash, Nrusingh Kumar Librarian, "Bibliometric Indicators for Assessing the Quality of Scholarly Communications: A Case Study on International Journal of Cooperative Information Systems" (2018). *Library Philosophy and Practice (e-journal)*. 2158.

<http://digitalcommons.unl.edu/libphilprac/2158>

Bibliometric Indicators for Assessing the Quality of Scholarly Communications: A Case Study on International Journal of Cooperative Information Systems

Dr. Basudev Mohanty^{1,2}

¹ Librarian, Institute of Physics Bhubaneswar; Odisha, India, E-mail: basudev@iopb.res.in

² HomiBhabha National Institute, BARC Training School Complex, Anushakti Nagar, Mumbai-400085, India

Dr. Jyotshna Sahoo³

³ Associate Professor & Head, Department of Library and Information Science, Khallikote University, Berhampur - 760001, Odisha, India. E-mail: Jyotshna_sahoo@rediffmail.com (*Corresponding Author*)

Dr. Nrusingh Kumar Dash⁴

⁴ Silicon Institute of Technology, Bhubaneswar, Odisha, India.

ABSTRACT:

This paper analyses various bibliometric dimensions of the journal literature such as authors' productivity, geographical distribution, citation pattern, institution-wise distribution of articles, discipline-wise distributions of articles, productive institutions, Productivity Index (PI), Activity Index (AI), Domestic Collaborative Index (DCI) and International Collaborative Index (ICI) etc. It also explores the applicability of Lotka's Inverse Square Law and Zipf's Law to examine the observed rank – frequency pattern of Keywords and Subject Terms of Information Systems (IS) literature. To illustrate these bibliometric indicators pertinent information on the field of Information Systems (IS) collected from EBSCO database for the International Journal of Cooperative Information Systems (IJCIS). Results indicated that a high level of collaboration exists among the authors, USA occupies the dominant position in terms of high productive authors, institutions and tops the list with highest number of domestic collaboration. Authors' productivity confirms to Lotka's law and the Frequency distribution of both Subject Terms and Keywords in IJCIS journal literature follow Zipf's distribution.

KEYWORDS: Bibliometrics, Scientometrics, Productive index, Authors' productivity, Lotka's Law, Zipf's Law, Information Systems.

INTRODUCTION:

A number of contributors especially in the field of Library and Information Science (LIS) have conducted bibliometric analysis of LIS as well as popular journals from other disciplines in different countries around the globe. Even a particular journal has been studied at different time period by scholars of different regions. Tiew et al. (2002) studied the Malaysian Journal of Library and Information Science (MJLIS) covering the period 1996-2000 while Bakri and Willett (2008) analyses publication and citation

patterns of the same journal MJLIS from 2001-2006 and compares the results with those obtained in an earlier study by Tiew et al. (2002). Tsay (2008) explored the relationship between Library and Information Science and other disciplines by analyzing citations of the Journal of the American Society for Information Science and Technology (JASIST). Kuhn (3rd ed., 1996) argued that research firmly based upon past scientific achievements supplies the foundation for future research. Thus, the assessment of journal quality should be derived from knowledge contributions or the actual use of the journals and their articles (Cooper *et al.*, 1993). Citation analysis allows the contributions of disciplines, journals, articles, or scholars to be evaluated by giving substantive expression to the use and diffusion of knowledge (Jackson and Rushton, 1987). Citation analysis, long used in physical and biological sciences, is now being used to examine the quality of business-related journals (Zinkhan and Leigh, 1999). The present study is modelled with the purpose to explore the quantitative and qualitative assessment of global Information Systems (IS) research published during the period from 1999-2009. It examines and presents an analysis of 212 research papers published in International Journal of Cooperative Information Systems (IJCIS). The International Journal of Cooperative Information Systems (IJCIS) is an academic, peer reviewed scholarly journal published quarterly by World Scientific Publishing Ltd., Singapore. The journal provides a forum for the presentation and dissemination of research covering all aspects of Cooperative Information Systems design, requirements, functionality, implementation, deployment, and evolution. It caters to the needs of researchers in the disciplines of Computer Science Applications, Information Systems and Management Information Systems.

RESEARCH QUESTIONS:

While there is ample room to explore many more issues in the scholarly communications of IS literature, the present study attempts to make a valid contribution to IS research by identifying the following research questions.

RQ 1 - What is the mean authorship and degree of collaboration of IS literature? Is there any relationship between these two parameters?

RQ 2 - Does the frequency of publications by authors follow Lotka's law?

RQ 3 - Which countries have significant contributions to IS literature and what are their profiles with respect to various indices (like Activity Index, DCI, ICI)?

RQ 4 - Does the frequency of Keywords and Subject Terms follow Zipf's law?

RQ 5 - What is the impact of IS research publications as regards to the citation pattern?

METHODOLOGY:

For carrying out the work, EBSCOhost Research Database is selected as the data source. All the available back volume papers of IJCIS published during 1999 - 2009 were included in this study, comprising of 212 articles from 11 volumes and 40 issues. For each volume and issue of IJCIS bibliographic details like, the *titles, names of authors, number of authorship, author's institutional affiliation, country and discipline, type of article, number of references, citations received, author supplied keywords, subject terms* etc. were collected. All the necessary data points were then recorded and the standardized data were compiled, tabulated and analyzed for making observations by various bibliometric indicators described below.

i) Application of Lotka's inverse Square Law of Scientific Productivity

The total number of authors Y in a given subject, each producing X publications, is inversely proportional to some exponential function n of X i.e. the number of authors making X contributions is about $1/X^n$ of those making one contribution, where parameter "n" nearly equals to two. The general formula of Lotka's Law is (Lotka, 1926):

$$X^n Y = C \Rightarrow n = \frac{\text{Log } C - \text{Log } Y}{\text{Log } X} \quad \text{Where,}$$

- X = Number of publications (1, 2, 3 , n)
- Y = Relative frequency of authors with X publications
- C = Constant which is equal to number of contributors with minimal Productivity
- n = Parameter "n" can be calculated by least square method in the simple regression model.

