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Scientometric Analysis of the Scientometric Literature

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Abstract

Using bibliographic records from the Social Science Citation Index, Science Citation Index, and Arts & Humanities Citation Index, this paper tries to give a complete view of the evolution of the field of Scientometrics based on its literature published during 1980 to 2009. This is a descriptive survey using scientometric indicators.

Findings revealed that out of 691 articles in the field of Scientometrics, a total number of 183 articles (26.48%) were written during 1980 to 2009 by the top ten authors. Some of these articles were produced in authors' collaboration and some of them were by single authors. Geographical analysis indicated that the field had evolved considerably in different regions of the world. Hungarian Academy of Science with 40 records (5.71%) was the most productive institution in the field of Scientometrics. Furthermore, chronological analysis disclosed that the scientific production in the field of Scientometrics showed a slow increase from 1980 to 2009. The overwhelming majority of documents were in English, and the international journal of *Scientometrics* was the most prolific journal in the field. It has also been declared that 67.87% of the literature was published in the area of Library and Information Science.

Keywords: Scientometrics, Scientific Production, Web of Science (WOS).

Introduction

Scientometrics is one of the most important measures for the assessment of scientific productions. Macias-Chapula argues that "scientometric indicators have become essential to the scientific community to estimate the state-of-the-art of a given topic" (quoted In Lolis et. al. 2009). Scientometrics is related to and has overlapping interests with Bibliometrics and Informetrics. The terms Bibliometrics, Scientometrics, and Informetrics refer to component fields related to the study of the dynamics of disciplines as reflected in the

production of their literature (Hood & Wilson, 2001).

“Scientometrics” is the English translation of the title word of Nalimov’s classic monograph *Naukometriy* in 1969, which was relatively unknown to western scholars even after it was translated into English. Without access to the internet and limited distribution, it was rarely cited. However, the term became better known once the journal *Scientometrics* appeared in 1978 (Garfield, 2007).

There are many definitions for the term “Scientometrics” in the literature; Scientometrics is the quantitative study of the disciplines of science based on published literature and communication. This could include identifying emerging areas of scientific research, examining the development of research over time, or geographic and organizational distributions of research (Glossary of Thompson..., 2008).

Tague-Sutcliffe (1992) defines Scientometrics as "the study of the quantitative aspects of science as a discipline or economic activity. It is part of the sociology of science and has application to science policy-making. It involves quantitative studies of scientific activities, including, among others, publication, and so overlaps bibliometrics to some extent”.

Van Raan (1997) believes that scientometric research is devoted to quantitative studies of science and technology. It aims at the advancement of knowledge and the development of science and technology; it is also in relation to social and political questions. He divides the core interests of scientometric research to four interrelated areas:

(1) Development of methods and techniques for the design, construction, and application of quantitative indicators in important aspects of science and technology.

(2) Development of information systems in science and technology.

(3) Study of the interaction between science and technology.

(4) Study of cognitive and socio-organizational structures of scientific fields and developmental processes in relation to social factors.

Since Nalimov’s coinage of the Russian equivalent of the term ‘Scientometrics’ (*naukometriya*) in 1969, this term has grown in popularity and is used to describe the study of science: growth, structure, interrelationships and productivity (Hood & Wilson, 2001). However, in the last few decades, many researchers used scientometric analysis to conduct their own specific surveys; yet there is not a comprehensive scientometric analysis of the term itself. In this article, the evolution of the field of Scientometrics has been studied based on literature published in WOS^[1]. In particular, the aim of the study is to determine the followings:

- Top authors of Scientometrics
- Geographical distribution of scientometric productions
- Most productive institutions
- Language distribution of scientometric literature
- Growth rate of the literature

- Top journals of Scientometrics
- Subject areas of the literature
- Document types of the literature

Review of Literature

In recent years, many researchers have conducted scientometric analysis in different subject fields. Osareh & Wilson (2002) analyzed international collaboration of Iranian scientific publications in Science Citation Index (SCI) during 1995 to 1999. One result of this study shows that Iran's publication outputs in science and technology increased dramatically in the SCI during the study period. Another result shows that Iran's main international collaborations are by authors with institutional affiliations in the U.S.A or UK. However, it is obvious that Iran is looking more and more for collaborating partners elsewhere. Collaboration with authors in Canadian and Australian institutions has increased either in absolute numbers, relative percentages or both.

