BIBLIOMETRIC AND SCIENTOMETRIC STUDIES IN PHYSICS AND ENGINEERING: RECENT TEN YEARS ANALYSIS

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Abstract

This paper analyses the growth and development of Bibliometric and scientometric research in physics and engineering field as per *INSPEC* database (1999-2008). During 1999-2008 a total of 1677 papers were published in the field. The average number of publications published per year was 167.7 the highest number of papers 296 were published in 2006. Authorship and collaboration trend was towards multi-authored papers. There were 1100 collaborative papers. National Institute of Science, Technology & Development Studies, New Delhi (India), and College of Information Science & Technology, Drexel University, Philadelphia, PA (USA) were the highly contributed institutions with 23 publications each followed by Sch. of Comput. & Inf. Tech., Wolverhampton Univ. (UK) with 20 publications, University of Western (Fac. of Inf. & Media Studies), Ontario (Canada) with 19 publications, Office of Naval Res., Arlington (USA) with 17 publications and Bhabha Atomic Research Centre (Scientific Information Resource Div.), Mumbai (India) with 14 publications. The most prolific authors were: Thelwall-M (Univ. of Wolverhampton, Wolverhampton, UK) with 32 publications, Rousseau-R (Ind. Sci. & Technol., KHBO, Oostende, Belgium) with 29 publications, Egghe-L (Hasselt Univ., Diepenbeek, Belgium) with 25 publications. The most preferred journals by the Bibliometric and scientometric researchers were: *Scientometrics* with 291 publications, *Journal-of-the-American-Society-for-Information-Science* with 149 publications, *Journal-of-the-China-Society-for-Scientific-and-Technical-Information* with 55 publications and *Information-Processing-and-Management* with 52 publications. The high frequency keywords were: citation-analysis (265), bibliometrics (102), bibliometric-analysis (100), Internet (75), information-retrieval (69), information-science (59).

Keywords: Bibliometrics, Scientometrics, Informetrics, Cybermetrics, Publication Analysis, Research Trends, *INSPEC*, Bibliographic Analysis, Information Science, Library Services

1. INTRODUCTION

The 20th century may be described as the century of the development of metric sciences. In this century itself there have been the developments of librametrics, bibliometrics, scientometrics, technometrics, biometrics, sociometrics, econometrics, cybermetrics or webometrics [Sen 2004; Ming, 2000], and lastly informatics. The term "bibliometrics" was first used by Pritchard [1969] to replace the name "statistical bibliography" for the growing field of quantitative analysis of bibliographies. For some years, however, both "bibliometry" and "bibliometrics" were in vogue. Borgman and Furner (2002) have reviewed the relationship of scholarly communication and bibliometrics. Bibliometrics is study of relationship of numbers and patterns in bibliographic data and use. Bibliographic studies include relationships among number of papers, growth of literature and patterns of library and database usage. Russians' independently used the term "Scientometrics" [Nalimov 1966] in late sixties. For quantitative aspects of studies in "science of science". Now scientometrics means Scientometric dimensions and cybernetics today [Kalyane and Kalyane 1991, 2001; Pekelis, 1984; Swarna et. al. 2002], studies of quantitative aspects of science of science and technology and would include "Technometrics" as

well. Microsoft Encarta [2006] defines bibliometrics and scientometric studies as information scientists analyse many and various phenomena that affect any aspect of information. They are interested in determining such things as: the life cycle and utility of literature on a given subject (bibliometrics); patterns of authorship (co-citation analysis); and the impact of reading on groups and societies (social epistemology).

The study of publication output in a field is a good indicator of status of research work in that field. Bibliographic databases are representative samples of publication activity in any field of knowledge [Vijai Kumar, 2004]. The analysis of the publication records gives some idea about the direction of research, pitfalls, and current trends in a microfield. The results are very much useful for academicians, young scientists, policy makers, professional bodies who confer awards and prizes etc. The handy outputs of such bibliometric and scientometric studies in a given field are very important information sources on some occasions. The present era has evolved with many scientometric techniques and studies not limited to traditional sources of information but digital and web resources [Anil Kumar, 2004, 2008; Prakasan; 2004].

INSPEC, produced by the Institution of Electrical Engineers, UK, is one of the largest-established and best-known bibliographic databases for engineering information. *INSPEC* database covers physics, electronics, electrical engineering, computer sciences, and library and information technology. It is available both online and on CD-ROM. *INSPEC* database has coverage of more than 40,000 records on library and information science. In practice, any given historical account must be limited by its choice of coverage, technique of analysis and objectives. Effective use of already available knowledge is as valuable as creation of new knowledge [Kalyane et. al. 2003, Kalyane et. al. 2004]. Hence, present effort is to highlight these aspects. The work has focused the literature available in the *INSPEC* database on bibliometric and scientometric studies.

The recent ten years have witnessed many scientometric and bibliometric studies in the field of physics and engineering. Even some physicists and engineers are also attracted towards the techniques of scientometrics especially citation analysis and have done important studies in the field. Some of the studies are published only in physics or computer related journals. It is high time to analyse these publications with the following objectives using the INSPEC database:

- to depict the growth of literature;
- to analyse the literature based on country in affiliation as well as country of publication;
- to find out the highly productive affiliated institutions;
- to identify the prolific authors in the field;
- to find the scattering of literature based on publication types;
- to list core journals communicated by the authors;
- to analyse the contents of the papers through keywords/descriptors;
- to quantify the publications as per the INSPEC subject fields; and
- to present language-wise proportion of the literature.

