

# **Scholarly Communication Among the Ph.D. Theses in the field of Networking: A Bibliometric Study**

**Mrs. K. Chandra Sena<sup>1</sup>; Dr. M. Doraswamy<sup>2</sup>**

Ph.D. Regular Research Scholar, Department of Library and Information Science,  
Dravidian University, Kuppam – 517 426, Chittoor Dist., Andhra Pradesh<sup>1</sup>; Professor and Head  
Department of Library and Information Science, Dravidian University,  
Kuppam, Andhra Pradesh<sup>2</sup>  
mdoraswamy@gmail.com

## **ABSTRACT**

*The present study is based on 4145 citations, cited in the 35 theses submitted to Acharya Nagarjuna University, Guntur, Andhra Pradesh for the award of the doctoral degree in Computer Science and Engineering in the specialization of Networking. It has been carried out bibliographic form-wise distribution of citations, ranked list of journals, productivity of journals, age-wise and half life period of journals etc. Journals and Proceedings of conference/seminars/conventions/workshops etc. are considered to be the most frequently information source rather than other sources. Distribution of cited journals in the field of networking clearly indicates that 626 journals are contributing to 1527 citations. Few number of journals covering half of the citations range between 1 to 9 journals. Ranked list of journals in specialization of networking shows that the journal entitled 'IEEE Journal of Selected Areas of Communications' from United States contributing highest number of citations. The maximum age of journal citations in the field of networking is 70 years.*

**KEYWORDS:** Bibliometrics, Citation analysis, Bibliometric methods, Scientometric, Networking Journals

## **1. INTRODUCTION**

In an academic research environment, scholarly communications become central part of the process of deliberations. Scholarly communications are carried out using certain channels of communications by scholars and academicians. Most important ones are scholarly journals, conference proceedings, research monographs, dissertations, research reports and personal memoirs. Internet now provides much easier and instant means of connection. Social Media is a boon for any type of communication. The scholarly communication objective is the process of sharing,

disseminating and publishing research findings of academics and researchers so that the generated academic contents are made available at the global academic communities.

Bibliometrics as a method can map the scholarly communication process by tracing the formal communication (articles published in journal and citations). Formal communication is demonstrated to be one of the most important communication channels in scholarly research. Because informal communication is not represented by something as concrete as the written work, the units of analysis are the individual and the group. Self-reports, observation, and questionnaires are the methods to study informal communication but all of these have their inherent problems. Examination of the formal written literature is often accomplished through quantitative bibliometric techniques such as citation analysis. The unit of analysis is most often the journal article. Most of the articles are focus on formal communication by using bibliometric method, and really made great process in the research field. Researchers in bibliometric and scholarly communication fields use models to explain processes to communication or flows of information.

## **2. REVIEW OF LITERATURE**

Gross & Gross (1927) used for the first time this citation analysis as a toll for identifying the core journals in the subject based on counting and citation given at the end of each article from a group of primary journals. Afterwards, a number of such studies were carried out on citations in Ph.D. theses, journals, conference proceedings, books etc. Vishwakaram & Anurag (2015) conducted a study on citation analysis of Doctoral Theses in Computer Science & Engineering submitted to the Department of Computer Science & Engineering, IIT Delhi during the period i.e. 2001-2011. The study found 2316 citations in 25 Ph.D. theses. The study revealed that conference documents were the most preferred sources of information used by the researchers in the field of computer science and engineering, accounting for 34.46% of total citations, followed by books with 27.68% citations. Geetha et al (2016) conducted a study on citation analysis of computer science theses submitted to the top five contributing universities in Shodhaganga electronic thesis repository during the period 2014-15. In this work, 4,490 citations are analyzed to ascertain the authorship patterns, besides the calculation of collaboration coefficient, type of literature, ranking of journals and books, time span, and geography. The study reveals that journals are the most preferred sources of information used by researchers in the field of computer science. The Journal of IEEE occupies the first rank as the most preferred journal having been cited 332 times. Yumnam. & Phuritsabam (2019) conducted a study entitled on citation analysis of doctoral theses in earth science accepted by Manipur University during 1989-2011. The study found that researchers cited journals articles more than other forms. They depended on literature from UK, Netherlands and USA, while English was the predominant language. It was also found that the single-authored papers were more than multi-authored papers and the degree of collaboration was fixed at 0.4003. A majority of the journals cited were published by Elsevier Publishing Company. The journal of Sedimentary Petrology was used more out of the nine journals that were identified as core journals. Bhargav et al. (2020) analysed 5318 citations, cited in the 55 theses submitted to Jawaharlal Nehru Technological University, Hyderabad, Telangana. The findings of the study reveal that the journals are the most preferred sources of information in the thermal engineering filed compared to other sources of information. Distribution of cited journals in the field of thermal engineering clearly indicates that a very small number of journals are contributing to maximum number of citations. Few number of journals covering half of the citations range between 1 to 36 journals.