The value of "n" is calculated from the observed frequencies of authorship pattern (Potter, 1981). Using the derived mean value of the parameter "n" (*originally n = 2 as theorized by Lotka*), the estimated frequencies of authors are calculated for authorship pattern.

ii) Kolmogorov-Smirnov (K-S) Goodness-of-fit test:

In order to test the applicability of Lotka's law to a set of data, a statistical test (goodness-of-fit) is needed. The K-S (Kolmogorov-Smirnov) test determines the maximum deviation (D) as under (Potter, 1981):

$$D = \text{Max } |F_o(x) - S_n(x)| \quad \text{where}$$

F_o(X) ~ is the theoretical cumulative frequency function and
S_n(X) ~ is the observed cumulative frequency function of a sample of n observations.

At a 0.01 level of significance, the K-S statistic is equal to $1.63/\sqrt{n}$. If D is greater than the K-S statistic, then the sample distribution does not fit the theoretical distribution.

iii) **Productivity Index (PI):**

With regard to the Lotka's classical method to test the regularity in publication activity of authors as cited above, the index called Productivity Index (PI) (Garcia, 2005; Sevukan, 2007) had been applied to identify the level of productions in IS literature. The PI is the logarithm values of n publications for each author which helped to find out three classical levels i.e. occasional producers, intermediate producers and larger producers as under:

- a) $PI = 0$ (Producing only 1 article each) > Occasional producers
- b) $0 < PI < 1$ (Producing 2 to 9 articles) > Intermediate producers
- c) $PI \geq 1$ (Producing 10 or more articles) > Larger producers

iv) **Degree of Collaboration:**

The degree of collaboration among authors is calculated using Subramanian's formula (Subramanian, 1983). The formula is:

$$DC = \frac{Nm}{Nm+Ns} \quad \text{where,}$$

DC = Degree of Collaboration
Nm = Number of Multi Authored Contributions
Ns = Number of Single Authored Contributions

v) **Year-wise Activity Index (AI) of Most Productive Countries:**

Activity Index (AI) characterizes the relative research effort of a country devotes to a given sub-field and takes into consideration the effect of the size of the country as well as the size of the sub-field (suggested by Frame (1977) and elaborated by Schubert and Braun (1986)). This methodology can be applied to the year-wise output of a country to the world's output and mathematically it can be expressed as:

$$AI (\text{Activity Index of X in year i}) = \left\{ \frac{X_i}{X_o} \right\} / \left\{ \frac{W_i}{W_o} \right\} * 100 \quad \text{where,}$$

X_i = Country output in year i
 X_o = Country output (total)
 W_i = World output in year i
 W_o = World output (total)

AI = 100 implies the country's year-wise output corresponds to the world average, AI > 100 reflects higher than average output, and AI < 100 reflects lower than average by that country.

vi) **Domestic and International Collaborative Profile of Most Productive Countries:**

Domestic and international collaborative profile of most productive countries has been calculated using Domestic Collaborative Index (DCI) and International Collaborative Index (ICI). Both the indexes (DCI/ICI) can be derived by calculating proportional output of domestically/internationally co-authored

papers. The methodology is similar to one suggested by Frame (1977) and elaborated by Schubert and Braun (1986) and applied by Garg and Padhi (2001).

$$\mathbf{DCI} = \{(\mathbf{D_i/D_{i0}}) / (\mathbf{D_o/D_{oo}}) \mathbf{X 100} \quad \text{where}$$

- $\mathbf{D_i}$ = No. of domestically co-authored papers for country i
- $\mathbf{D_{i0}}$ = Total contribution of country i
- $\mathbf{D_o}$ = No. of domestically co-authored papers from all the countries
- $\mathbf{D_{oo}}$ = Total contribution from all the countries

Similarly, $\mathbf{ICI} = \{(\mathbf{I_i/I_{i0}}) / (\mathbf{I_o/I_{oo}}) \mathbf{X 100} \quad \text{where}$

- $\mathbf{I_i}$ = No. of internationally co-authored papers for country i
- $\mathbf{I_{i0}}$ = Total contribution of country i
- $\mathbf{I_o}$ = No. of internationally co-authored papers from all the countries
- $\mathbf{I_{oo}}$ = Total contribution from all the countries

DCI/ ICI = 100 implies the country’s collaborative effort corresponds to the world average, DCI/ICI > 100 reflects higher than average collaboration effort, and DCI/ICI < 100 reflects lower than average collaboration effort by that country.

vii) Citation-based Indices for Journal Quality:

Based on the citation data available in EBSCO database, different citation-based indices for journal quality are derived. Journal quality is a multifaceted concept and can be reflected by different measures (Mylonopoulos and Theoharakis, 2001; Zinkhan and Leigh, 1999). Definitions and derivations of each citation-based index for journal quality are presented below:

Citations per article are the average number of citations received per target article published in each year.

$$\text{Citations per article} = \frac{\text{number of citations received by articles published in base year}}{\text{number of articles published in base year}}$$

Un-cited ratio is the percentage of the target articles, published each year that are not cited.

$$\text{Un – cited ratio} = \frac{\text{number of un – cited articles published in base year}}{\text{number of articles published in base year}} \times 100$$

10+ citations is the percentage of the target articles, published in each year, that are cited at least 10 times.