2. MATERIALS AND METHODS

Bibliometric and scientometric literature scattered in the *INSPEC* bibliographic database during 1999 to November 2008 were explored. Normal subject keyword search is adopted to retrieve literature related to bibliometric and scientometric studies. The following are the search queries applied to elicit records pertaining to the present study:

Search History

Query No.	Query	No. of records
#1	bibliometric* or scientometric* or publication* analysis or webometrics or informetric* or reasearch trend*	(956 records)
#2	'citation* analysis'	(1208 records)
#3	#1 or #2	(1756 records)
#4	#3 and (PY=1999-2008)	(1677 records)

Normal count procedure [Kalyane and Vidyasagar Rao, 1995] is used throughout the collection of data.

3. RESULTS AND DISCUSSION

3.1. Growth of Literature

The most famous 'Ideal Logistic Growth Model' of literature in a field has been well discussed in early 1990s [Garg and Kari 1992], [Braun et al 2000], and [Garg and Padhi 2002]. Patra et al. [2006] has analysed growth pattern in the field of bibliometrics using data from Library and Information Science Abstracts (LISA). Growth of literature does not show any definite pattern. Logistic growth assumes that the growth rate is proportional to the product of present size and future growth. The escalating growth after maturation implies that old topics of research are no longer relevant and new directions in research, new discoveries, and new opportunities keep growing. According to Gompertz the logistic growth of any field of knowledge ideally takes an extended S-shape [Sharma et al 2002]. The search for the present study has resulted in a total of 1677 records. Figure 1 depicts year-wise and cumulative number of publications related to bibliometric and scientometric studies in physics and engineering during the recent ten years period (1999-2008). Even though there are fluctuations in number of publications every year, an increasing trend can be observed when the cumulative growth is observed. Maximum number of publications (296) were found in the year 2006 and minimum (492) in 2000.

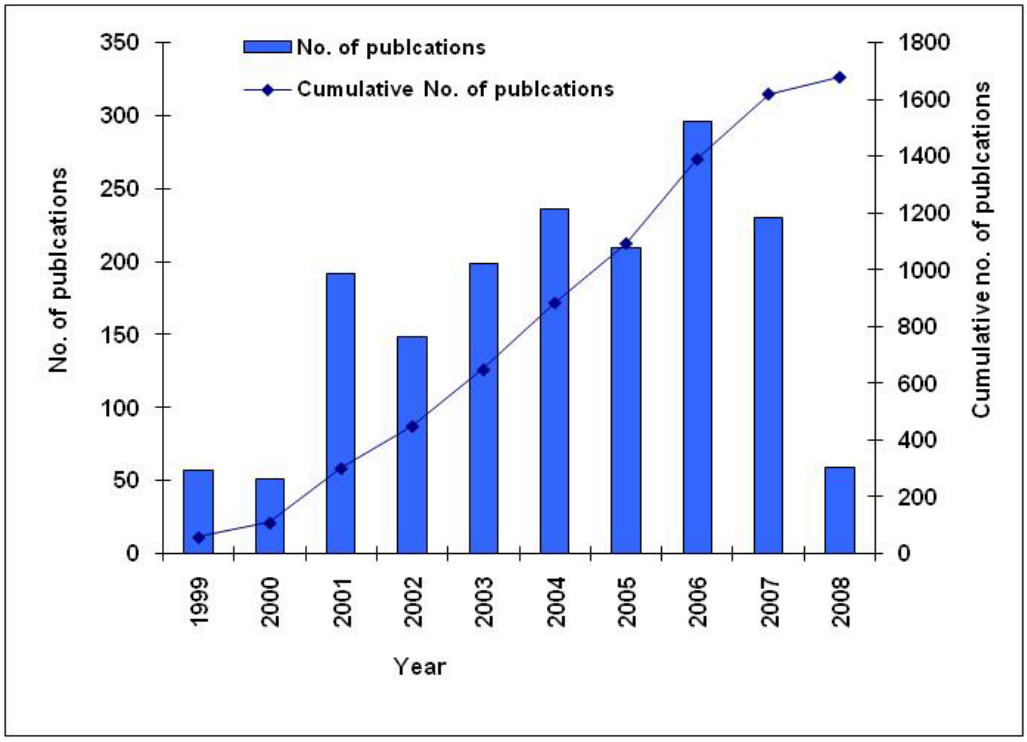

Figure 1: Trend of bibliometric and scientometric related R&D publications in the field of physics and engineering as per *INSPEC* (1999-2008)

3.2 Country-wise Input

There were a total of 57 countries involved in bibliometric and scientometric related R&D in the field of physics and engineering. Even though authors of the studies were from 57 countries, these publications were published only by 31 countries. The number of publications from countries of affiliations of authors (CA) and countries of the publishing (CP) is given in Table 1. USA is at the top position (CA=449 and CP=58) followed by China (CA=119 and CP=69), India (CA=117 and CP=59), UK (CA=114 and CP=236). The total literature output of top 4 countries on bibliometrics and scientometric related research in physics and engineering amounted to about 47 per cent of the total publications.

