

A SCIENTOMETRIC ANALYSIS OF THE LITERATURE OF CLOUD COMPUTING

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Abstract

The study presents the growth and the contribution of research literature output of cloud computing. The data for the study was taken from the Web of Science on-line database published by the Institute for Scientific information (ISI) for a period of 35 years 1980 to 2014. The study analysis growth of literature, prolific author, source wise The pattern of communications of authors and scattering of their research output in different journals, The study shows that there was a gradual growth of publications during 2007-2014. An average research output in cloud computing are 287 articles per year. Authors contributed (90.70 %) research articles. Astronomy & Astrophysics Journal has the highest number of publication with 372 papers. USA is found to be the highest country that contributed (2707 articles). Science Technology stood first rank with 7128 publications with 129411 citation and 146 h-index.

Keywords: *Cloud computing, Data Analysis, Bibliometric Study, Scientometric study,*

Introduction

Cloud computing is a general term for anything that involves delivering hosted services over the Internet. These services are broadly divided into three categories: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS). The name cloud was inspired by the symbol that's often used to represent the Internet in flowcharts and diagrams.¹ Scientometrics can be defined as the “quantitative study of science, communication in science, and science policy” (Hess, 1997, 75).² Bibliometric techniques using references made to other documents can be applied to establish statistical models of scholarly communication flow. For example, citations can be used to map relationships between documents, between journals or other channels of scholarly communications. It also can be clustered to identify the flow of topics within and among disciplines (Borgman, 1999, p. 118).³

Review of Literature

There are two studies were conducted to measure the research output of cloud computing. The study analyse the quantum literature output in the area of cloud computing from 2008 - 2012 from the Web of Knowledge. The downloaded 2207 data were analysed. This objective of this article is to identify and analyse the rate and growth of scholarly publication, analyse the authorship pattern and to examine the publication type of research,

application of Lotka’s Law, Creating Label View, Cluster View and finding the Citation map. This study provides extensive insights into publication patterns, research impact and research productivity. Furthermore, it explores the interplay of related subtopics by analyzing keyword clusters. The results of this study provide a better understanding of patterns, trends and other important factors as a basis for directing research activities, sharing knowledge and collaborating in the area of cloud computing research. There were no studies for conducted for long period, but these studies will comprehensively analysis the research output of cloud computing for 35 years.

Objectives of Study

The specific objective of the present study addresses the following aspects:

1. To identify the contribution of prolific authors
2. To identify the choice of journals of the researchers for the publication of their research findings.
3. To find out the year-wise growth of publications in cloud computing.
4. To find out the language wise distribution of publication.
5. To examine domain wise contribution.
6. To study the channel of communication used by scientists.
- 7 To identify the source of country wise distribution of publication.

Methodology

The data for the study was taken from the Web of Science (WoS) database published by Institute for Scientific Information (ISI). To hunt all records published by authors, an advanced search query was submitted by defining the term cloud computing time span 1980-2014. This means those records having term cloud computing published during 1980-2014 the text file were retrieved and analyzed with HistCite Software and MSEXcel.

Results and Discussion

Growth of Publication

Table 1 depicts the year wise contribution of articles. There are total 7175 publications published in cloud computing during 1980- 2014. It is found that the highest numbers of articles (1342) were published in the year 2014 while the least number of articles (6) were brought out in the year 1990. The articles published in the year 2009 have yielded the highest number of citations (9513) for 139 articles whereas the least number of citations (87) were found in the year 1990 for 6 articles. Over all citations per articles are counts to be 18.0568. It may be observed from the table that there is a fluctuation in the contributions of the papers during 1991 to 1996. There is a gradual growth in the number of publications during 2007 to 2014. An average research output in cloud computing are 287 articles per year.