$$10 + \text{ citations} = \frac{\text{number of articles published in base year receiving at least 10 citation}}{\text{number of articles published in base year}} \times 100$$

Annual mean citation rate per article provides a normalized quality index of the target articles based on the number of years since publication.

$$\text{Annual mean citation rate per article} = \frac{\text{number of citations received by articles published in base year}}{\text{number of articles published in base year} \times \text{years of publication}}$$

Cited count, the number of citations to a specific journal, is a measure of the journal's cumulative influence on knowledge production. Cumulative influence signifies journal quality because it demonstrates that a journal is a current knowledge source and research is valued for its originality (Zinkhan and Leigh 1999). Given such connotation, the Cited-to-Citing ratio is an indicator of journal quality. A relatively high ratio indicates that the journal is a knowledge source; a relatively low ratio indicates that the journal is a knowledge user.

$$\text{Cited – to – Citing ratio} = \frac{\text{number of citations received by articles published in base year}}{\text{number of references made by articles published in base year}}$$

This index measures the frequency with which the articles in the journal were cited over the most recent two-year period (Garfield, 1979). *Current article impact* for a reference year is derived by dividing the number of citations made only to the target articles published during two years prior to the reference year by the number of target articles that were published during the same time period.

$$\text{Current article impact} = \frac{\text{number of citations received by articles published in last two years}}{\text{number of articles published in last two years}}$$

RESULTS AND DISCUSSION:

On the basis of nature of the published articles, the total numbers of publications (212) of IJCIS are divided into two categories namely, research papers (RP=186) and short communications (SC=26). For this paper apart from RP, other publications are categorized as short communications. Out of 212 contributions, the highest is Research Papers (186) that accounts for 87.7% of the total contributions followed by Editorials (15papers, 7.1%) and author index (8 papers, 3.8%) respectively. The categories like “Preface and forewords, “Erratum” & “Review” papers though appeared in the journal but the number is very less that accounts for 0.5% for each category.

Authorship Pattern:

It is observed that 186 number of RPs are contributed by 583 numbers of authors which reflects that the average number of authors per paper is **3.14** (*Mean Authorship*). Out of 186 papers, only 9% (17) papers are contributed by single authors while rest 91% (169) by multiple authors. Further it is observed that the contributions of two, three, and four authored papers are very high that is 50 (27%), 55 (30%) and

38 (21%) respectively which covers almost of 78% of total RPs. As the multi-authored papers are dominant, it can be inferred that the collaborative research is at the front in IS literature.

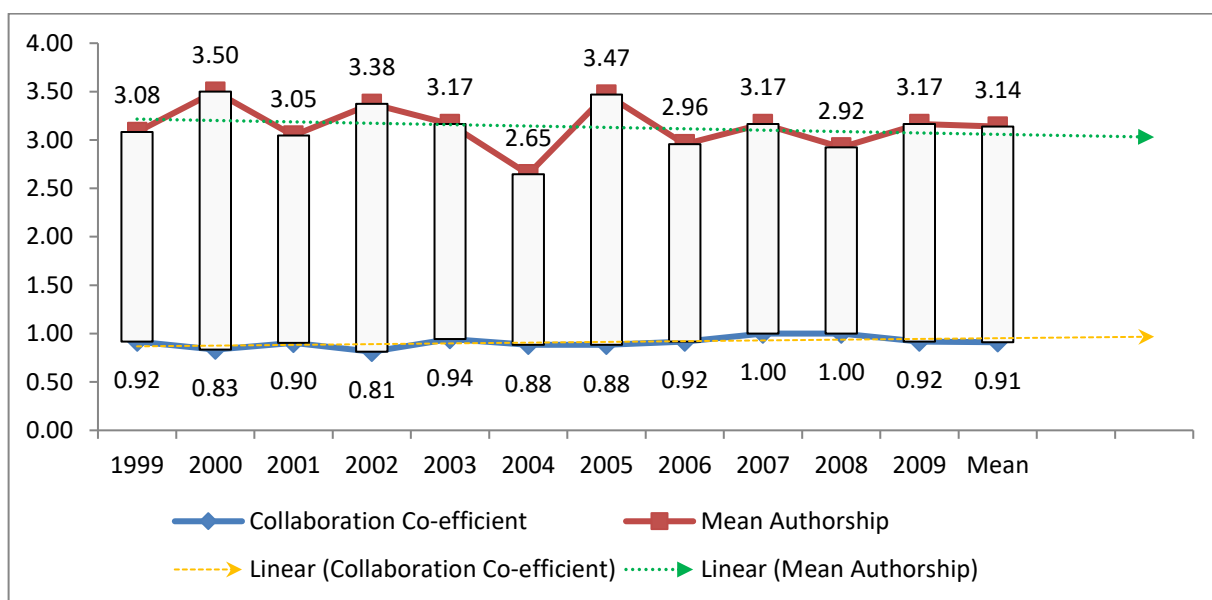
Table 1: Year wise distribution of Authorship Pattern