Table 1: Country wise productivity (author affiliation) and country of publishing (country of input) observed in bibliometric and scientometric related publications in physics and engineering as per *INSPEC* database 1999-2008

Sr. No.	Country	Country in affiliations (CA)		Country of publishing (CP)		Percentage (CA – CP)
		Publications	Percentage	Publications	Percentage	
1	USA	439	26.18	584	34.82	-8.64
2	China	119	7.1	69	4.11	2.99
3	India	117	6.98	59	3.52	3.46
4	UK	114	6.8	236	14.07	-7.27
5	Spain	74	4.41	50	2.98	1.43
6	Canada	70	4.17	8	0.48	3.69
7	Belgium	64	3.82	1	0.06	3.76
8	Netherlands	56	3.34	337	20.10	-16.76
9	Japan	55	3.28	18	1.07	2.21

Sr. No.	Country	Country in affiliations (CA)		Country of publishing (CP)		Percentage (CA – CP)
		Publications	Percentage	Publications	Percentage	
10	Germany	50	2.98	92	5.49	-2.51
11	Taiwan	37	2.21	2	0.12	2.09
12	France	36	2.15	5	0.30	1.85
13	Australia	32	1.91	110	6.56	-4.65
14	Denmark	31	1.85	5	0.30	1.55
15	Singapore	23	1.37	2	0.12	1.25
16	Hungary	20	1.19	3	0.18	1.01
17	Israel	20	1.19	-	0.00	1.19
18	South Korea	18	1.07	2	0.12	0.95
19	Mexico	17	1.01	-	0.00	1.01
20	Brazil	16	0.95	18	1.07	-0.12
21	Malaysia	15	0.89	30	1.79	-0.9
22	Sweden	14	0.83	1	0.06	0.77
23	Italy	11	0.66	2	0.12	0.54
24	South Africa	11	0.66	5	0.30	0.36
25	Iran	10	0.6	-	0.00	0.6
26	New Zealand	10	0.6	-	0.00	0.6
27	Switzerland	9	0.54	18	1.07	-0.53
28	Finland	9	0.54	-	0.00	0.54
29	Cuba	8	0.48	1	0.06	0.42
30	Austria	7	0.42	1	0.06	0.36
31	Greece	7	0.42	3	0.18	0.24
32	Norway	7	0.42	-	0.00	0.42
33	Thailand	7	0.42	-	0.00	0.42
34	Russia	6	0.36	4	0.24	0.12
35	Slovenia	5	0.3	-	0.00	0.3
36	Turkey	5	0.3	-	0.00	0.3
37	Kuwait	4	0.24	-	0.00	0.24
38	Nigeria	4	0.24	3	0.18	0.06
39	Argentina	3	0.18	-	0.00	0.18
40	Chile	3	0.18	-	0.00	0.18
41	Poland	3	0.18	1	0.06	0.12
42	Romania	3	0.18	-	0.00	0.18
43	Hong Kong	2	0.12	-	0.00	0.12
44	Indonesia	2	0.12	-	0.00	0.12
45	Portugal	2	0.12	-	0.00	0.12
46	Belarus	1	0.06	-	0.00	0.06
47	Croatia	1	0.06	-	0.00	0.06
48	Cyprus	1	0.06	-	0.00	0.06
49	Czech Republic	1	0.06	-	0.00	0.06
50	Egypt	1	0.06	-	0.00	0.06
51	Ghana	1	0.06	-	0.00	0.06
52	Kenya	1	0.06	-	0.00	0.06
53	South Korea	1	0.06	-	0.00	0.06
54	Tanzania	1	0.06	-	0.00	0.06
55	Tunisia	1	0.06	-	0.00	0.06
56	United Arab Emirates	1	0.06	-	0.00	0.06
57	Uruguay	1	0.06	-	0.00	0.06
58	Ireland	-	0	6	0.36	-0.36
59	Colombia	-	0	1	0.06	-0.06
60	No country	90	5.37	-	0.00	5.37
1-60	All	1677	100	1677	100.00	

3.3 Highly Preferred Journals

The total number of 1332 articles related to bibliometric and scientometric studies related to physics and engineering were scattered in 269 individual journals. The most preferred five journals were: *Scientometrics* topped the list with 291 (21.85% of total) articles followed by *Journal of the American Society for Information Science* with 149 (11.19%) articles, *Journal of the China Society for Scientific and Technical Information* with 55 (4.13%) articles, *Information Processing and Management* 52 (3.9%) articles, *Revista Espanola de Documentacion Cientifica* with 35 (2.63 %) articles, and *SRELS Journal of Information Management* with 29 (2.18%). Table 2 gives the list of the top journals preferred by authors for publishing bibliometric and scientometric related research in physics and engineering.

Table 2: Journals publishing bibliometric and scientometric related research in physics and engineering publications with the number of publications (≥5) as per INSPEC database 1999-2008