Table -1 : Year Wise Distribution Of Research Output Of Cloud Computing

Sr.	Year	No. of Articles	Citation	%	h -index
1.	1990	6	87	0.08	4

2.	1991	84	5078	1.17	30
3.	1992	82	4500	1.14	32
4.	1993	98	5885	1.36	38
5.	1994	97	5626	1.35	37
6.	1995	110	4674	1.53	38
7.	1996	117	6858	1.63	44
8.	1997	121	6342	1.68	45
9.	1998	141	7743	1.96	42
10.	1999	124	5089	1.72	39
11.	2000	120	6643	1.67	42
12.	2001	126	4993	1.75	38
13.	2002	119	4393	1.65	38
14.	2003	139	9513	1.93	43
15.	2004	151	4088	2.10	33
16.	2005	167	7801	2.31	40
17.	2006	146	4001	2.03	34
18.	2007	174	5246	2.42	38
19.	2008	192	4872	2.67	36
20.	2009	282	5276	3.93	35
21.	2010	420	6414	5.85	35
22.	2011	701	5725	9.77	31
23.	2012	977	4688	13.61	27
24.	2013	1139	3333	15.87	18
25.	2014	1342	690	18.70	7
	Total	7175	129558	100	844

Types of Publications

It is evident from table 2 that the article published in the subject cloud computing are categorized into nine types namely articles, Meeting, Reviews, Editorials, Abstracts, News, letters, Correction. Out of nine, Out of these seven types, (90.70 %) fall under the category

of research articles followed by meeting (3.49%) Review (2.62) editorial (2.54%) Abstract (0.23) News (0.22%) Letter (0.12%) Book (0.06%) correction (0.01%) Mostly, it is deduced from the study that authors are more interested in contributing research articles than any other category or, the journal has a specific percent to this category of contributions obviously for their intrinsic value of qualitative research.

Table -2 Types of Publication of Literature of Cloud Computing

Sr.	Name of Document	No. of Articles	Citation	%	h -index
1.	Articles	6952	113984	90.70	135
2.	Meeting	267	3598	3.49	31
3.	Review	201	14455	2.62	50
4.	Editorial	195	586	2.54	14
5.	Abstract	18	0	0.23	0
6.	News	17	201	0.22	2
7.	Letter	9	313	0.12	7
8.	Book	5	51	0.06	2
9.	Correction	1	63	0.01	1
	Total	7665	133251	100	242

Scattering of Articles in Different Journals

Table 3 explains the top ten journals in different discipline of cloud computing. The cumulated records for the 35 years period revealed that, a sum of total journals has 1805 papers. Astronomy & Astrophysics Journal has highest number of publication with 372

papers followed by Astrophysics Journal with 370 papers which have received the highest citation with 23588 records and also has the highest h index (83) followed by Journal of Geophysics Research Atmosphere with 265 articles. It is identified from the above analyses, the Astronomy & Astrophysics is leading journal with 372 articles.

Table- 3 Scattering of Articles in different Journals

Sr.	Name of Source Title	No. of Articles	Citation	h - index
1.	Astronomy & Astrophysics	372	15394	62
2.	Astrophysics Journal	370	23588	83
3.	Journal Of Geophysics Research Atmosphere	265	9097	49
4.	Future Generation Computer System The International journal of GRID Computing and Escience	181	1550	18
5.	Monthly Notices of The Royal Astonomical Society	173	9227	40
6.	Journal of Astropheric Sciences	108	4901	37
7.	Journal of Super Computing	103	237	7
8.	IEEE Transaction on Parallel and Distributed Systems	83	471	10
9.	Journal of Climate	78	2369	28
10.	Atmospheric Chemistry and Physics	72	2300	23

Most Prolific Authors

The most prolific authors of the subject cloud computing have been identified and ranked from greater to lesser contribution. Table 4 it is found that Buyya R (1208 articles) is found to be the most prolific author among the contributors with 53 articles. Second in the

rank was Yang P. with (44 articles) Third Liou K N with (36 articles) value measured; Followed by the Li j (35 articles); Chen J J (30 articles); respectively. It could be identified from this analysis, the author Buyya R. has a higher frequency of incidence of his name in the author of the records.