No. of Authors >		One		Two		Three		Four		> = Five		Total RP	Total Authorship (TA)	Mean Authorship
SL. No.	Year	No.	%	No.	%	No.	%	No.	%	No.	%			= (TA/RP)
1	1999	1	5.9	2	4	6	10.9	1	2.6	2	7.7	12	37	3.08
2	2000	3	17.6	2	4	2	3.6	8	21.1	3	11.5	18	63	3.50
3	2001	2	11.8	8	16	5	9.1	3	7.9	3	11.5	21	64	3.05
4	2002	3	17.6	4	8	3	5.5	2	5.3	4	15.4	16	54	3.38
5	2003	1	5.9	2	4	11	20.0	2	5.3	2	7.7	18	57	3.17
6	2004	2	11.8	8	16	3	5.5	3	7.9	1	3.8	17	45	2.65
7	2005	2	11.8	4	8	2	3.6	5	13.2	4	15.4	17	59	3.47
8	2006	2	11.8	8	16	8	14.5	2	5.3	4	15.4	24	71	2.96
9	2007	0	0.0	5	10	7	12.7	4	10.5	2	7.7	18	57	3.17
10	2008	0	0.0	4	8	6	10.9	3	7.9	0	0.0	13	38	2.92
11	2009	1	5.9	3	6	2	3.6	5	13.2	1	3.8	12	38	3.17
Total		17	100	50	100	55	100	38	100	26	100	186		
% w.r.t RP		9.1		26.9		29.6		20.4		7.5		100		
Authorship		17		100		165		152		149			583	
Authorship %		2.9		17.2		28.3		26.1		25.6			100	
Mean		1.5		4.5		5.0		3.5		2.4		16.9	53	3.14
SD		1.04		2.42		2.93		1.97		1.36		3.67	11.76	0.25

Degree of Collaboration:

The degree of collaboration among authors reflected was calculated using Subramanian’s formula (Subramanian, 1983). To show the observed trends, the year-wise collaboration co-efficient and mean authorship is plotted in figure – 1 along with their respective linear trend lines. The mean collaboration co-efficient touches the optimal point (i.e., 1) in the year 2007 and 2008 as the contribution of single authored papers are nil in those two years and the mean collaboration co-efficient is 0.91. The optimal value of degree of collaboration as well as the minimal value of standard deviation indicates that IJCIS has accommodated more number of collaborative works than single authored ones.

Figure 1: Degree of Collaboration and Mean Authorship of Research Papers



Application of Lotka's inverse Square Law of Scientific Productivity:

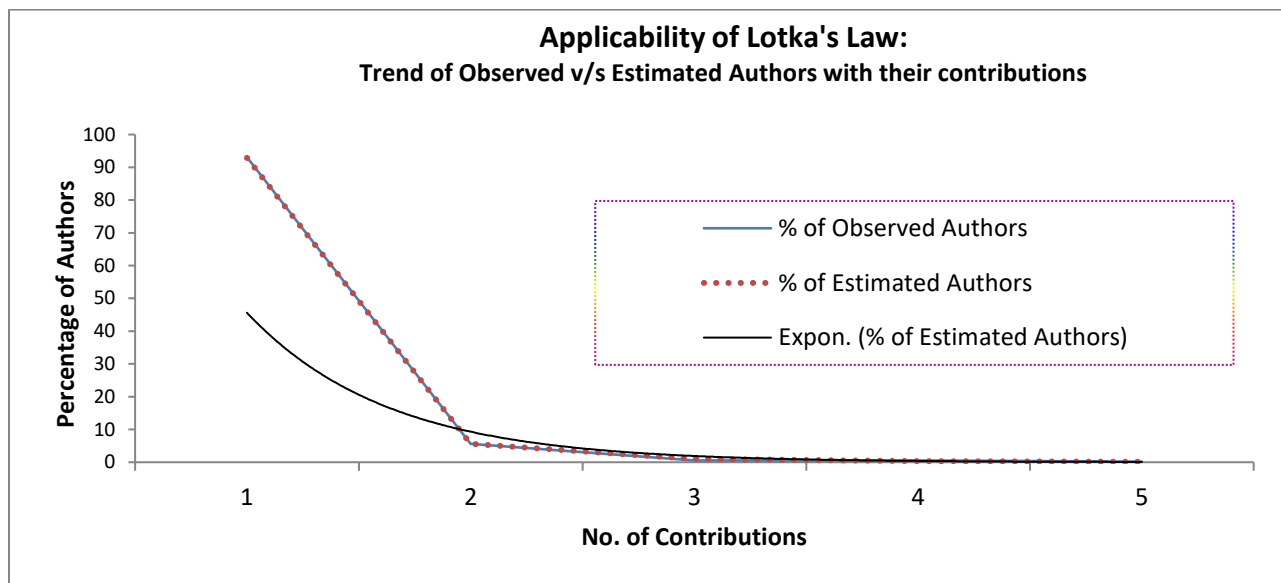
Table 2: Number of expected Authors derived using Lotka's inverse Square Law

No. of contributions "X"	Log X	No. of Authors Observed "Y"		Log Y	Total Contributions		n = (Log C - Log Y)/Log X	POWER (n,4.06)	Estimated Frequency of Authors	
		No.	%		No.	%			No.	%
1	0.000	497	93.07	6.209	497	85.25		1.00	497	92.90
2	0.693	30	5.62	3.401	60	10.29	4.05	16.68	30	5.57
3	1.099	3	0.56	1.099	9	1.54	4.65	86.52	6	1.07
4	1.386	3	0.56	1.099	12	2.06	3.69	278.20	2	0.33
5	1.609	1	0.19	0.000	5	0.86	3.86	688.36	1	0.13
		534	100	6.280	583	100	4.06		535	100
							Mean			

C = No. of Authors with minimal productivity (i.e. 497) & Log C = 6.209

Measuring of author productivity is a vital part of the metric study is induced for the present research and presented in Table - 2. It is observed that, 497 (93%) numbers of authors have contributed single paper each which gives the value of *Constant (C)* i.e. *number of contributors with minimal productivity*. The values of parameter "n" are calculated and the mean value of "n" is found to be 4.06. Figure – 2 illustrates the variation of observed and estimated authors' percentile with their contributions respectively.

