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The Scientometric Evaluation of Research Output on Computer Communication

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Abstract

This study discusses the scientific productivity in the field of Computer Communication during the period 1971-2010, taken from Web of Science (SCI, SSCI, and ACH) through Scientometrics analysis. This study investigates the growth pattern of computer communication literature, collaboration pattern of authors, and tested Bradford's law of scattering the journal. The present study will help the library professionals in developing and implement of strategic plan for management of science and technology libraries.

Keywords: *Bradford's Law, Collaboration Measures, Computer Communication, Growth Rate, Scientometrics, Scattering of Journals*

1. INTRODUCTION

Every human have always communicated through various ways. In the beginning of mankind, man and woman used speech and body languages [1]. Nowadays, we use telecommunication technology for communication. Computers will be able to communicate with each other; often over wireless networks. During the relative short era of computers we have developed languages and rules for communication between us. These languages and rules are called protocols. The most well-known protocols are TCP/IP, used in the Internet [2]. In our research, we focus on the computer communication research output and its performance in the library field for library users and professionals in the global level. In the future, computers will be so common in our everyday appliances and mobile units that we will not react on them [3].

2. OBJECTIVES OF THE STUDY

The main objectives of the study are

i To identify the variety of sources brought out the computer communication;

ii To know about the exponential growth rate;

iii To study the authorship pattern and of author productivity;

iv To find out the core journals and test the Bradford's law of scattering of journal;

v To investigate the collaborative research trend in terms of Degree of Collaboration (DC).

3. DATABASE AND METHODOLOGY

The data for the study were retrieved from the Web of Science, Science Citation Index Expanded (SCIE), published by Thomson Reuters, by using relevant keywords related to Computer Communication field. Records pertaining to artificial cell were collected from 1971-2010 [4].

4. ANALYSIS AND INTERPRETATION

4.1 Source-wise Analysis

The Table 1 clearly reveals that journal article source that appeared in the journals have shown a predominant contribution (77.7 %) and this source occupies the first position with respect to total number of publications reported during the study period. The proceeding papers as a source of computer communication research publication output follows second rank in order (15.5 %)

in terms of total sources of publication output taken in this analysis. The review as a source of research publication output takes third in the order (3.6 %) with respect to total number of publications examined in the study. The editorial material as a source of publication output slips down to fourth in order (1.3%) of output performance [5]. The remaining sources are having below 0.6 % of research output from over all the various types of research output in this study.

Table 1 Analysis of Source-wise Distribution on Computer Communication

Type of Document	1971-1975	1976-1980	1981-1985	1986-1990	1991-1995	1996-2000	2001-2005	2006-2010	Total	%
Article	32	48	72	83	1359	1905	2226	3584	9309	77.7
Proceeding Paper	-	-	-	10	317	403	644	483	1857	15.5
Review	1	-	1	1	25	73	116	202	429	3.6
Editorial Material	2	3	14	6	9	28	25	66	156	1.3
Note	2	6	4	2	42	-	-	-	67	0.6
Meeting Abstract	8	6	5	3	1	5	15	9	52	0.4
Letter	1	-	5	2	13	14	7	4	46	0.4
Book Review	1	2	7	-	2	8	7	10	37	0.3
Reprint	-	-	-	-	1	8	3	1	13	0.1
Bibliography	-	-	-	-	-	4	5	-	9	0.1
Correction	-	-	-	-	-	1	2	1	4	0
Bibliographical Item	-	-	-	-	-	-	2	-	2	0
News Item	-	-	-	-	-	1	-	1	2	0
Abstract of Pub. Item	1	-	-	-	-	-	-	-	1	0
Correction, Addition	-	-	-	-	1	-	-	-	1	0
Discussion	-	-	1	-	-	-	-	-	1	0
Total	48	65	109	107	1769	2450	2052	4357	11986	100

It could be deduced from the above discussion that journal articles predominate over other sources of publications. It is due to the pivotal place of journals as a medium of scientific communication than any other form of publication, majority of the computer communication scientists published their research papers in journals.

4.2 Analysis Relative Growth Rate and Doubling Time

Table 2 Exponential Growth in Number of Publication Observed during 1971-2010

Five year Blocks	Number of publication	Growth Rate(%)
1971 - 1975	48	-
1976 - 1980	65	1.35
1981 - 1985	108	1.66
1986 - 1990	107	0.99
1991 – 1995	1708	15.96
1996 – 2000	2465	1.44
2001 – 2005	3135	1.27
2006 - 2010	4350	1.38

The Table 2 reveals the exponential growth rate of publications in computer communication during different five year blocks. An exponential growth in number of publication was observed during 1971 to 2010. The highest growth rate (15.96%) was found during 1991-1995 with 1708 publication followed by 1.66 % with 108 publications during 1981-1985. 1.44 % with 2465 publications during 1996-2000 and 1.38 % with 4350 publication is published during 2006-2010. It is found that the average exponential growth rate is 3.07% during the sample periods.