Table – 4 Most prolific Authors

Sr.	Name of Authors	No. of Articles	Citation	h -index
1.	Buyya R.	53	1208	14
2.	Yang P.	44	1595	21
3.	Liou K N	36	2429	18
4.	Li J	35	425	8
5.	Chen J J	30	168	8
6.	Liu X	24	256	8
7.	Barker H W	24	956	16
8.	Wang J	23	326	7
9.	Wang C	23	358	10
10.	Minnis P	22	1256	15

Country Wise Distribution

The geographical distribution of contributors is presented in Table 5. It is found the sample total of 7665 articles. USA is found to be the highest country that contributed (2707 articles). China ranked second with 897 (articles). Germany stood third rank with 610 articles. France found fourth rank contributed 604 articles.

Table- 5 Country wise distribution of Literature

Sr.	Name of Countries	No. of Articles	Citation	h -index
1.	USA	2707	74927	122
2.	Peoples R China	897	3417	28
3.	German	610	22520	67
4.	France	604	21939	65
5.	England	506	14095	58
6.	Italy	399	11351	55
7.	Canada	358	8508	45
8.	Spain	333	4695	35
9.	Australia	326	4679	36
10.	Taiwan	264	1029	15

Domain Wise Distribution of Publications

The records collected from the Web of Science database were found in three domains and they are listed in Table 6. The highest 99.04 % h index 146 of articles were found under of domain Science and Technology followed by Social Sciences 0.95 %, Arts and Humanities 0.01%.

Table-6 Domain wise distribution of Publications

Research Domain					
Sr.		No. of Articles	Citation	%	h -index
1.	Science and Technology	7128	129411	99.04	146
2.	Social Sciences	68	519	0.95	10
3.	Arts Humanities	1	0	0.01	0

Language Wise Distributions

Analysed of language wise publication of research output in any discipline is a key factor of communication of research information. Generally English is the medium of research communication as it is widely recognized all over the world. The table 7 presents data of totally ten languages wise distribution in cloud communication research output. It is found from the table that, English language has the highest number of publication 6884 articles which has received the highest citation 129542 and has highest h-index 146. Authors contributed 450 papers in Korean Languages occupied the second place. Authors contributed below 22 papers contributed in rest of the languages Spanish, Portuguese, Chinese, German, French, Russian etc. languages.

Table -7 Language wise distributions

Sr.	Name of Language	No. of Articles	Citation	h -index
1.	English	6884	129542	146
2.	Korean	450	6	1
3.	Spanish	22	3	1
4.	Purtuguese	11	5	1
5.	Chinese	9	63	1
6.	German	7	3	1
7.	French	6	9	2
8.	Russian	5	26	4

9.	Polish	2	0	0
10.	Italian	1	0	0

Conclusion

There are total 7175 publications published in cloud computing during 1980- 2014. It is found that the highest numbers of articles (1342) were published in the year 2014 while the least number of articles (6) were brought out in the year 1990. There is a gradual growth in the number of publications during 2007 to 2014. An average research output in cloud computing are 287 articles per year. It is found that Buyya R (1208 articles) is found to be the most prolific author among the contributors with 53 articles. The article published in the subject cloud computing are categorized into nine types namely articles, Meeting, Reviews, Editorials, Abstracts, News, letters, Correction. Out of nine, Out of these seven types, (90.70 %) fall under the category of research articles. Astronomy & Astrophysics Journal has the highest number of publication with 372 papers followed by Astrophysics Journal with 370 papers which have received the highest citation with 23588 records. . It is found the sample total of 7665 articles. USA is found to be the highest country that contributed (2707 articles). It is found from the table that, English language has highest number of publication 6884 articles which has received the highest citation 129542 and has the highest h-index 146. Cloud Computing has contributed significantly to three main domains: Science Technology stood first rank with 7128 publications with 129411 citation and 146 h-index. The trends towards collaborative research is gaining currency day-by-day. Every work of researchers

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depends purely on the library because it contains more source information. The researchers have become an important entity wherein more and more researchers help to make it innovative.

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