Figure 2: Trend of Observed v/s Estimated Authors with their contributions



In order to test the applicability of Lotka’s law to a set of data, a statistical test (goodness-of-fit) is applied and presented in Table – 3. As shown in table - 3, the value of D is **0.0029** which is less than the K-S statistic i.e. $1.63/\sqrt{534} \sim 0.0705$. Therefore Lotka’s generalized formula fits to the present sample of IJCIS literature.

Table 3: Kolmogorov-Smirnov (K-S) Goodness-of-fit test

No. of contributions	Observed Authors			Estimated Authors			Deviation	Dmax
	No.	Cumulative Frequency	Relative Frequency { Sn(x) }	No.	Cumulative Frequency	Relative Frequency { Fo(x) }	D= Fo(x)-Sn(x)	Max of Fo(x)-Sn(x)
1	497	497	0.9307	497	497	0.9290	-0.0017	0.0029
2	30	527	0.9869	30	527	0.9847	-0.0022	
3	3	530	0.9925	6	533	0.9954	0.0029	
4	3	533	0.9981	2	534	0.9987	0.0006	
5	1	534	1.0000	1	535	1.0001	0.0001	
Total	534			535				
K-S statistics = 1.63/SQRT(n = 534) --- >								0.0705

Productivity Index (PI):

With regard to the above aspect of Lotka’s law, the index called Productivity Index (PI) has been applied to identify the level of classification of authors. The PI is the logarithm of the values of n publications for each author. The PI at Table – 4, reveals that occasional producers (93% authors) who published only one paper each (PI = 0) contribute as much as 85% of total IJCIS literature while intermediate producers (7% authors) who published 2 – 9 papers (0 < PI < 1) contribute rest (15%) of IJCIS literature in the absence of larger producing group (who published 10+ papers; PI > = 1).

Table 4: Productivity Index (PI)

Productivity Index (PI)	No. of Authors	% of Authors	% of Contributions	Level of contributions
PI = 0 (1 article)	497	93.07	85.25	Occasional producers
0 < PI < 1 (2 - 9 articles)	37	6.93	14.75	Intermediate producers
PI >= 1 (10 or more)	0	0.00	0.00	Larger producers

Geographical Distribution of Authorship:

Table 5: Country-wise contributions of Authors

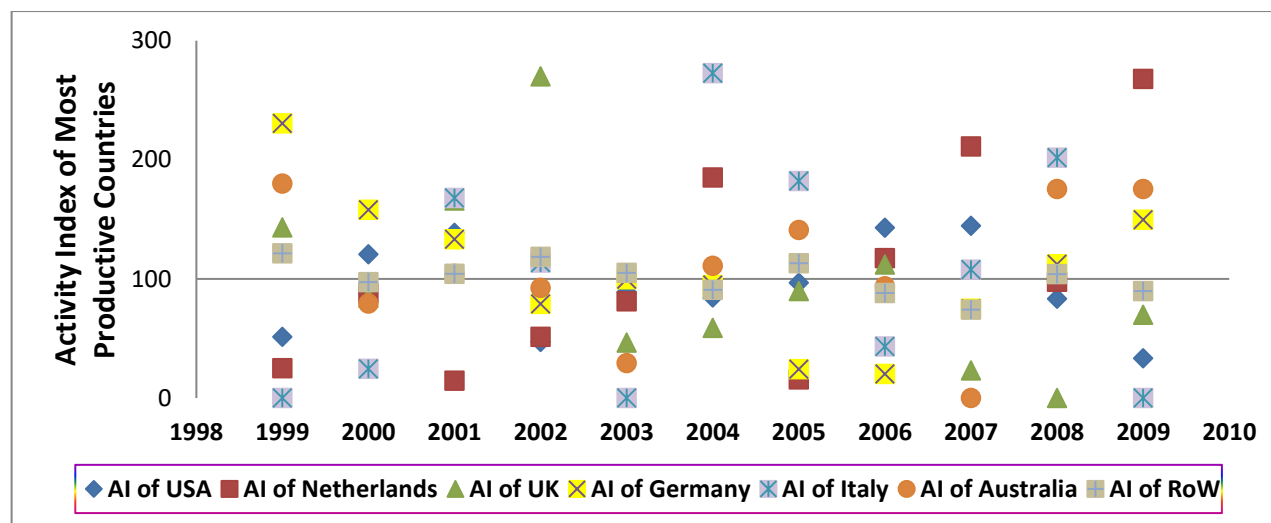
Sl. No.	Considering All Authors				Considering only 1st Authors			
	Country of Affiliation	No.	%	Rank	Country of Affiliation	No.	%	Rank
1	USA	92	15.78	1	USA	31	16.67	1
2	Netherlands	63	10.81	2	Netherlands	23	12.37	2
3	UK	44	7.55	3	UK	14	7.53	3
4	Germany	41	7.03	4	Germany	13	6.99	4
5	Italy	38	6.52	5	Italy	12	6.45	5
6	Australia	35	6.00	6	Australia	10	5.38	6
7	France	34	5.83	7	France	10	5.38	6
8	Canada	31	5.32	7	Canada	5	2.69	8
9	Spain	21	3.60	8	Spain	5	2.69	8
10	Japan	16	2.74	9	Japan	3	1.61	10
11	India	15	2.57	10	India	2	1.08	11
12	Korea	14	2.40	11	Korea	7	3.76	7
13	Hong Kong	13	2.23	12	Hong Kong	3	1.61	10
14	Brazil	11	1.89	13	Brazil	3	1.61	10
15	Taiwan	11	1.89	13	Taiwan	4	2.15	9
16	Portugal	10	1.72	14	Portugal	4	2.15	9
17	Others (23 Countries)	94	16.12		Others (18 Countries)	37	19.89	
Total	39	583	100		34	186	100	