Dutt, Garg & Bali (2003) analyzed 1317 papers published in the first fifty volumes of the international journal of *Scientometrics* during 1978 to 2001. They found that the U.S.A share of papers is constantly declining while that of the Netherlands, India, France and Japan is on the rise. The research output is highly scattered as indicated by the average number of papers per institution.

Signore & Annovazzi (2004) carried out a research on Medline covering a 1-year period to evaluate the number and the scientific "weight" of the Nuclear Medicine papers published from European as compared with other countries. They found that Europe leads research in Nuclear Medicine (939 papers, 38.9%) followed by the U.S.A (608 papers, 25.2%). Among European countries, Germany is the nation that is currently making the greatest contribution to the scientific production of Nuclear Medicine in Europe.

Moin, Mahmoudi & Rezaei (2005) evaluated the scientific production of Iran during 1967 to 2003 and compared it with 15 selected countries. They found that Iran has had an increasing growth after the Iraq-Iran war.

Wen et. al. (2007) in a survey entitled "Scientific production of electronic health record research, 1991–2005" came to the conclusion that numbers of published articles have significantly increased compared to each 5-year period. Most articles were published in English (98%) and were from the region of America (57%). The top 10 of the 374 journals accounted for 41% of the number of published articles. An analysis of the number of articles related to population showed a high publication output for relatively small countries like Switzerland, Netherlands, and Norway. Generally, they found a considerable increase in the literature of "electronic health research" during 1991 to 2005.

Mukherjee (2008) analyzed the authorship pattern of scientific productions of the four most productive Indian academic institutions for the eight-year –period from 2000 to 2007.

The results show that among four universities, the authors of Delhi University contributed the highest number of articles, followed by Banaras Hindu University. There is also an increasing tendency toward collaborative research among Indian authors as well as more frequent collaboration with international authors. Biochemistry and Molecular Biology are two of the most prolific research areas in these four Indian universities. The average rate of references per item is 28 and the citations received per item are 3.56.

Osareh & McCain (2008) studied the intellectual structure of Iranian chemistry research in Science Citation Index (SCI) during 1990 to 2006. The results of this study showed that since 1990, Iranian chemistry research, as represented in the SCI, has grown at a rate of roughly 26% and 7 major clusters were formed during the study period. The topic areas were firstly in Organic Chemistry, and secondly in Analytical Chemistry.

Tian, Wen & Hong (2008) conducted a bibliometric analysis to evaluate global scientific production of Geographic Information System (GIS) papers from 1997 to 2006 in Science Citation Index. Results indicated that GIS research steadily increased over the period and the annual paper production in 2006 was about three times higher comparing to 1997s paper productions.

Arruda et. al. (2009) analyzed the distribution of some characteristics of computer scientists in Brazil according to region and gender. Findings revealed that in the areas of artificial intelligence, computers in education and human-computer interface, Brazilian computer scientists had 5.3 journal publications per male researchers and 6.0 per female researchers, and the difference is statistically significant. And for conferences, the productivity is 23.73 and 30.92 for males and females, respectively. On the other hand, there is not a significant difference in male and female productivity in areas of hardware, network, distributed systems, and theory. Regarding regional differences, there are some statistically significant differences in productivity among different regions, and some differences in the concentration of researchers in a few research topics.

Methodology

This study is based on the scientific productions in Scientometrics as reflected in Social Science Citation Index (SSCI), Science Citation Index (SCI), and Arts and Humanities Citation Index (A&HCI). The time period considered in this study is from 1980 to 2009. A search was carried out in WOS database to get an overall picture of the size of the scientometric literature. SSCI, SCI, and A&HCI were searched by topic (TS) field (scientometric*) by limiting it to the period between 1980 and 2009. The search was performed on the November 3, 2009. Note that the results for 2009 are likely to be incomplete as the databases are continually being updated. Finally, the evaluation was based on parameters including authors, countries, institutions, journals, growth rate, document types, language, and subject areas.

It should be stated that besides articles, there are other types of documents including book reviews, editorials, letters to the editor, notes, bibliographies, proceedings papers, meeting abstracts, etc which are indexed in ISI databases. However, these document types have also been considered in the study.

Results

All document types published in the field of Scientometrics during 1980 to 2009 have been processed. The total number of records from 1980 to November 2009 is 691.

Top Authors of Scientometrics

There were a total number of 836 name occurrences of the authors contributing 691 articles in the field of Scientometrics during the thirteen years. The top 10 authors are listed below in Table 1. This table ranks authors by the number of publications.