Sl #	*Name of Source*	# Publications	% of total
1	*Scientometrics*	291	21.85
2	*Journal-of-the-American-Society-for-Information-Science*	149	11.19
3	*Journal-of-the-China-Society-for-Scientific-and-Technical-Information*	55	4.13
4	*Information-Processing-and-Management*	52	3.90
5	*Revista-Espanola-de-Documentacion-Cientifica*	35	2.63
6	*SRELS-Journal-of-Information-Management*	29	2.18
7	*Journal-of-the-Medical-Library-Association*	25	1.88
8	*Malaysian-Journal-of-Library-and-Information-Science*	24	1.80
9	*Journal-of-Information-Science*	23	1.73
10	*Journal-of-Documentation*	19	1.43
11	*Science-and-Technology-Libraries*	17	1.28
12	*Ciencia-da-Informacao*	15	1.13
13	*Aslib-Proceedings-New-Information-Perspectives*	14	1.05
14	*Online-Information-Review*	14	1.05
15	*IASLIC-Bulletin*	13	0.98
16	*Journal-of-Information-Processing-and-Management*	13	0.98
17	*Library-Trends*	13	0.98
18	*DESIDOC-Bulletin-of-Information-Technology*	12	0.90
19	*Information-Research*	11	0.83
20	*Technological-Forecasting-and-Social-Change*	11	0.83
21	*El-Profesional-de-la-Informacion*	10	0.75
22	*Serials-Librarian*	9	0.68
23	*Behavioral-and-Social-Sciences-Librarian*	8	0.60
24	*Issues-in-Science-&-Technology-Librarianship*	8	0.60
25	*Journal-of-Academic-Librarianship*	8	0.60
26	*Law-Library-Journal*	8	0.60
27	*NFD-Information-Wissenschaft-und-Praxis*	8	0.60
28	*Canadian-Journal-of-Information-and-Library-Science*	7	0.53
29	*Medical-Reference-Services-Quarterly*	7	0.53
30	*Proceedings-of-the-SPIE-The-International-Society-for-Optical-Eng.*	7	0.53
31	*Communications-of-the-ACM*	6	0.45
32	*Library-and-Information-Science-Research*	6	0.45
33	*Libri-*	6	0.45
34	*Mathematical-and-Computer-Modelling*	6	0.45
35	*Searcher-*	6	0.45
36	*World-Patent-Information*	6	0.45
37	*Cataloging-and-Classification-Quarterly*	5	0.38
38	*Cybermetrics-*	5	0.38

Sl #	*Name of Source*	# Publications	% of total
39	*Information-Technology-and-Libraries*	5	0.38
40	*Legal-Reference-Services-Quarterly*	5	0.38
41	*Library-Collections,-Acquisitions,-&-Technical-Services*	5	0.38
42	*Publications-of-the-Astronomical-Society-of-the-Pacific*	5	0.38
43	*South-African-Journal-of-Library-and-Information-Science*	5	0.38
44-269 (Journals with less than 4 articles)		346	25.98

3.4 Authorship and Collaboration Pattern

Authorship and collaboration trend was towards multi-authored publications. There were a total of 1100 (65.59%) multi-authored publications and 577 (34.41%) single-authored publications and a total of 3766 authorships found in 1677 publications. There were five publications which had more than ten authors. Table 5 gives authorship pattern in bibliometric and scientometric research in physics and engineering. Figure 2 depicts the year-wise trend of single authored and collaborative publications in the field.

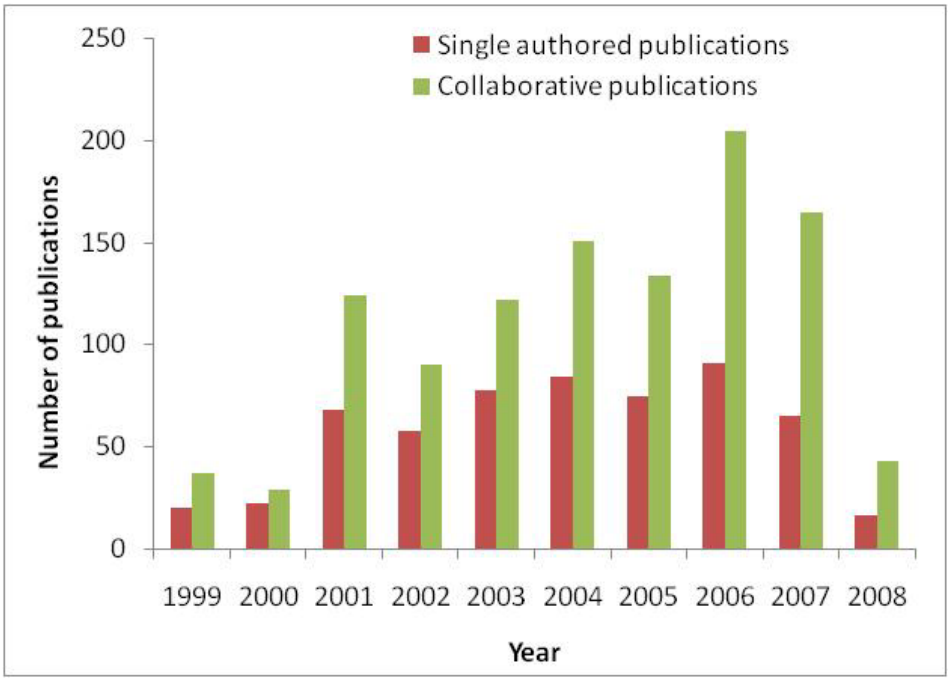

Figure 2: Authorship pattern in bibliometric and scientometric research in physics and engineering as per INSPEC database 1999-2008

3.5 Most prolific Authors

There are 2582 authors who have published 1677 publications with 3766 authorships. The most prolific authors are: Thelwall-M (32), Rousseau-R (29), Egghe-L (25), Glanzel-W (20), Leydesdorff-L (20), Kostoff-RN (18), Vaughan-L (16), Giles-CL (15), Gupta-BM (15), Vijai-Kumar (14), Chaomei-Chen (14). Table 3 gives the list of most prolific authors with the number of publications against them.