Table - 5 reflects the share of major nations output on the basis of authors' affiliation considering all authors as well as considering the first authors only. A total of 583 authors occurred in the affiliations when considered all authors and 186 authors occurred when considered only first authors. It is reflected that the USA occupies the first (1st) rank among the countries contributed to IJCIS literature and it accounts for 15.78% of the total contributions on the basis of affiliating countries (92 authors belong to the USA) when considered all authors and it again accounts for 16.67% contributions (31 authors belong to the USA) when considered only first authors. Netherland accounts for 10.8% of total author affiliation

followed by UK with 7.5% and both the countries occupy second and third rank respectively. The other countries of affiliation of authors are Germany (7.03%), Italy (6.52%), Australia (6%), France (5.83%), Canada (5.32%), Spain (3.6%), Japan (2.74%), India (2.57%) etc. those hold rank 4 to 10 whereas 23 other countries jointly account for 16.24% of the total affiliating countries. A similar trend is also observed when considered the first authors up to the rank 6 and then after a slight deviation is observed in both the rank lists.

Year-wise Activity Index (AI) of Most Productive Countries v/s Rest of World:

Figure 3: Activity Index (AI) of USA, UK, Germany, Italy & Australia v/s Rest of World



The result of the Activity Index (AI) of most productive countries mainly USA, Netherland, UK, Germany, Italy and Australia along with Rest of World (RoW: rest of the 33 countries) are given in Figure – 3. It is observed that, the above average score of AI for most productive countries is scattered over time. Since none of the countries maintain consistency over time in terms above average (>100) score of AI, it can be concluded that no specific country is the leader in IS literature. Thus all the most productive countries fall in the moderate/intermediate group while rests of the countries (33) are in the occasional category.

Domestic and International Collaborative Profile of Most Productive Countries:

Domestic and international collaborative profile of most productive countries has been calculated using DCI and ICI and presented in Table – 6. It is observed that USA tops the list with 45 (DCI = 102) number of domestic collaboration. Other countries having above average DCI (> 100) are Netherland, Germany, Italy, France, Japan, Korea and Taiwan. The reason for the higher value of DCI for the USA is mainly due to the highest number of affiliated institutions (143; 64%) belongs to the USA. In case of ICI, a reverse trend is observed i.e. countries those having lower than the average score of DCI exhibit the

trend of a higher score of ICI (>100) values. Thus, IS literature is well developed in those countries which exhibit less than the world average of ICI score and does not require a higher magnitude of international collaboration.

Table 6: Domestic and International Collaborative Indexes of Most Productive Countries

Country	Domestic Collaboration	Domestic Collaborative Index (DCI)	International Collaboration	International Collaborative Index (ICI)	Total Contributors
USA	45	102	47	98	92
Netherlands	43	143	20	61	63
UK	12	57	32	139	44
Germany	24	122	17	80	41
Italy	19	104	19	96	38
Australia	12	72	23	126	35
France	22	135	12	68	34
Canada	13	88	18	111	31
Spain	10	100	11	100	21
Japan	13	170	3	36	16
India	7	98	8	102	15
Korea	9	134	5	68	14
Hong Kong	5	80	8	118	13
Brazil	5	95	6	105	11
Taiwan	9	171	2	35	11
Portugal	0	0	10	192	10
Others (23 Countries)	31	69	63	129	94
Total	279	100	304	100	583

Zipf's Law applicability for Keywords and Subject Terms of IJCIS literature:

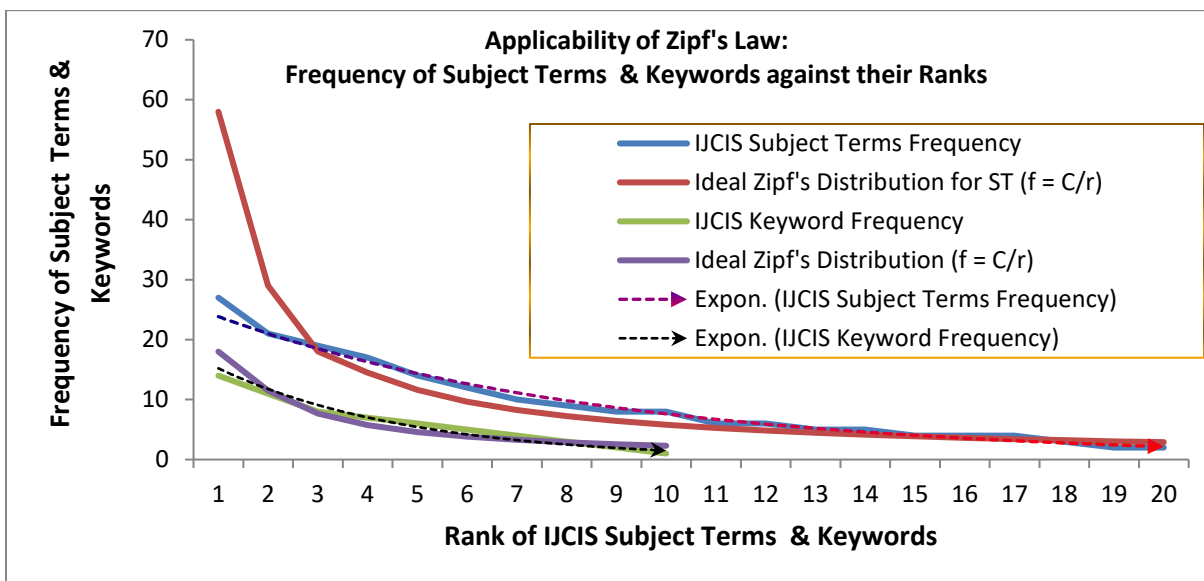
Zipf's law is found to be applicable in many diversified areas like natural languages (Miller, Newman & Friedman, 1958), web assess statistics, company sizes (Stanely et al., 1995), population sizes etc. but the most common one is the frequency of English words. Zipf's law states that if the words in a given text are ranked by the frequency of the occurrence, then the frequency of the second most common word is half the frequency of the most common word; frequency of the third most common word a third; and so on. i.e.,

