

# IEEE Transaction on Semiconductor Manufacturing (1998-2007): A Bibliometric Study

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**Abstract** – Bibliometric analysis of journals citations collected from IEEE Transaction on Semiconductor Manufacturing has been carried out to determine the use pattern of literature in the area. The study covers ten volumes (Volume 11-20) containing 40 issues of Semiconductor Manufacturing during the years 1998-2007. The data collected was recorded on to sheets with predesigned columns. All the required data like cost of journals, title of article, number of authors, number of pages, number of references and their forms were tabulated. The study indicates that research collaboration in the field of Applied Physics is becoming more collaborative than the solo research. This can be attributed to the interdisciplinary nature of the subject.

**Keywords:** Bibliometric Analysis, Semiconductor Manufacturing

## I. INTRODUCTION

Bibliometric is a simple statistical method or quantitative studies are useful indicators of scientific productivity, trends and emphasis of research in various discipline and researcher performance for publication. It shows interesting information about knowledge producers and their interactions. Bibliometric studies can be applied to any discipline to find out trends and growth of the literature. The selection of source for collection of the data is very important in such studies. Since journal articles include current research, usually journals are considered as a source for testing. Studies of Journals citations may be useful in decision-making process of a library regarding acquisition of reading materials and provision of better service to its users. Although sizeable work on bibliometrics has been carried out in the field of Applied Physics, there has been little effort towards bibliometric analysis of online journals. So that present study chooses IEEE Transaction on Semiconductor Manufacturing for bibliometric Analysis.

## II. ABOUT IEEE TRANSACTIONS ON SEMICONDUCTOR MANUFACTURING

It is electronic published quarterly by the Institute of Electrical and Electronics Engineers (IEEE). This publication's main focus on innovations of interest to the

integrated circuit manufacturing researcher and professional. Includes advanced process control, equipment modeling and control, yield analysis and optimization, defect control and manufacturability improvement. It is also addresses the factory modeling and simulation, production planning and scheduling, as well as environmental issues in semiconductor manufacturing.

## III. OBJECTIVES OF THE STUDY

1. Rising cost of Journals;
2. Year-wise distribution of Articles and Citation;
3. To identify the forms of documents mostly used;
4. To find number of pages per articles;
5. To derive the Authorship pattern and Degree of Collaboration;
6. To find out a ranked list of highly cited Author / Authors;
7. To find out a ranked list of highly cited Journals.

## IV. METHODOLOGY

The study covers ten volumes (Volume 11-20) containing 40 issues of Semiconductor Manufacturing during the years 1998-2007. The data collected was recorded on to sheets with predesigned columns. All the required data like cost of journals, title of article, number of authors, number of pages, number of references and their forms were tabulated. The data was subjected to the analysis as per the objectives of the study. All the relevant data is arranged systematically supported with table.

## V. RESULTS AND DISCUSSION

Bibliometric analysis of journals citations collected from IEEE Trans. on Semiconductor Manufacturing has been carried out to determine the use pattern of literature in the area. It is observed that major citations are from Journals literature although citations from books, conference proceedings, patent, report, standards, and thesis are also found. Among the citations from journal literature majority are from the foreign journals.

TABLE I RISING COST OF JOURNALS

Sl. No.	Vol. No.	Year	Cost in USD (\$)
1	11	1998	245
2	12	1999	265
3	13	2000	300
4	14	2001	321
5	15	2002	351
6	16	2003	380
7	17	2004	415
8	18	2005	447
9	19	2006	474
10	20	2007	499

Table I represents the rising cost of journals it is very clear that the subscription rates are increasing rapidly. The subscription cost of the journal in 1998 was \$ 245.00 in 1999 it rose to \$ 265.00 and in 2000 it became \$ 300.00 and finally in 2007, \$ 499.00.

TABLE II YEAR WISE DISTRIBUTION OF ARTICLES AND REFERENCES

Sl No.	Vol. No.	Years	No.of References							Total Article	%
			0	01-10	11-20	21-30	31-40	41-50	>50		
1	11	1998	0	13	30	23	3	1	1	71	11.16
2	12	1999	0	12	26	11	3	1	0	53	8.33
3	13	2000	0	13	26	8	3	0	2	52	8.18
4	14	2001	0	12	18	6	2	2	2	42	6.60
5	15	2002	0	25	25	10	2	1	0	63	9.78
6	16	2003	0	28	28	18	8	0	0	82	12.89
7	17	2004	0	26	29	14	4	1	0	74	11.52
8	18	2005	0	25	38	12	4	2	3	84	13.21
9	19	2006	0	6	20	16	6	2	2	52	8.18
10	20	2007	0	16	28	8	8	2	1	63	9.91
		Total	0	176	268	126	43	12	11	636	
		%	0.00	27.67	42.14	19.57	6.76	1.89	1.73		99.76

Table II shows that 636 articles those in which reference are 42.14 % article are with 11 to 20 references i.e. maximum and no article were found without reference. Out of 636 articles, 1 to 10 references are in 176 articles, 21 to 30 references are in 126 articles, 31 to 40 references are in 43 articles, 41 to 50 references are in 12 articles & more than 50 references are in 11 articles. It is also shown that total papers in "Semiconductor Manufacturing" were 636. The maximum number of 84 papers were published in 2005 while minimum number of papers were published in 2001 i.e. 42.