### 3. OBJECTIVES OF THE STUDY

The objectives of the study are:

- To find out the information sources cited by the researchers of computer science;
- To identify the core journals in the field of networking;
- To find out the productivity of journals in the field of networking; and
- To know the age-wise distribution of citations of journals.

### 4. MATERIALS AND METHODS

In the present study, the data was primarily obtained from doctoral theses in Computer Science and Engineering particularly in the field of Networking. The study examination of 35 doctoral theses submitted by research scholars in specialization of networking in Computer Science and Engineering branch to Acharya Nagarjuna University, Guntur, Andhra Pradesh, India. The researchers have identified 4145 citations for analysis as a part of this study with every thesis contributing 118.43 citations on average. The authors studied all the appended citations as appearing in the submitted theses in the specialization of networking. The authors examined the citations and recorded findings on significant aspects like author types, bibliographic forms, name of the journal, year of publication etc. Ulrich's International Periodical Directory was referred to obtain information on cited journals, such as the publishing country, the relevant subject, which was then transcribed in the reference cards and later entered into Ms-Excel work sheet. Finally, the data processing was done through a tool i.e. the Statistical Package for Social Sciences (SPSS).

### 5. RESULT AND DISCUSSIONS

#### 5.1 Bibliographic Forms

The distribution of cited literature in the field of networking in different bibliographic forms is shown in Table 1.

**Table 1: Distribution of cited literature in the field of networking in different bibliographic forms**

<b>Bibliographic forms</b>	<b>Number of Citations</b>	<b>Percentage</b>
Journals	1527	36.84
Conferences/Seminars/Workshops/ Symposiums etc.	1245	30.04
Books	998	24.08
Websites	146	3.52
Reports	114	2.75
Theses	48	1.16
Others	42	1.01
Lecture notes	25	0.60
<b>TOTAL</b>	<b>4145</b>	<b>100.00</b>

(Others: Patents, standards, newsletters, newspapers, reviews, meetings etc.)

It is obvious from the Table 1 that journals contribute the highest number of citations, accounting for 36.48 percent of the total citations. Conferences/Seminars/Workshops/Symposiums etc. secured the second highest number of citations, accounting for 30.04 percent of the total citations, followed by books (24.08%), websites (3.52%), reports (2.75%), thesis (1.16%), and lecture notes (0.40%). The remaining 1.01 percent of citations is found in other

bibliographic forms. Hence, it can be concluded from the table that the research scholars in the field of networking use journals and conference/seminar proceedings mostly for their research work.

## 5.2 Rank List of Cited Journals in the field of networking

The rank list of cited journals in the field of networking is exhibited in Table 2.

**Table 2: Ranks list of journals in the field of networking**

S.No	Name of the journal	Citations			Cumulative	
		Rank	No	%	No	%
1	IEEE Journal on Selected Areas of Communications	1	42	2.750491	42	2.750491
2	IEEE Transactions on Communications	2	38	2.48854	80	5.239031
3	IEEE/ACM Transactions on Networking	3	28	1.833661	108	7.072691
4	IEEE Transactions on Software Engineering	4	22	1.440733	130	8.513425
5	IEEE Communications Magazine	5	21	1.375246	151	9.88867
6	Atmospheric Environment	6	19	1.24427	170	11.13294
7	Communications of the ACM	6	19	1.24427	189	12.37721
8	IEEE Wireless Communications	6	19	1.24427	208	13.62148
9	IEEE Transactions on Knowledge and Data Engineering	7	18	1.178782	226	14.80026
10	IEEE Transactions on Mobile Computing	7	18	1.178782	244	15.97904
11	International Journal of Bank Marketing	7	18	1.178782	262	17.15783
12	IEEE Transactions on Pattern Analysis and Machine Intelligence	8	17	1.113294	279	18.27112
13	IEEE Transactions on Systems, Man and Cybernetics	8	17	1.113294	296	19.38441
14	Proceedings of the IEEE	9	16	1.047806	312	20.43222
15	IEEE Transactions on Image Processing	10	15	0.982318	327	21.41454
16	Operations Research	10	15	0.982318	342	22.39686
17	Journal of Applied Probability	11	14	0.91683	356	23.31369
18	Journal of environmental Quality	11	14	0.91683	370	24.23052
19	IEEE Transactions on Vehicular Technology	11	14	0.91683	384	25.14735
20	IEEE Transactions on Information Theory	11	14	0.91683	398	26.06418
21	Journal of Molecular Biology	12	12	0.785855	410	26.85003