Findings revealed that out of 691 articles, a total number of 183 articles (26.48%) were written during 1980 to 2009 by top ten authors. Some of these articles are the result of collaborative efforts and some of them are by single authors. It was interesting to know who the most productive author in the field of Scientometrics was during the period. Findings disclosed that Schubert, A. with 35 articles (5.07 %) was the most productive scientist of Scientometrics. As can be understood from Table 1, Braun and Glanzel each with 24 articles appeared in the next positions, respectively.

Table 1

Top Authors of Scientometrics

Authors	Record Count	Percentage
SCHUBERT, A	35	5.07
BRAUN, T	24	3.47
GLANZEL, W	24	3.47
LEYDESDORFF, L	22	3.18
VINKLER, P	19	2.75
GARG, KC	18	2.60
GARFIELD, E	14	2.03
BONITZ, M	9	1.30
COURTIAL, JP	9	1.30
KRAUSKOPF, M	9	1.30
Total	183	26.48

Geographical Distribution of Scientometric Productions

In this section, we examine the distribution of output of different countries in the field of Scientometrics during 1980 to 2009. Results indicated that the works were published by authors from 56 different nationalities. The countries contributing most to the field of Scientometrics for 30 years are presented in Figure 1.

As it is illustrated in the Figure 1, U.S.A, Hungary, India, Netherlands, Russia, Germany, Spain, England, France, and Belgium were the countries with high contributions in the field of Scientometrics.

It is interesting to observe that on average, six countries (U.S.A, Hungary, India, Netherlands, Russia, and Germany) accounted for 56.44 % of the scientific literature over the studied period. U.S.A was the leading contributor accounting for 14.62 % of the literature in the period. U.S.A was followed by Hungary and India, which accounted for 10.56%, and 8.83% of the literature, respectively. Generally speaking, the study indicates that the field has evolved considerably in different regions of the world.

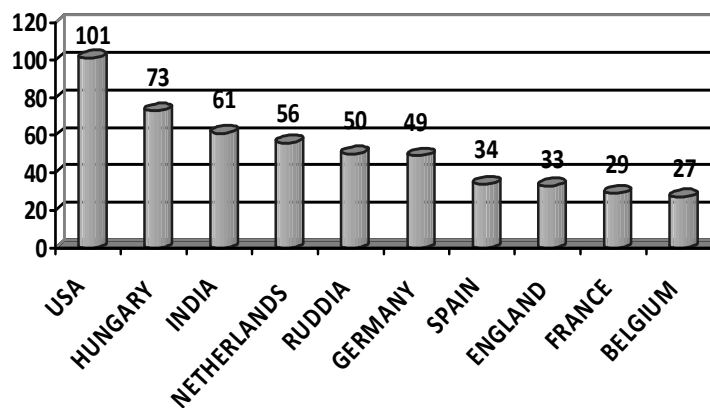


Figure 1. Geographical distribution of scientometrics productions

Institutional Distribution of Contributors

It was feasible to analyze the publications based on institutional distribution of contributors. A total number of 165 records (24.19%) have been contributed by ten institutions during 1980 to 2009. Table 3 shows the most prolific institutions in the field of Scientometrics. Findings revealed that Hungarian Academy of Science with 40 records (5.71%) is the most productive institution in the field of Scientometrics.

Table 2

Institution Distribution of Contributors

Institution Name	Record Count	Percentage
Hungarian Acad Sci	40	5.71
Natl Inst Sci Technol & Dev Studies	26	3.76
Univ. Amsterdam	19	2.75
Univ. Granada	14	2.03
Inst Sci Informat	13	1.88
Lib Hungarian Acad Sci	13	1.88
Leiden Univ	11	1.59
Russian Acad Sci	11	1.59
Katholieke Univ Leuven	9	1.30
Unive Sussex	9	1.30
Total	165	24.19

As can be seen in Table 2, of the 10 prolific institutions, two are from Hungary, two from the Netherlands, and one from India, Spain, U.S.A, Russia, Belgium, and England. The two Hungarian institutes are HUNGARIAN ACAD SCI and LIB HUNGARIAN ACAD SCI. Also, prolific institutes from the Netherlands are UNIV. AMSTERDAM and LEIDEN UNIV. One of interesting findings of this study is that NATL INST SCI TECHNOL & DEV STUDIES (The National Institute of Science, Technology and Development Studies), which is located in India, is the second prolific institution in the field of Scientometrics. It produced 26 papers during the studied period.