Table III shows the Forms of Documents in Semiconductor Manufacturing during 1998-2007. Its data shows the publication or form of document i.e. books / journals / conference proceedings / report / thesis / reference books / webliography etc. From the table, it is very clear that the journals were cited in majority i.e 5069 (45.26 %) journals out of total 11192 citation the maximum no. of journals were cited in 2007 i.e.661 while minimum is in 2002 i.e. 395.

No. of conference proceedings, symposium, seminar and meeting were cited during 1998 to 2007 is 3173 which is 28.35 % of the total citation. The maximum no. of above reference were cited in 2005 i.e. 478 while only 164 were cited in 2001. No. of books cited during 1998 to 2007 is 1305 which is 11.66 % of the total citation. The maximum no. of books cited in 1998 i.e. 224 while only 88 books in 2007. The other citations have i.e. 343 letters, 182 thesis & dissertations, 158 webliography, 145 reference books, 137 patents/standard/manual, 83 reports& 597 others form

TABLE III FORM OF DOCUMENTS

Sl No.	Vol. No.	Years	Books	Conference/ Seminar / Symp. / Meetings	Report	Thesis/ Dissert ation	Patent/ Standard / Manual	Refere nce Books	Letter	Webog raphy	Govt. Pub. Unpub lished Doc/ Others	Journals	Total	%
1	11	1998	224	347	9	32	11	29	35	0	120	519	1326	11.82
2	12	1999	141	191	1	17	9	17	18	6	37	399	836	7.47
3	13	2000	110	308	4	15	11	12	20	1	56	410	947	8.46
4	14	2001	114	164	12	9	14	10	34	7	67	396	827	7.39
5	15	2002	127	254	12	22	12	24	18	8	71	395	943	8.43
6	16	2003	135	426	15	17	10	12	39	18	65	616	1353	12.09
7	17	2004	113	386	7	19	16	22	28	28	59	481	1159	10.36
8	18	2005	146	478	10	20	34	11	52	36	62	620	1469	13.10
9	19	2006	107	285	8	16	13	5	35	27	32	572	1100	9.83
10	20	2007	88	334	5	15	7	3	64	27	28	661	1232	11.01
		Total	1305	3173	83	182	137	145	343	158	597	5069	11192	
		%	11.66	28.35	0.74	1.63	1.22	1.30	3.06	1.41	5.33	45.26		99.96

of documents. The maximum no. of citation: letter i.e. 64 in 2007, thesis i.e. 32 in 1998, webography i.e. 36 in 2005, reference books i.e. 29 in 1998, patent/ standard/manual i.e. 34 in 2005, report i.e. 15 in 2003.

The minimum no. of citation: webography i.e. nil (0) in 1998, report i.e. 1 in 1999, reference books i.e. 3 in 2007, patent / standard/manual i.e. 7 in 2007, thesis i.e. 9 in 2001 & letter i.e. 18 in 2002. There are the maximum number of citation were cited in 2005 i.e. 1469, while the minimum is in 2001 i.e. 827 & no patent were cited in 2000.

TABLE IV LENGTH OF ARTICLE

Length of article (Pages)	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	No. of Articles	%
1-5	5	6	6	4	10	13	8	10	1	4	67	10.53
6-10	46	33	31	26	41	58	50	60	37	41	423	66.51
11-15	16	14	15	8	12	10	16	13	12	17	133	20.91
16-20	3	0	0	3	0	1	0	1	2	1	11	1.73
21-25	1	0	0	1	0	0	0	0	0	0	2	0.31
26-30	0	0	0	0	0	0	0	0	0	0	0	0.00
>30	0	0	0	0	0	0	0	0	0	0	0	0.00
	71	53	52	42	63	82	74	84	52	63	636	99.99

The length of articles and the no. of pages of article as shown in Table IV. The table shows that the maximum length of articles is 6-10 pages. It is also observed that the average length of articles varied from a minimum of 21-25 pages.

“Writing makes an exact man” said by Bacon. The importance of writing and development of writing skill has been recognized from time immemorial, but this aspect has assumed greater importance in this age of information explosion. The author has a key role in communication of information. The authors have to share the responsibility for

quick dissemination of information from the source to the user. The productivity of the scientific community is subject to a number of factors, one of which is the increase in multiple authorship.