22	IEEE Transactions on Wireless Communications	12	12	0.785855	422	27.63589
23	Energy Policy	13	11	0.720367	433	28.35625
24	IEEE Transactions on Parallel and Distributed System	13	11	0.720367	444	29.07662
25	Advances in Applied Probability	14	10	0.654879	454	29.7315
26	IEEE Network Magazine	14	10	0.654879	464	30.38638
27	IEEE Transactions on Circuits and Systems for Video Technology	14	10	0.654879	474	31.04126
28	IEEE Transactions on Computers	14	10	0.654879	484	31.69614
29	IEEE Transactions on Signal Processing	14	10	0.654879	494	32.35101
30	IEEE Personal Communications	15	9	0.589391	503	32.94041
31	International Journal of Computer Science and Information Technologies	15	9	0.589391	512	33.5298
32	Nature	15	9	0.589391	521	34.11919
33	IEEE Transactions on Neural networks	15	9	0.589391	530	34.70858
34	IEEE Computer	16	8	0.523903	538	35.23248
35	International Journal of Computer Science and Network Security	16	8	0.523903	546	35.75638
36	Journal of Molecular Biology	16	8	0.523903	554	36.28029
37	Pattern Recognition Letters	16	8	0.523903	562	36.80419
38	Ad Hoc Networks	17	7	0.458415	569	37.26261
39	Computer Communications	17	7	0.458415	576	37.72102
40	Computer networks	17	7	0.458415	583	38.17944
41	Electronics Letters	17	7	0.458415	590	38.63785
42	Expert Systems with Applications	17	7	0.458415	597	39.09627
43	IEEE Internet Computing	17	7	0.458415	604	39.55468
44	International Journal of Computer Applications	17	7	0.458415	611	40.0131
45	Machine Learning	17	7	0.458415	618	40.47151
46	Wireless Networks	17	7	0.458415	625	40.92993
47	IEEE Transactions on Industrial Electronics	18	6	0.392927	631	41.32285
48	Internet Research	18	6	0.392927	637	41.71578
49	Journal Machine Learning Research	18	6	0.392927	643	42.10871
50	Journal of Computer Science	18	6	0.392927	649	42.50163
51	Management Information Systems	18	6	0.392927	655	42.89456
52	Nucleic Acids Research	18	6	0.392927	661	43.28749
53	Protein Engineering	18	6	0.392927	667	43.68041

54	Proteins: Structure, Function and Genetics Supplement	18	6	0.392927	673	44.07334
55	Science of the total Environment	18	6	0.392927	679	44.46627
56	Agriculture, Ecosystems & Environment	19	5	0.327439	684	44.79371
57	European Journal of Operational Research	19	5	0.327439	689	45.12115
58	IEEE Transactions on Multimedia	19	5	0.327439	694	45.44859
59	International Journal of Computer Theory and Engineering	19	5	0.327439	699	45.77603
60	International Journal of Greenhouse gas control	19	5	0.327439	704	46.10346
61	Journal of Parallel and Distributed Computing	19	5	0.327439	709	46.4309
62	Pattern Recognition	19	5	0.327439	714	46.75834
63	Protein Science	19	5	0.327439	719	47.08578
64	IEEE Transactions on Information Forensics and Security	19	5	0.327439	724	47.41322
88	24 journals with 4 citations	20	96	6.28684	820	53.70006
134	46 journals with 3 citations	21	138	9.03732	958	62.73738
211	77 journals with 2 citations	22	154	10.08513	1112	72.82251
<b>626</b>	415 journals with 1 citation	23	415	27.17747	<b>1527</b>	<b>99.99998</b>

Table 2 shows that the journal citations cited by researchers in the field of networking are scattered in 626 journals. Among them 'IEEE Journal on Selected Areas of Communication' gets first rank for being cited more number of times with 2.75 percent of citations, followed by 'IEEE Transactions on Communications' (2.49%), 'IEEE/ACM Transactions on Networking' (1.83%), 'IEEE Transactions on Software Engineering' (1.44%) and 'IEEE Communications Magazine' (1.38%).