Table 3: The most prolific authors with number of publications (≥5) observed in bibliometric and scientometric related publications in physics and engineering as per INSPEC database 1999-2008

Sl #	Authors	# publications
1.	Thelwall-M	32
2.	Rousseau-R	29
3.	Egghe-L	25
4.	Glanzel-W	20
5.	Leydesdorff-L	20
6.	Kostoff-RN	18
7.	Vaughan-L	16
8.	Giles-CL	15
9.	Gupta-BM	15
10.	Vijai-Kumar	14
11.	Chaomei-Chen	14
12.	Kalyane-VL	12
13.	Wilson-CS	12
14.	Bar-Ilan-J	11
15.	Jacso-P	11
16.	Meyer-M	11
17.	Bhattacharya-S	9
18.	Burrell-QL	9
19.	Kademani-BS	9
20.	Qiu-Junping	9
21.	Braun-T	8
22.	Garfield-E	8
23.	Kretschmer-H	8
24.	Ming-Yueh-Tsay	8
25.	Wilkinson-D	8
26.	Zitt-M	8
27.	Anil-Sagar	7
28.	Bassecoulard-E	7
29.	Bihui-Jin	7
30.	Cardona-M	7
31.	Carr-L	7
32.	Cronin-B	7
33.	Debackere-K	7
34.	Ingwersen-P	7
35.	Lawrence-S	7
36.	Lewison-G	7
37.	White-H-D	7
38.	Anil-Kumar	6
39.	Bordons-M	6
40.	Borner-K	6
41.	de-Moya-Anegon-F	6
42.	Gomez-I	6
43.	Herrero-Solana-V	6
44.	Kumar-S	6
45.	Marx-W	6
46.	Moed-HF	6
47.	Onyancha-OB	6
48.	Oppenheim-C	6
49.	Schubert-A	6
50.	Shaw-D	6
51.	Small-H	6
52.	Van-Raan-A-F-J	6
53.	Vinkler-P	6
54.	Accomazzi-A	5
55.	Archambault-E	5
56.	Duan-Yufeng	5
57.	Eichhorn-G	5
58.	Lafouge-T	5
59.	Schneider-JW	5
60.	Thijs-B	5
61.	Wormell-I	5
62-2582 authors with < 5 publications		3194

3.6 Institution-wise Distribution of Publications

Out of 1677 records 1587 (95%) records had author affiliation mentioned in INSPEC database while remaining 90 (5%) records had no author affiliation information. The reason behind non availability of affiliation information for more than 5 % records may become the topic for further study. There were 1137 institutions involved in the research. The most productive institutions were: National Institute of Science, Tech Dev Studies, New Delhi (India) and Coll. of Inf. Sci. & Technol., Drexel Univ., Philadelphia (USA) with 23 publications each followed by Sch. of Comput. & Inf. Technol., Wolverhampton Univ. (UK) with 20 publications, Fac. of Inf. & Media Studies, Univ. of Western Ontario, London, Ont. (Canada) with 19 publications, Office of Naval Res., Arlington, VA (USA) with 17 publications and Scientific Information Resource Division, Bhabha Atomic Research Centre, Mumbai (India)

with 14 publications. Table 4 gives the list of institutions contributed 5 or more publications during 1999-2008.

Table 4: Total Institutions with number of publications (≥5) in bibliometric and scientometric related publications as per INSPEC database 1999-2008

Sl #	Institution	# Publications
1	Nat. Inst. of Sci., Technol. & Dev. Studies, New Delhi	23
2	Coll. of Inf. Sci. & Technol., Drexel Univ., Philadelphia, PA, USA	23
3	Sch. of Comput. & Inf. Technol., Wolverhampton Univ., UK	20
4	Fac. of Inf. & Media Studies, Univ. of Western Ontario, Canada	19
5	Office of Naval Res., Arlington, VA, USA	17
6	Sci. Inf. Resource Div., Bhabha Atomic Res. Centre, Mumbai	14
7	R. Sch. of Libr. & Inf. Sci., Copenhagen, Denmark	12
8	Centre for Sci. & Technol. Studies, Leiden Univ., Netherlands	12
9	Sch. of Libr. & Inf. Sci.na Univ., Bloomington, IN, USA	11
10	Sch. of Inf. Syst., Technol. & Manage., New South Wales Univ., Australia	11
11	Sch. of Comput. Eng., Nanyang Technol. Univ., Singapore	10
12	Amsterdam Sch. of Commun. Res., Amsterdam Univ., Netherlands	10
13	Steunpunt O&O Statistieken, Katholieke Universiteit Leuven, Belgium	9
14	Sch. of Libr., Archive & Inf. Studies, Hebrew Univ., Jerusalem, Israel	9
15	Univ. of Hawaii, Manoa, HI, USA	8
16	Limburgs Univ. Centrum, Diepenbeek, Belgium	8
17	Dept. of Inf. Syst. & Comput., Brunel Univ., Uxbridge, UK	8
18	Dept. of Inf. Studies, R. Sch. of Libr. & Inf. Sci., Copenhagen, Denmark	7
19	Sch. of Libr. & Inf. Studies, Oklahoma Univ., Norman, OK, USA	6
20	Limburgs Universitair Centrum, Diepenbeek, Belgium	6
21	Inst. of Sci. & Tech. Inf. of China, Beijing, China	6
22	Dept. of Inf. Sci., Loughborough Univ., UK	6
23	Dept. of Comput. Sci. & Eng., Pennsylvania State Univ., University Park, PA, USA	6
24	Res. Center for Chinese Sci. Evaluation, Wuhan Univ., China	5
25	NEC Res. Inst., Princeton, NJ, USA	5
26	Dept. of Inf. Sci., City Univ., London, UK	5
27	Dept. of Ind. Eng., Seoul Nat. Univ., South Korea	5
28	Departamento de Biblioteconomia y Documentacion, Univ. Carlos III de Madrid, Spain	5
29	Chem. Res. Center, Hungarian Acad. of Sci., Budapest, Hungary	5
29-1137		1386

Authors from India were also very much involved in bibliometric and scientometric studies in physics and engineering. The study has segregated author affiliations of Indian origin from the list and given in Table 5 with number of publications. Nat. Inst. of Sci., Technol. & Dev. Studies, New Delhi; Sci. Inf. Resource Div., Bhabha Atomic Res. Centre, Mumbai; Dept. of Phys., Univ. of Calcutta, Kolkata; Tata Inst. of Social Sci., Mumbai; and Nat. Inst. of Sci. Commun. & Inf. Resources, New Delhi are the premier five institutions in India where bibliometrics and scientometric studies in physics and engineering were concentrated.