The approach taken here is an examination of the distribution of single and multiple authorship. The approach taken here is an examination of the distribution of single and multiple authorship in the field of physics analysis of Semiconductor Manufacturing during 1998 – 2007.

TABLE V AUTHORSHIP PATTERN

Sl. No.	Volume No.	Year	Number of Authors				Total	%
			One Author	Two Authors	Three Authors	More Than 3 Authors		
1	11	1998	3	21	21	26	71	11.16
2	12	1999	1	14	13	25	53	8.33
3	13	2000	4	11	14	23	52	8.18
4	14	2001	0	13	11	18	42	6.60
5	15	2002	3	19	15	26	63	9.91
6	16	2003	7	19	16	40	82	12.39
7	17	2004	7	10	22	35	74	11.64
8	18	2005	7	18	15	44	84	13.21
9	19	2006	5	12	11	24	52	8.18
10	20	2007	6	17	14	26	63	9.91
		Total	43	154	152	287	636	
		%	6.27	24.21	23.90	45.13		99.51

Table VI shows that out of 636 articles published, 45.13% are of more than three authors, 24.21 % are two authors, 23.90 % are three authors and only 6.27 % of articles are contributed by one authors.

In order to determine extent of collaboration in quantitative terms the formula given by K. Subramanyam has been used.

$$C = \frac{Nm}{Nm + Ns}$$

Where

- C = Degree of collaboration in a discipline
- Nm = Number of multiple authored papers
- Ns = Number of single authored papers

$$C = \frac{593}{593 + 43} = \frac{593}{636} = .932$$

Thus the degree of collaboration in Semiconductor Manufacturing is 0.932%. This brings out clearly the prevalence of non solo research in the field.

TABLE VI MOST CITED AUTHORS (5 OR MORE) OF ARTICLES

Rank	Author	Citation
1	Gary S. May	11
2	Anthony J. Walton,	9
2	Duane S. Boning	9
3	Arthur Tay	8
3	Costas J. Spanos	8
3	WengKhuen Ho,	8
4	Stewart Smith	7
5	John W. Fowler	6
5	Richard A. Allen	6
6	Fan-Tien Cheng	5
6	J. E. Rooda	5
6	Linda S. Milor,	5
6	Nital S. Patel,	5
6	S. Joe Qin,	5
6	Thomas F. Edgar	5

TABLE VII MOST CITED AUTHORS (MORE THEN 30) OF JOURNALS CITED

Rank	Author	Citation
1	D.S.Boning	38
2	C.H.Stapper	36
3	E.Sachs	33
3	R.S.Gyuresik	33
4	D.Boning	32
4	G.S.May	32
4	R.Uzsoy	32
4	S.W.Butler	32
5	C.J.Spanos	31
5	R.Singh	31
6	G.May	30

Bibliometric studies are useful in understanding the dynamics and performance of science, as well as for making policy decision. For decades librarians have used citation counts to determine the adequacy of a periodical collection, the optimum size of back titles to be acquired, binding and retention schedules and for cost benefit analysis in the management of subscription budget. Some important conclusions based on the study are:

The ranked list of periodicals / Authors based on the frequency of citation counts is a simple technique and can be used as a guide for formulating the acquisition policy periodicals.

Citations cited in the Journals are not in the standard format. Researchers have not adopted the uniform pattern and sequence while citing the document. The importance of Bibliometric study to see the effectiveness of a system is already well accepted, as it is a distinctive research technique for measurement of science based on citation data. Citation analysis is one of the most important bibliometric techniques involving analysis of the references forming part of primary communication, as citations are the format explicit linkage between scientific communications that have particular point in common.

Studies of journals citations may be useful in decision-making process of a library regarding acquisition of reading materials and provision of better service to its user. One of the authors earlier made a study and suggested a way to find out highly used titles so as to help decision-making process of the library towards renewal of subscription to journals based on their use factors.

The part of literature which is cited most and in which part of the globe such relevant works are going on can be judged through citation study, which provides helpful guidance in the process of collection development of the library. Further the shelving space of a library does not grow along with the growth of the collection.

In this study there are 670 core journals were cited and it's arranged in decreasing frequency of citations. It is found that the highly cited journal "IEEE Trans on Semiconductor Manufacturing" which is cited 849 times (16.74%), Journal of Electrochemical Society has been cited 295 times occupying 2nd position with a percentage of 5.82 %, IEEE Trans. Electron Devices 229 times occupying 3rd position with a percentage of 4.51%, J. Applied Physics cited 186 times (3.66%) and J. Vacuum science Technology which were cited 180 times (3.55%) and respectively occupies 4th and 5th place in the ranked list of core journals.