### 5.3 Productivity of Journals in the field of networking

The productivity of cited journals in the field of networking is exhibited in Table 3.

**Table 3: Productivity of Journals in networking literature**

S.No	Percentage of Citations	No. of Citations	No. of Journals covered	Percentage of Journals	Average Productivity of articles
1	0 – 25%	384	19	3.05	20.21
2	26 – 50%	380	55	15.97	6.91
3	51 – 75%	382	171	27.32	2.23
4	76 – 100%	381	381	60.86	1.00
<b>Total</b>		<b>1527</b>	<b>626</b>	<b>100.00</b>	<b>2.44</b>

Table 3 shows that in the field of networking the first 25 percent of citations are from the 19 journals, thus signifying their high rate of productivity. The average rate of productivity of journals in the first group is 20.21 articles, followed by second group is 6.91 articles, third group is 2.23 articles and the last group is only 1.00 articles. Hence, this shows the concentration of more number of citations in a few i.e. 19 journals.

#### **5.4 Age-wise distribution of citations of journal articles**

The distribution of citations of journal articles in the field of networking according to the age-wise is shown in Table 4.

**Table 4: Age-wise citations of journals in the field of networking**

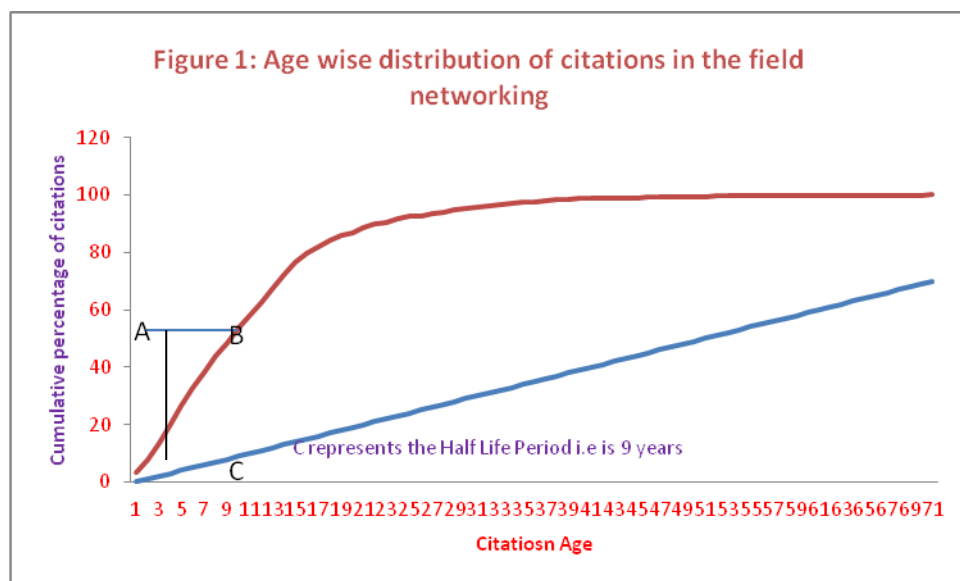
<b>Age</b>	<b>Number of citations</b>	<b>Cumulative Citation</b>	<b>Percentage</b>	<b>Cumulative percentage</b>
0	48	48	3.143418	3.143418
1	71	119	4.64964	7.793058
2	90	209	5.89391	13.68697
3	100	309	6.548788	20.23576
4	98	407	6.417813	26.65357
5	92	499	6.024885	32.67845
6	82	581	5.370007	38.04846
7	91	672	5.959398	44.00786
8	65	737	4.256713	48.26457
9	84	821	5.500982	53.76555
10	66	887	4.3222	58.08775
11	72	959	4.715128	62.80288
12	65	1024	4.256713	67.05959
13	77	1101	5.042567	72.10216
14	69	1170	4.518664	76.62082
15	44	1214	2.881467	79.50229
16	39	1253	2.554028	82.05632
17	30	1283	1.964637	84.02096
18	26	1309	1.702685	85.72364
19	18	1327	1.178782	86.90242
20	23	1350	1.506221	88.40864
21	21	1371	1.375246	89.78389
22	12	1383	0.785855	90.56974
23	19	1402	1.24427	91.81401
24	11	1413	0.720367	92.53438
25	4	1417	0.261952	92.79633
26	13	1430	0.851343	93.64767
27	6	1436	0.392927	94.0406
28	12	1448	0.785855	94.82646
29	6	1454	0.392927	95.21938
30	7	1461	0.458415	95.6778