Table 5: Indian affiliations of authors with number of publications (≥2) in bibliometrics and scientometric studies in physics and engineering as per INSPEC database 1999-2008

Sl #	Institutions	# Publications
1	Nat. Inst. of Sci., Technol. & Dev. Studies, New Delhi	23
2	Sci. Inf. Resource Div., Bhabha Atomic Res. Centre, Mumbai	14
3	Dept. of Phys., Univ. of Calcutta, Kolkata	3

Sl #	Institutions	# Publications
4	Tata Inst. of Social Sci., Mumbai	2
5	Nat. Inst. of Sci. Commun. & Inf. Resources, New Delhi	2
6	M. S. Swaminathan Res. Found., Chennai	2
7	Indira Gandhi Nat. Open Univ., New Delhi	2
8	Indian Cardamom Res. Inst., Keral	2
9	DLIS, Univ. of Madras, Chennai	2
10	Dept. of Libr. & Inf. Sci., M.L.B. Gov. Coll. of Excellence, Gwalior	2
11	Dept. of Libr. & Inf. Sci., Karnatak Univ., Dharwad	2
12	Dept. of Libr. & Inf. Sci., Annamalai Univ., Tamil Nadu	2
13	Dept. of Libr. & Inf. Sci., Aligarh Muslim Univ.	2
14	Dept. of Biochem. Eng. & Biotechnol.n Inst. of Technol., New Delhi	2
15	Zakir Husain Libr., New Delhi	1
16	Univ. of Kashmir, Kashmir	1
17	Univ. of Burdwan, Bardhaman	1
18	SKN Coll. of Agric., Jobner	1
19	Sir Dorabji Tata Memorial Libr., Tata Inst. of Social Sci., Mumbai	1
20	SET Labs., Infosys Technol. Ltd., Bangalore	1
21	Sarada Ranganathan Endowment for Libr. Sci., Bangalore	1
22	Rajiv Gandhi Coll. of Eng. & Technol., Pondicherry	1
23	Rain Forest Res. Inst., Jorhat	1
24	Postgraduate Dept. of Libr. & Inf. Sci., Sambalpur Univ.	1
25	Orissa State Museum, Bhubaneswar	1
26	National Inst. of Occupational Health, Ahmedabad	1
27	National Centre for Sci. Inf.n Inst. of Sci., Bangalore	1
28	Nat. Res. Centre for Soybean, Indore	1
29	Nat. Phys. Lab., New Delhi	1
30	Nat. Instn. of Sci. & Technol. Policy, Pilani	1
31	Nat. Inst. of Occupational Health, Ahmedabad	1
32	Nat. Inst. of Immunology, New Delhi	1
33	NAARM, Hyderabad	1
34	N.K.C.Centre for Dev. Studies, Orissa State	1
35	Mysore Univ. Libr.	1
36	Madurai Kamaraj Univ.	1
37	Machine Intelligence Unitn Stat. Inst., Kolkata	1
38	Libr. & Inf. Sci. Div., Annamalai Univ., Annamalainagar	1
39	Libr. & Inf. Consultant, New Delhi	1
40	Karnatak Univ., Dharwad	1
41	Kalyani Univ. Nadia, Nadia	1
42	JRD Tata Memorial Libr., Bangalore	1
43	Inst. of Genomics & Integrative Biol., New Delhi	1
44	Informatics Centren Nat. Sci. Acad., New Delhi	1
45	Indian Inst. of Technol., Kharagpur	1
46	Indian Inst. of Sci., Bangalore	1
47	Indian Council of Med. Res., Nat. Inst. of Occupational Health, Gujarat	1
48	GN Ramachandran Knowledge Centre, Inst. for Genomics & Integrative Biol., New Delhi	1
49	G B Pant Univ. of Agric. & Technol., Uttranchal	1
50	Documentation Res. & Training Centren Stat. Inst., Bangalore	1
51	Dept. of Ocean Dev., Integrated Coastal & Marine Area Manage., Chennai	1
52	Dept. of Libr. & Inf. Sci., Lucknow Univ.	1
53	Dept. of Libr. & Inf. Sci., Kuvempu Univ., Shankaraghatta	1
54	Dept. of Libr. & Inf. Sci., Gulbarga Univ., Gulbarga	1
55	Dept. of Libr. & Inf. Sci., Cochin Univ. of Sci. & Technol., Kottayam	1
56	Dept. of Libr. & Inf. Sci., Calicut Univ.	1