$$Frequency\ of\ rank\ N = (Frequency\ of\ rank\ 1) / N$$

To examine whether the observed rank – frequency pattern of Keywords and Subject Terms of IS literature exhibits any similarity to that of Zipf's Law, the estimated frequencies were calculated and plotted against the observed pattern (Gorla & Walker, 1998) in figure 4. It shows the frequency distribution of both Subject Terms and Keywords in IJCIS journal literature follow Zipf's distribution.

Further to bring more clarity on the similarity of observed distribution against ideal distribution, exponential trend lines were drawn which exhibit similar behaviour with that of Zipfian curve.

Figure 4: IJCIS Subject Term & Keyword distribution v/s Ideal Zipf's distribution



Reference Pattern and Citation Received:

Table – 7 represents reference characteristics as well as the citation indicators for the journal IJCIS in terms of year-wise distribution of references, references per article, chronological distribution of citations appeared in EBSCO database, percentage of citations per article, number of un-cited articles and the respective ratio, articles received at least 10 and 10+citations, cited to citing ratio and annual mean citation rate per article. It reveals from the above table that a total of 5844 references are appended to 186 research articles. The average number of references per article varies from minimum 14 in 2002 to maximum 41 in 2004, and the mean reference per RP is 31. Since 80% of the articles having more than 20+ references, it can be stated that the contributors of IJCIS refer a good number of research papers. From the citing pattern, it is observed that all total 144 numbers of citations received by 186 research papers and the mean citation is found be 0.8. A number of documents that have never been cited are 122 out of which highest articles not cited (17) in the years 2006 while the mean un-cited ration is 65.59%. The *cited to citing the ratio* of IJCIS article is 0.02. *Citations per article*, and the *Cited-to-Citing ratio* is higher for older articles than for recent articles and it indicates that older articles get more time to accumulate more citations. To address this issue, *annual mean citation rate per article* is calculated considering the years elapsed since the publication of the target articles. It is observed that the annual mean citation rate per IJCIS article is highest (0.42) in 2009 and lowest (0.10) in 2001 while the mean is 0.16.

Table 7: Referencing and Citation Pattern of IJCIS

<i>SL. No.</i>	<i>Year</i>	<i>No. of Research Papers (RP)</i>	<i>References</i>	<i>References per article</i>	<i>Citations in EBSCO DB</i>	<i>Citations per article</i>	<i>number of un-cited articles</i>	<i>Un-cited ratio (%)</i>	<i>Articles received at least 10 citations</i>	<i>10+ Citations (%)</i>	<i>Cited-to-Citing ratio</i>	<i>Number of years since publication</i>	<i>Annual mean citation rate per article</i>
1	1999	12	382	32	9	0.8	7	58.33	0	0.0	0.02	11	0.07
2	2000	18	546	30	21	1.2	12	66.67	0	0.0	0.04	10	0.12
3	2001	21	753	36	18	0.9	11	52.38	0	0.0	0.02	9	0.10
4	2002	16	231	14	15	0.9	7	43.75	0	0.0	0.06	8	0.12
5	2003	18	595	33	18	1.0	10	55.56	0	0.0	0.03	7	0.14
6	2004	17	702	41	8	0.5	12	70.59	0	0.0	0.01	6	0.08
7	2005	17	575	34	29	1.7	9	52.94	0	0.0	0.05	5	0.34
8	2006	24	715	30	12	0.5	17	70.83	0	0.0	0.02	4	0.13
9	2007	18	481	27	7	0.4	15	83.33	0	0.0	0.01	3	0.13
10	2008	13	455	35	2	0.2	12	92.31	0	0.0	0.00	2	0.08
11	2009	12	409	34	5	0.4	10	83.33	0	0.0	0.01	1	0.42
Total	11 Years	186	5844	31	144	0.8	122	65.59	0	0.0	0.02		0.16
						Mean		Mean		Mean	Mean		Mean

IMPLICATIONS OF RESEARCH QUESTIONS:

The notable implications to the proposed research questions are as under:

RQ 1: The mean authorship is found to be 3.14 and degree of collaboration (DC) is **0.91** for IS literature which indicates that the journal has accommodated more number of collaborative works over time. Further, it is observed that there is a directly proportional relationship between these two bibliometric parameters i.e. higher the values of collaborative co-efficient exhibit high values of mean authorships and vice versa.

RQ 2: The sample data on authors' productivity fit to the Lotka's generalized formula for $n = 4.06$. This is higher than what is proposed by Lotka ($n = 2$) because a large proportion of all authors (more than 93%) published only a single work.

RQ 3: It is found that USA dominates in the field of IS research as 15.78% of authors affiliations belong to this country followed by Netherland and UK with 10.81% and 7.55% affiliations respectively while India occupies 11th Rank with 2.57% of affiliations.

Since none of the countries maintain consistency over time in terms above average (>100) score of AI, it can be concluded that no specific country is the leader in IS literature.

The IS literature is well developed in the USA, Netherland, Germany, Italy, France, Japan, Korea and Taiwan as these countries exhibit higher DCI (>100) and lesser ICI (<100) and does not require a higher magnitude of international collaboration.