Language Distribution of the Literature

For all of the 691 documents, the publication language was examined. The language distribution of the 691 records, though overwhelming majority English (629), includes Spanish (17), German (16), Russian (15), Czech (5), Portuguese (3), French (2), Rumanian (2), Japanese (1), and Turkish (1) (Table 3).

Table 3

Language Distribution of the Literature

Language	Record Count	Percentage
ENGLISH	629	91.03
SPANISH	17	2.46
GERMAN	16	2.32
RUSSIAN	15	2.17

Language	Record Count	Percentage
CZECH	5	0.72
PORTUGUESE	3	0.43
FRENCH	2	0.29
RUMANIAN	2	0.29
JAPANESE	1	0.14
TURKISH	1	0.14
Total	691	100.00

Growth Rate of the Literature

The results of the growth rate are shown in Table 4 and Figure 2. Keep in mind that the frequencies for 2009 are most likely incomplete. It can be observed in Figure 2 that the greatest number of articles was published in 2009 and 2008; conversely, in 1980 and 1983 this number was lower, only with two published works.

We can see in the Figure 2 that the scientific production in the field of Scientometrics has a slow increase from 1980 to 2009; however, in some years fluctuations can be observed in the trend. There are significant increases in 1988, 1994, and 2008.

Table 4

Chronological Distribution of Scientometric Literature

Year	Rec. Co.	Per.	Year	Rec. Co.	Per.	Year	Rec. Co.	Per.
1980	2	0.29	1990	13	1.88	2000	39	5.64
1981	5	0.72	1991	19	2.75	2001	37	5.35
1982	8	1.16	1992	21	3.04	2002	30	4.34
1983	2	0.29	1993	22	3.18	2003	26	3.76
1984	6	0.87	1994	37	5.35	2004	21	3.04
1985	7	1.01	1995	12	1.74	2005	44	6.37
1986	6	0.87	1996	30	4.34	2006	37	5.35
1987	4	0.58	1997	32	4.63	2007	42	6.08
1988	14	2.03	1998	18	2.60	2008	57	8.25
1989	14	2.03	1999	25	3.62	2009	61	8.83

Figure 2 shows the growth rate of the scientometric literature more clearly.

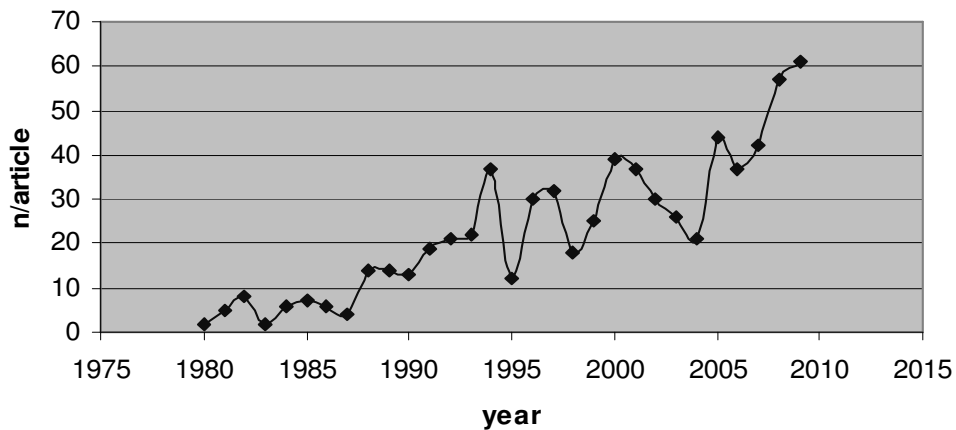


Figure 2. Growth rate of scientometric literature

Top Journals of Scientometrics

The top 10 journals in the field of Scientometrics are listed in descending frequency order in Table 5. It can be inferred from this table that concentration of 46.31% of the total literature is in the international journal of *Scientometrics*. Indeed, “this journal covers almost the complete spectrum of bibliometric research” (Schoepflin & Glanzel, 2001). But, “we are well aware that the journal *Scientometrics* is not the only source of knowledge in the field” (Schubert, 1999). Other journals covering scientometric records are listed in the Table 5.

It should be noted that among the all journals examined, top ten journals listed in Table 5 represent the 62.52% of the total scientometric literature.