Sl #	Institutions	# Publications
57	Dept. of Libr. & Inf Sci., Burdwan Univ.	1
58	Dept. of Humanities & Social Sci.n Inst. of Technol., New Delhi	1
59	Dept. of Comput. Sci. & Eng., St. Thomas Coll. of Eng. & Technol., Kolkata	1
60	Dept. of Comput. Sci. & Eng., Haldia Inst. of Technol.	1
61	Dept. of Commun. & Journalism, Univ. of Kerala, Thiruvananthapuram	1
62	Defence Sci. Inf. & Documentation Centre, Delhi	1
63	CSK Himachal Pradesh Agric. Univ., Palampur	1
64	CSIR, Chennai	1
65	Coll. of Leather Technol., Kolkata	1
66	Central Library, Acharya N.G. Ranga Agric. Univ., Hyderabad	1
67	Central Libr., Banaras Hindu Univ., Varanasi	1
68	Central Leather Res. Inst., Adyar	1
69	Bharathidasan Univ., Tamil Nadu	1

3.7 INSPEC Subjects Fields

It is worthy to note the subject categories to which more number of articles were contributed. The articles were categorised as per the *INSPEC* Classification. The study has observed 19 individual subject categories of bibliometric and scientometric related publications in physics and engineering in *INSPEC* database and they are listed in Table 6 with the number of articles falling in each category. 'Computers and Control' with 847 (50.51%) publications, 'Computers and Control Technology' with 664 (39.59%) publications, 'Physics General' with 25 (1.49%) publications, 'Manufacturing and Production' with 19 (1.13%) publications. These were the leading subject categories and they constitute more than 92 per cent of bibliometric and scientometric related publications.

Table 6: Subject-wise distribution of bibliometric and scientometric related publications in physics and engineering as per INSPEC database 1999-2008

Subject Field	# Publications	% of total
Computers-and-Control	847	50.51
Computers-and-Control-Technology	664	39.59
Physics (General)	25	1.49
Manufacturing-and-Production	19	1.13
Electrical-and-Electronic-Engineering; Computers-and-Control	18	1.07
Computers-and-Control; Manufacturing-and-Production	17	1.01
Physics-; Computers-and-Control-Technology	16	0.95
Computers-and-Control; Information-Technology-for-Business	14	0.83
Electrical-and-Electronic-Engineering	13	0.78
Physics-; Computers-and-Control	11	0.66
Physics-; Electrical-and-Electronic-Engineering; Computers-and-Control	9	0.54
Computers-and-Control-Technology; Information-Technology	7	0.42
Computers-and-Control-Technology; E-	5	0.30
Physics-; Electrical-and-Electronic-Engineering	4	0.24
Electrical-and-Electronic-Engineering; Manufacturing-and-Production	4	0.24
Physics-; Manufacturing-and-Production	1	0.06
Manufacturing-and-Production; Electrical-and-Electronic-Engineering	1	0.06
Manufacturing-and-Production; Computers-and-Control	1	0.06

Computers-and-Control; Electrical-and-Electronic-Engineering	1	0.06

3.8 Keywords/Descriptor Analysis

Keywords of publications convey precisely the thought contents of the papers and one of the best bibliometric indicators to understand and grasp instantaneously the thought content of the publications and to find out the growth of the subject field. By analyzing the keywords appeared either in the title or assigned by the indexer or the author himself help in knowing in which direction the knowledge grows. The high frequency keywords will enable us to understand what are all the aspects that have been studied. In the current study the keywords appeared in the 'Keywords' field of *INSPEC* database were analysed for the purpose. The total number of keywords/descriptors appeared in the 1677 bibliometric and scientometric related publications in physics and engineering as per the *INSPEC* database were 8294. A list of most frequently occurred 140 keywords/descriptors (at least 6 times occurred) were given in Table 7. The highly occurred keywords were: citation analysis (265), bibliometrics (102), bibliometric analysis (100), Internet (75); information retrieval (69), information science (59), citations (57), and bibliometric study (50).

Table 7: List of keywords occurred more than 6 times in keyword fields of the records pertaining to bibliometric and scientometric studies in physics and engineering as per INSPEC database 1999-2008

Sl #	Keywords	No. of times occurred	Sl #	Keywords	No. of times occurred
1	citation analysis	265	30	classification	14
2	bibliometrics	102	31	cluster analysis	14
3	bibliometric analysis	100	32	information visualization	14
4	Internet	75	33	ISI	14
5	information retrieval	69	34	author cocitation analysis	13
6	information science	59	35	bibliometric methods	13
7	citations	57	36	data collection	13
8	bibliometric study	50	37	information dissemination	13
9	impact factor	34	38	knowledge discovery	13
10	data mining	29	39	author co citation analysis	12
11	bibliometric indicators	27	40	bibliometric data	12
12	digital libraries	26	41	biotechnology	12
13	Institute for Scientific Information	26	42	co citation analysis	12
			43	databases	12
14	journal articles	26	44	electronic publishing	12
15	informetrics	25	45	impact factors	12
16	authorship pattern	23	46	information technology	12
17	citation patterns	18	47	authorship	11
18	cocitation analysis	18	48	bibliographic databases	11
19	content analysis	18	49	bibliographic references	11
20	digital library	18	50	citation graph	11
21	indexing	18	51	citation index	11
22	citation	17	52	document clustering	11
23	electronic journals	16	53	Google Scholar	11
24	humanities	16	54	history	11
25	citation data	15	55	information systems	11
26	India	15	56	journal citation	11
27	journal citation reports	15	57	knowledge production	11
28	journal impact factor	15	58	library	11
29	China	14	59	bibliometric studies	10