31	5	1466	0.327439	96.00524
32	6	1472	0.392927	96.39817
33	9	1481	0.589391	96.98756
34	5	1486	0.327439	97.315
35	5	1491	0.327439	97.64244
36	4	1495	0.261952	97.90439
37	7	1502	0.458415	98.3628
38	3	1505	0.196464	98.55927
39	3	1508	0.196464	98.75573
40	2	1510	0.130976	98.88671
41	0	1510	0	98.88671
42	1	1511	0.065488	98.95219
43	1	1512	0.065488	99.01768
44	0	1512	0	99.01768
45	1	1513	0.065488	99.08317
46	1	1514	0.065488	99.14866
47	0	1514	0	99.14866
48	0	1514	0	99.14866
49	1	1515	0.065488	99.21415
50	3	1518	0.196464	99.41061
51	2	1520	0.130976	99.54158
52	0	1520	0	99.54158
53	2	1522	0.130976	99.67256
54	1	1523	0.065488	99.73805
55	0	1523	0	99.73805
56	0	1523	0	99.73805
57	2	1525	0.130976	99.86902
58-60	0	1525	0	99.86902
61	1	1526	0.065488	99.93451
62-69	0	1526	0	99.93451
70	1	<b>1527</b>	0.065488	<b>100</b>

### 5.5 Half-life of Citations

A graph is plotted by taking into account the age of citations (in years) on X-axis and the cumulative percentage of citations on Y-axis to determine the half-life of citations. A line parallel to the X-axis is drawn from a point, preferably 'A' representing the half of the citations to meet the curve say 'B'. Then, perpendicular to X-axis (BC), this line is drawn from point to meet the X-axis at C. 'C' represents the half-life period of citations. So, the observed half-life period is 9 years as exhibited in Figure 1.





## 5. DISCUSSION

Bibliometric analysis is an analytical tool which deals with reference citation of research articles undertaken by research scholars. The present study has examined various critical aspects such as bibliographic forms, ranking list of journals, productivity of journals, age-wise distribution of journals and half-life period journals etc. The findings of the study indicate that journals contribute the highest number of citations, accounting for 36.84% of the total number of citations. This finding not agrees with Vishwakaram & Anurag (2015) conducted a study on citation analysis of Doctoral Theses in Computer Science & Engineering which revealed that conference documents were the most preferred sources of information, accounting for 34.46% of total citations. As far as journals usage is concerned, the researchers in the field of networking mostly preferred journal entitled ‘*IEEE Journal on Selected Areas of Communication*’. In the first group, the average rate of productivity of journals is 20.21 articles (refer Table 3), which shows the concentration of citations found in a few journals (19). The studies on aging or frequency of documents usually assess the decline in the use of a representative set of documents over time. Here, it is also important to note that growth in the literature of a particular field plays a dominant role in age distribution. Such studies help the library professionals in deciding the documents that are kept or discarded so that a proper need-based collection in libraries is maintained. In order to compare the speed of decay in different subjects, ‘half-life’ is used as a measure. Half-Life refers to the time during which half of the current active literature is published. The present study observes that the half-life period for journal citations is 9 years in the field of networking. This finding is closely agrees with Bhargav et al (2020) ranking and scattering of journals in the field of thermal engineering which revealed that the half life period for journals citations is 11 years.

## 6. CONCLUSION

The present study was undertaken to study the bibliometric analysis in literature working by researchers in the field of networking. In this study, citation analysis techniques were applied to analyze the citations in general. The present study examined citations numbering 4145 appearing in 35 doctoral theses submitted by researchers in the field of networking. Various bibliographic forms, like periodicals, conference/seminar/workshop proceedings, books, reports, theses/dissertations, reports websites etc. are found as referred by researchers. In this specialization, amongst all the bibliographic forms, journals and conference/seminar proceedings are the most preferred sources in networking field. The finding of the study underscores the dominant habit among researchers to use journals most

frequently, justifying its indispensability for quality research and academic pursuits. No wonder, journals have emerged as the most primary and authentic channels of communication for scientific information sharing and dissemination. The distribution of cited journals in the field of networking clearly indicates that a few journals seem to be contributing to the maximum number of citations as reflected in the findings from the study of select specialization of theses in networking, with a small number of journals even accounting for half of the citations ranging between 1 and 9 journals (refer Table 3). In the field of the networking, the most frequently cited journal is 'IEEE Journal on Selected Areas of Communication'. The oldest journal (70 years old) referred by researchers in the field of networking is 'Journal of the IEE.

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