Table 5

Top Ten Most Productive Journals in the Literature of the Scientometrics

Journal Name	Record Count	Per.
Scientometrics	320	46.31
Information Proceeding & Management	20	2.89
Journal of Information Science	20	2.89
Current Science	14	2.03
Journal of The American Societ for Information Science and Technology	14	2.03
Journal of Informatiocs	11	1.59
Journal of Analytical Chemistry	9	1.30
Journal of Documentation	9	1.30
Research Evaluation	8	1.16
Current Contents	7	1.01
Total	432	62.52

Subject Areas of Scientometric Literature

As Table 6 indicates, major contribution of the total output came from two subject areas (Library and Information Science and Computer Science Interdisciplinary Application). According to Table 6, out of the 691 records 469 (67.87%) were published in the area of Library and Information Science. The next most popular research areas among the authors were Computer Science Interdisciplinary Application with 47.18% and Computer Science Information System with 13.02%. It should be noted that some of the scientific productions fall in more than one subject area. Due to this fact, the total number of articles belonging to subject areas exceeds the population of the study.

Table 6

Subject Areas of Scientometric Literature

Subject Area	Record Count	Per.
Information Science & Library Science	469	67.87
Computer Science Interdisciplinary Application	326	47.18
Computer Science Information System	90	13.02
Multidisciplinary Sciences	35	5.07
Chemistry Analytical	19	2.75
Chemistry Multidisciplinary	13	1.88
Biology	12	1.74
Management	11	1.59
Social Sciences Interdisciplinary	11	1.59
Medicine Research & Experimental	10	1.45

Document Types of Literature

As mentioned earlier, the data contains all types of documents about Scientometrics published in WOS during 1980 to 2009.

Results disclosed that scientific articles, "strongly encouraged among researchers" (Lolis et. al., 2009), constitute the format of most publications, as only 31.11% were found in the form of other document types. Table 7 details different types of documents in the field of Scientometrics.

Table 7

Document Type of Scientometric Literature

Document Type	Record Count	Per.
Article	476	68.89
Proceedings Paper	63	9.12

Document Type	Record Count	Per.
Editorial Material	39	5.64
Review	37	5.35
Note	23	3.33
Book Review	17	2.46
Bibliography	10	1.45
Biographical-Item	7	1.01
Meeting Abstract	6	0.87
Letter	4	0.58
Reprint	4	0.58
Item About An Individual	3	0.43
Correction	1	0.14
Correction Addition	1	0.14
Total	691	100.00

Conclusion

Bibliometric methods can quantitatively characterize the development of global scientific production in a specific research field (Tian, Wen & Hong, 2008). The use of scientometric indicators for decision making is constantly on the rise resulting in the rapid growth of scientometric studies (Dutt, Garg & Bali, 2003). The objective of this study was to perform a quantitative analysis, using the scientometric technique, of the global publication in the field of Scientometrics during 1980 to 2009. Results of this study revealed that a total number of 691 contributions related to the Scientometrics were published during the period. The overwhelming majority of the articles (91.03%) were in English language. This may be because the source journals are in English. Therefore, it can be stated that the dominant language of the global publications in Scientometrics is English. The results show that out of 691 articles in the field of Scientometrics, 183 articles (26.48%) were written by top ten authors of this field.

We found that researchers of several nationalities are working on the scientometric themes, with a predominance of U.S.A researchers. Almost 14.62% of studied publications were performed by authors from the United States of America. This result supports one of Osareh & Wilson's (2002) findings that U.S.A is the first collaborator of Iranian authors in their research. The sum of research output of the authors from U.S.A, Hungary, India, Netherland, Russia, and Germany reaches 56.44% of the total productivity. Only 6 studies, corresponding to 0.87%, were published by Iranians. Data analysis showed that out of 6 articles, 3 articles (50%) were published in 2008. The publication dates of other 3 Iranian articles were in 2003, 2005, and 2009. It should be noted that, among Iranian institutions,

Shahid Chamran University of Ahvaz ranked first with 2 articles.

Hungarian Academy of Science with 40 records (5.71%) was the most productive institution in the field of Scientometrics. On the other hand, the international journal of *Scientometrics* was the most prolific journal in the field. Since the place of publication of this journal is Hungary, one can conclude that most of Hungarian scientometricians prefer to publish their scientometric articles in *Scientometrics* and this caused the share of Hungarian institutions to be relatively high.

It has been also declared that 67.87% of the literature was published in the area of Library and Information Science. Therefore, it can be stated that library professionals have more tendency to conduct scientometric studies.

Finally, chronological analysis disclosed that the scientific production in the field of Scientometrics shows a slow increase from 1980 to 2009. Generally, results of this study revealed that the share of scientometric literature is on the rise.

Endnote

1. Web of Science (WOS)

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