TABLE VIII RANKED LIST OF HIGHLY CITED JOURNALS

Sl No.	Rank	Journals Name	Citation	Cumulative Citation	% of Citation	% of Cumulative Citation
1	1	IEEE Trans Semiconduct. Manufact	849	849	16.749	16.749
2	2	J. Electrochemical Society	295	1144	5.820	22.569
3	3	IEEE Trans. Electron Devices	229	1373	4.518	27.086
4	4	J. Appl. Phys	186	1559	3.669	30.756
5	5	J. Vacuum Science Technology	180	1739	3.551	34.307
6	6	Japanese J. Appl.Phys	127	1866	2.505	36.812
7	7	Solid State Technology	107	1973	2.111	38.923
8	8	IEEE J. Solid State Circuits	97	2070	1.914	40.836
9	9	IEEE Trans. Computer- Aided Design	92	2162	1.815	42.651
10	10	IEEE Trans. Semconduct. Manufact	83	2245	1.637	44.289

Table IX represents journals arranged in decreasing order of the frequency of citations (5069) received from the “Semiconductor Manufacturing”. Bradford’s law of scattering is verified by plotting a graph taking cumulative

number of journals (Rn) on the ordinate against the logarithm of cumulative number of citations log (n) in the abscissa. It is observed that the resulting bibliography is a nonlinear curve and indicates non-observation of Bradford’s law of scattering.

TABLE IX DISTRIBUTION OF JOURNALS IN DECREASING ORDER OF CITATIONS

No of Journals	Cumulative No. Of Journals	Log of Cumulative No. Of journals	No of Citation	Total No. of Citation	Total No. of Cumulative Citation	% of 2	% of 6
1	1	0.000	849	849	849	0.149	16.749
1	2	0.301	295	295	1144	0.299	22.569
1	3	0.477	229	229	1373	0.448	27.086
1	4	0.602	186	186	1559	0.597	30.756
1	5	0.699	180	180	1739	0.746	34.307
1	6	0.778	127	127	1866	0.896	36.812
1	7	0.845	107	107	1973	1.045	38.923
1	8	0.903	97	97	2070	1.194	40.836
1	9	0.954	92	92	2162	1.343	42.651
1	10	1.000	83	83	2245	1.493	44.289
1	11	1.041	74	74	2319	1.642	45.749
1	12	1.079	65	65	2384	1.791	47.031
1	13	1.114	63	63	2447	1.940	48.274
2	15	1.176	60	120	2567	2.239	50.641
1	16	1.204	57	57	2624	2.388	51.766
1	17	1.230	52	52	2676	2.537	52.791
1	18	1.255	47	47	2723	2.687	53.719
1	19	1.279	45	45	2768	2.836	54.606
2	21	1.322	44	88	2856	3.134	56.342
1	22	1.342	43	43	2899	3.284	57.191
2	24	1.380	40	80	2979	3.582	58.769
1	25	1.398	38	38	3017	3.731	59.519
1	26	1.415	37	37	3054	3.881	60.249
1	27	1.431	36	36	3090	4.030	60.959
1	28	1.447	35	35	3125	4.179	61.649
1	29	1.462	32	32	3157	4.328	62.281
1	30	1.477	31	31	3188	4.478	62.892
1	31	1.491	29	29	3217	4.627	63.464
1	32	1.505	27	27	3244	4.776	63.997

2	34	1.531	25	50	3294	5.075	64.983
2	36	1.556	21	42	3336	5.373	65.812
1	37	1.568	20	20	3356	5.522	66.206
2	39	1.591	19	38	3394	5.821	66.956
2	41	1.613	18	36	3430	6.119	67.666
1	42	1.623	17	17	3447	6.269	68.002
4	46	1.663	16	64	3511	6.866	69.264
5	51	1.708	15	75	3586	7.612	70.744
2	53	1.724	14	28	3614	7.910	71.296
2	55	1.740	13	26	3640	8.209	71.809
2	57	1.756	12	24	3664	8.507	72.283
6	63	1.799	11	66	3730	9.403	73.585
8	71	1.851	10	80	3810	10.597	75.163
4	75	1.875	9	36	3846	11.194	75.873
11	86	1.934	8	88	3934	12.836	77.609
15	101	2.004	7	105	4039	15.075	79.680
18	119	2.076	6	108	4147	17.761	81.811
21	140	2.146	5	105	4252	20.896	83.882
27	167	2.223	4	108	4360	24.925	86.013
54	221	2.344	3	162	4522	32.985	89.209
98	319	2.504	2	196	4718	47.612	93.076
351	670	2.826	1	351	5069	100.000	100.000

## VI. CONCLUSION

The trend towards collaborative research is gaining currency day-by-day. Now-a-days each and every work of research depends purely on the library because it contains more data. The research in the field of library and information science has become a collective entity wherein more and more researcher helps to make it innovate. The results further reveal that the Journal is wholly a solely devoted to digital / electronics libraries and its associated facts.

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