4.3 Continents-wise Research Output of Computer Communication

This analysis part covers the scientists' research output on computer communication publication at continents level. There are seven continents, but here only six continents have been taken for the study because the last continent of Antarctica is do not have any contribution of the publication. So for this part of analysis, only six continents such as North America, Europe, Asia, South America and Africa were selected.

Table 3 indicated that the continent-wide distribution of total research output on computer communication literature. The North American continent is placed in the first rank and highest publication (34.67 %) output about the computer communication along with 76944 total citation scores. The European continent has second rank (34.06 %) with 67145 total citation scores. There is not much contrast their output from North America. The Asian continent placed the third rank (23.93 %) among the six continents along with 18697 total citation scores. The Australian continent has 3.39% along with 4123 total citation scores, South American continent has 1.20 % with 1025 total citation scores and African continent has 0.92 % output during the study period along with 351 total citation scores. Apart from these continent output, unknown articles also found with 1.8 % along with 800 total citation scores. Overall continent's citation scores are 169,085.

Table 3 Continent-wise Research Output of Computer Communication Research Output

S.No	Continent	R o/p	Rank	%	TCS
1	North America	4197	1	35.01	76944
2	Europe	4051	2	33.79	67145
3	Asia	2856	3	23.82	18697
4	Australia	411	4	3.42	4123
5	Unknown	215	5	1.79	800
6	South America	145	6	1.20	1025
7	Africa	111	7	0.92	351
	Total	11986	-	100	169085

It could be deducted from the above analysis; North American Continent has highest publication and largest total citation scores are there in the field of computer communication and dominate first rank. Followed by the European continent has palced in second rank for both publication output and the total citation scores.

4.4 Bradford's Law of Scattering of Journals

The Bradford's law aims to explain that a group journal could be arranged in an order of decreasing productivity and revealed that journals which yield most productive articles are coming first and the most unproductive in the last. According to this law the journals are to be grouped into a number of zones each producing a similar number of articles. However the number of journals in each zone will be increasing rapidly. Then the relationship between the zones is 1:a:n2. For the present study the journals are ranked on the basis of their published papers in computer communication research. In this analyzed period, computer communication scientists have produced 9309 articles contributions scattered over 2048 journals.

Table 4 Bradford's Law of Scattering

S.No.	No. of Journals	R. o/p	Total No. of R.o/p	Cum. No. of R.o/p
1	1	219	219	219
2	1	198	198	417
3	1	170	170	587
4	1	89	89	676
5	3	83	249	925
6	1	80	80	1005
7	1	74	74	1079
8	1	71	71	1150
9	1	69	69	1219
10	1	64	64	1283
11	1	63	63	1346
12	2	61	122	1468
13	1	54	54	1522
14	1	52	52	1574
15	1	51	51	1625
16	1	50	50	1675
17	2	46	92	1767
18	3	45	135	1902
19	1	44	44	1946
20	1	43	43	1989
21	1	42	42	2031
22	3	41	123	2154
23	1	38	38	2192
24	3	37	111	2303
25	2	36	72	2375
26	2	35	70	2445
27	3	34	102	2547
28	1	33	33	2580
29	1	32	32	2612
30	2	31	62	2674
31	4	30	120	2794
32	4	29	116	2910
33	1	28	28	2938
34	2	27	54	2992
35	3	26	78	3070
36	6	25	150	3220
37	6	24	144	3364
38	5	23	115	3479
39	7	22	154	3633
40	5	21	105	3738
41	6	20	120	3858
42	7	19	133	3991
43	6	18	108	4099
44	7	17	119	4218
45	3	16	48	4266
46	11	15	165	4431
47	12	14	168	4599
48	10	13	130	4729
49	11	12	132	4861
50	15	11	165	5026
51	19	10	190	5216
52	22	9	198	5414
53	34	8	272	5686
54	38	7	266	5952
55	42	6	252	6204
56	81	5	405	6609
57	91	4	364	6973
58	211	3	633	7606
59	369	2	738	8344
60	965	1	965	9309
	2048	2450	9309	

According to Bradford's formulation, it should be 2:4:16, whereas the observed numbers of journals in the three zones stand as 56:275:1717. Table 4 indicates the observation that small groups of fifty six periodicals (2.73%) were identified in the nuclear or core zone representing 32.14 % of total journals are covered. While the second larger group of 275 (13.42 %) journals provides 3212 (34.5%) article were covered, and the third largest of 1717 (83.83%) journals were yield the next 3105 (33.35%) articles. When this analysis is done for a wider range of periods, the extent of scattering can get increased. Hence the analysis of data clearly discounts Bradford's Law of scattering. It means less than what Bradford formulated and the final zone contains a very large number of journals which assumes to be greater than Bradford's expectations.

Table 5 Bradford's Distribution of Journals

Zone	No. of Journals (%)	No. of Records (%)	Multiplier Factor
1	56 (2.73)	2992 (32.14)	-
2	275 (13.42)	3212 (34.5)	4.91
3	1717 (83.83)	3105 (33.35)	6.24
	2048	9309	5.58

4.5 Authorship Pattern

Table 6 indicates the authorship pattern in computer communication research output. Here the authors are classified according to the number of research contributions by the taken duration.