RQ 4: The frequency distribution of both Subject Terms and Keywords of IS journal literature follow Zipf's distribution and exhibit similar behaviour to that of Zipfian curve.

RQ 5: A total of 5844 references have been appended to 186 RPs during the study period and the average number of reference per article is 31. As 68% of the articles having more than 20+ references, it can be stated that the contributors of IS literature refer a good number of research papers for publishing their manuscripts.

A total of 144 citations have been received in EBSCO and the mean citation is 0.8 per article. A number of articles that have never been cited is 122 (65%). It is observed that, the mean *cited to citing ratio* is 0.02% for IS literature. It is expected that the last two years of the study period have more number of un-cited articles (more than 80%) as two-year elapsed time is the generally estimated time between submissions of an article and its appearance in print. The annual mean citation rate per article is 0.16 for IS sample. This provides a normalized quality index of the target articles based on the number of years since publication because older articles are likely to be cited more often than the recent articles.

CONCLUSION:

The pattern of various citation based indices like *Citations per article*, *10+ citations*, and the *Cited-to-Citing ratio* is higher for older articles than for recent articles. The value of various bibliometrics indicators as well as the steady growth rate shows the popularity, the quality as well as the impact of IJCIS publications in IS literature. These indicators, not only helps editors to evaluate their journals with respect to others but also to the researchers, librarians and academic administrators to identify which are the core journals within the subject field.

REFERENCES:

1. Cooper, R. B., Blair, D., and Pao, M. (1993). Communicating MIS Research: A Citation Study of Journal Influence. *Information Processing & Management*, 29(1), 113-127.
2. Cote, J. A., Leong, S. M., and Cote, J. (1991). Assessing the Influence of Journal of Consumer Research: A Citation Analysis. *Journal of Consumer Research*, 18, 402-410.
3. Dash, N. K., Sahoo, J. and Mohanty, B. (2015). *Evolution of Library Assessment Literature – A Bibliometric Analysis of LAC Proceedings*. in *Innovative Librarianship: Adapting to Digital Realities in Proceedings of 10th International CALIBER – 2015*, March 12-14, HP University, IAS, Shimla and INFLIBNET Centre, Himachal Pradesh, India, 91- 103.
4. Frame, J. D. (1977). Mainstream Research in Latin America and Caribbean, *Interciencia*, 2, 143-148.
5. Garcia, P., et al. (2005). Evolution of Spanish Scientific Production in International Obstetrics and Gynecology Journals during the period 1986-2002. *Journal of Obstetrics & Gynecology and Reproductive Biology*, 123, 150-156.
6. Garfield, E. (1979). *Citation Indexing: Its Theory and Application in Science, Technology, and Humanities*. New York, NY: Wiley.
7. Garg, K. C., and Padhi, P. (2001). A Study of Collaborations in Laser Science Technology, *Scientometrics*, 51, 415-427.
8. Gorla, N., and Walker, G. (1998). Is the lack of keyword synergism inhibiting maturation in the MIS theory? An exploratory perspective. *Information Processing & Management*, 34 (2/3), 325-339.
9. Jackson, D. N., and Rushton, P. (1987). *Scientific Excellence: Origins and Assessment*. Beverly Hills, CA: Sage.
10. Kuhn, T. (1996). *The Structure of Scientific Revolutions*, 3rd edition, Chicago, IL: University of Chicago.
11. Leong, S. M. (1989). A Citation Analysis of the Journal of Consumer Research. *Journal of Consumer Research*, 5(March), 492-497.

12. Lotka, A. J. (1926). Frequency distribution of scientific productivity. *Journal of Washington Academic Science*, 16(12), 317-323.
13. Miler, G. A., Newman, E. B., and Friedman, E. A. (1958). Length-frequency statistics for written English. 1, 370-389.
14. Mohanty, B., and Sahoo, J. (2016). The Intellectual Patterns of Management Information System Research: A Bibliometric study on International Journal of Management Reviews, *Library Philosophy and Practice* (e-journal). <http://digitalcommons.unl.edu/libphilprac/1402/>
15. Mylonopoulos, N., and Theoharakis, V. (2001). Global Perceptions of IS Journals. *Communications of the ACM*, 9(44), 29-33.
16. Potter, W. G. (1981). Lotka's Law revisited. *Library Trends*, 30, 21-29.
17. Sahoo, J., and Mohanty, B. (2002). Communication Pattern in the Journals "Studies in Conservation": A Bibliometric Analysis. *ILA Bulletin*, 38(3), 2002, 98 – 105.
18. Schubert, A., and Barun T. (1986). Relative Indicators and Relational Charts for Comparative Assessment of Publication Output and Citation Impact, *Scientometrics*, 9, 281-291.
19. Sethi, B. B., Sahoo, J., and Mohanty, B. (2014). A Bibliometric Sketch on Environmental Science Literature with special reference to India's Scenario. *Library Philosophy and Practice* (e-journal). Paper 1174. (8/2014). <http://digitalcommons.unl.edu/libphilprac/1174>
20. Sevukan, R. et. al. (2007). Research Output of Faculties of Plant Sciences in Central Universities of India: a Bibliometric Study, *Annals of Library and Information Sciences*, 54, 129-139.
21. Stanely, M. H. R. et al. (1995). Zipf's plot and the size distribution of firms. *Economic Letters*, 49, 453-457.
22. Subramanian, K. (1983). Bibliometric studies of research collaboration: a review. *Journal of Information Science*. 6(1), 33-38.
23. Zinkhan, G. M. and Leigh, T. W. (1999). Assessing the Quality Ranking of the Journal of Advertising: 1986-1997. *Journal of Advertising*, 2(28), 51-70.