Sl #	Keywords	No. of times occurred
60	bibliometric techniques	10
61	chemistry	10
62	citation databases	10
63	computer science	10
64	data analysis	10
65	factor analysis	10
66	ISI Web of Science	10
67	journals	10
68	author productivity	9
69	citation counts	9
70	citation indexing	9
71	coauthorship	9
72	document retrieval	9
73	economics	9
74	Google	9
75	international collaboration	9
76	journal citation report	9
77	academic libraries	8
78	Arts and Humanities Citation index	8
79	authors	8
80	bibliographic citations	8
81	bibliographic database	8
82	bibliographic records	8
83	citation frequency	8
84	citation networks	8
85	citation searching	8
86	electronic journal	8
87	hyperlinks	8
88	Japan	8
89	journal article	8
90	abstracts	7
91	artificial intelligence	7
92	bibliography	7
93	bibliometric approach	7
94	bibliometric method	7
95	biology	7
96	Chinese science citation database	7
97	citation database	7
98	citation information	7
99	clinical medicine	7
100	co word analysis	7
101	cybermetrics	7

Sl #	Keywords	No. of times occurred
102	EndNote	7
103	grey literature	7
104	information services	7
105	information sources	7
106	INSPEC database	7
107	intellectual structure	7
108	journal literature	7
109	knowledge management	7
110	librarians	7
111	libraries	7
112	library and information science	7
113	academic journals	6
114	bibliometric indicator	6
115	bibliometric maps	6
116	bibliometric measure	6
117	bibliometric research	6
118	cataloguing	6
119	citation distribution	6
120	citation impact	6
121	citation links	6
122	citation network	6
123	citation study	6
124	collection development	6
125	database	6
126	database tomography	6
127	fuzzy set theory	6
128	h index	6
129	immediacy index	6
130	information access	6
131	information production	6
132	information use	6
133	informetric analysis	6
134	intellectual property	6
135	interdisciplinary research	6
136	ISI database	6
137	journal	6
138	journal evaluation	6
139	journal ranking	6
140	knowledge organization	6
		(truncated)

3.9 Types of Publication Media

It is noteworthy to analyse which is the most preferred medium of communication of the outputs of the research activities in the field. Out of the 1677 publications, 1332 (79.4%) were published as journal articles and 342 (20.4%) as conference papers and the rest of the 3 (0.17%) were published as chapters of books.

3.10 Language-wise Publications

Another interesting observation is the growing number of languages in which literature is being communicated. Table 8 lists languages in which the bibliometric and scientometric related literatures in physics and engineering were published. Consistent with the countries of publication, English is the predominant language of articles. English language articles constitute about 90% of the total number of articles. There were only 10% non-English-language articles. This may be due to the fact that the USA and the UK are the predominant countries of publication and the *INSPEC* is a Europe-based database. Moreover, English is the official language for most international conferences (Ming et al. 2000).

Table 8: Language distribution of bibliometric and scientometric publications in physics and engineering as per *INSPEC* (1999-2008)

Sl #	Language	#publications	% of total	Cumulative%
1.	English	1505	89.74	89.74
2.	Chinese	66	3.94	93.68
3.	Spanish	50	2.98	96.66
4.	German	16	0.95	97.61
5.	Japanese	16	0.95	98.57
6.	Portuguese	15	0.89	99.46
7.	Hungarian	3	0.18	99.64
8.	French	2	0.12	99.76
9.	Italian	2	0.12	99.88
10.	Korean	1	0.06	99.94
11.	Polish	1	0.06	100.00

3. CONCLUSION

The *INSPEC* has more than 40,000 research articles related to Library and Information Science. This study explored the growth and other publication characteristics of 1677 publications related to bibliometric and scientometric studies in physics and engineering based on the *INSPEC* database. The study has observed a gradual growth in number of publications in the field under study and recent years have produced a good number of articles compared to the olden days. Frequently occurred author affiliations prove that countries like USA; China; India; UK; and Spain are actively engaged research in the field. The Study also revealed that Netherlands had published many articles than what they have produced in the field. The highly preferred journals to publish the articles by the authors in the field were identified and it found that *Scientometrics* toped of the list followed by *Journal of the American Society for Information Science*; *Journal of the China Society for Scientific and Technical Information*; *Information Processing and Management*; *Revista Espanola de Documentacion Cientifica* and *SRELS Journal of Information Management*.

The current trend of more collaborative papers was evident in the present study. Thelwall-M; Rousseau-R; Egghe-L; Glanzel-W; Leydesdorff-L; Kostoff-RN; Vaughan-L; Giles-CL; Gupta-BM; and Vijai-Kumar were prolific identified as the most contributors in the field. National Institute of Science, Tech Dev Studies, New Delhi (India); Coll. of Inf. Sci. & Technol., Drexel Univ., Philadelphia (USA); Sch.

of Comput. & Inf. Technol., Wolverhampton Univ. (UK); Fac. of Inf. & Media Studies, Univ. of Western Ontario, London, Ont. (Canada); Office of Naval Res., Arlington, VA (USA); and Scientific Information Resource Division, Bhabha Atomic Research Centre, Mumbai (India) are the highly productive affiliations of the authors.

As per the INSPEC database subject category analysis, 92 per cent of the bibliometric and scientometric related publications in physics and engineering covered under the 'Computers and Control'; 'Computers and Control Technology'; 'Physics General'; 'Manufacturing and Production' subject categories. Citation analysis; bibliometrics; bibliometric analysis; Internet; information retrieval; information science; citations; and bibliometric study are most occurred keywords along with the records of the study. As usual, journal articles were the favourite medium of authors in the field to communicate their research works and English was the most predominant language in which 90 percentages of the articles was published.

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