Table 6 Authorship Patterns in the Area of Computer Communication

Year	Single Author	Double Authors	Triple Authors	Four Authors	Five Authors	Six & above Authors	Total
1971	6	1	2	-	-	1	10
1972	2	1	3	2	-	-	8
1973	5	3	1	1	-	1	11
1974	2	3	1	-	-	2	8
1975	7	3	1	-	-	-	11
1976	4	3	1	-	1	-	9
1977	7	6	3	-	-	2	19
1978	6	3	2	1	-	-	12
1979	6	3	2	-	-	-	11
1980	5	6	3	-	-	-	14
1981	8	10	2	-	1	-	21
1982	10	6	2	-	-	2	20
1983	9	10	3	-	-	1	23
1984	16	6	1	2	-		25
1985	9	7	1	-	-	2	19
1986	9	9	2	1	-	-	21
1987	5	7	1	-	1	-	14
1988	4	6	2	2	-	-	14
1989	6	5	2	-	1	-	14
1990	21	10	6	4	2	1	44
1991	64	87	41	19	11	9	231
1992	84	100	75	27	12	11	309
1993	87	121	88	33	13	21	362

1994	100	135	96	46	15	24	416
1995	95	134	80	36	17	28	390
1996	81	133	73	39	15	38	379
1997	86	156	92	41	30	21	426
1998	88	145	115	50	34	37	469
1999	132	173	118	60	29	33	545
2000	149	199	147	74	29	48	646
2001	119	156	123	60	30	27	515
2002	128	168	120	88	34	54	592
2003	117	192	155	78	50	45	637
2004	107	153	155	94	50	67	626
2005	152	198	191	96	52	76	765
2006	152	199	168	106	49	81	755
2007	150	219	176	128	65	80	818
2008	149	257	208	145	76	110	945
2009	165	253	190	154	68	106	936
2010	155	242	194	141	66	98	913
Total	2507 (20.91)	3528 (29.43)	2646 (22.07)	1528 (12.74)	751 (6.26)	1026 (8.55)	11986

It is noted that out of 11986 research papers envisaged in the study, the double author contributed papers rank first in the order (29.43%). by year - wise analysis indicates that performance of double authored papers are quite impressive during 2008 and 2009. The triple authors' contributions rank second in order (22.07%) in respect to total number of output published during whole period of this analysis. The single author contributed 2507 (20.91%) articles and placed in the third rank, by knowing year-wise after 1999 only single authors contribute more articles. It could be seen collaborate contribution is given the more number of articles compared than the individual contribution.

4.6 Degrees of Collaboration

In order to identify the author productivity and authorship pattern, the analysis of the nature of the researcher's participation in research activity is a prime factor. This study aims at analyzing the degree of collaboration on computer communication research output. It enables one to examine the research trends in terms of author productivity and author pattern. It also aims at explaining the extent to which single-author contributed research output is in relation to group research output. Hence the following discussion considers the same with the testing of collaboration on computer communication research output

It could be observed from the above analysis that the percentage of single authored contributions is less than that of multi authored contributions. It is inferred from the Table 7 that at the aggregate level, the degree of collaboration is 0.79. The period-wise analysis indicates that its level is somewhat less in the first three period (1971-75: 0.63; 1976-80: 0.54; 1981- 85:0.53; 1986-1990: 0.65), and it has shown an increasing trend during the periods 1996-2000 & 2001 - 2005 (0.80). This clearly brings out the high level of pervasiveness of collaborative research on computer communication.

Table 7 Degrees of Collaboration

Year	Single authors		Multi authored		Total	Degrees of Collaboration
	No. of Output	%	No. of Output	%		
1971 - 75	15	0.59	26	0.27	48	0.63
1976 - 80	30	1.19	36	0.37	65	0.54
1981 - 85	48	1.91	56	0.59	108	0.53
1986 - 90	33	1.31	62	0.65	107	0.65
1991 - 95	356	14.2	1279	13.49	1708	0.78
1996 - 00	482	19.22	1929	20.35	2465	0.80
2001 - 05	620	24.73	2512	26.5	3135	0.80
2006 - 10	923	36.81	3579	37.75	4367	0.79
	2507	100	9479	100	11986	0.79

5. CONCLUSION

To sum up, this study can support improvement of evaluating their current situation regarding book selection policy for library professionals. It could be deduced from the above discussion that journal articles predominate over other sources of publications. North American Continent has highest publication and largest total citation scores are there in the field of computer communication and dominate first rank. Followed by the European continent has placed in second rank for both publication output and the total citation scores. By year-wise analysis indicates that performances of double authored papers are quite impressive during 2008 - 2009. Single authored contributions are less than that of multi authored contributions, at the aggregate level, the degree of collaboration is 0.79.

This type of investigation may be useful for understanding the importance of research and development activities, measuring the relative growth and exponential growth rate, scattering of journals and core journals. It helps in making research and development policies for improving the productivity of scientists in various fields.

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