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The literature of bibliometrics, scientometrics, and informetrics

WILLIAM W. HOOD, CONCEPCIÓN S. WILSON

School of Information Systems, Technology and Management, The University of New South Wales, Sydney (Australia)

Since Vassily V. Nalimov coined the term 'scientometrics' in the 1960s, this term has grown in popularity and is used to describe the study of science: growth, structure, interrelationships and productivity. 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. Areas of study range from charting changes in the output of a scholarly field through time and across countries, to the library collection problem of maintaining control of the output, and to the low publication productivity of most researchers. These terms are used to describe similar and overlapping methodologies. The origins and historical survey of the development of each of these terms are presented. Profiles of the usage of each of these terms over time are presented, using an appropriate subject category of databases on the DIALOG information service. Various definitions of each of the terms are provided from an examination of the literature. The size of the overall literature of these fields is determined and the growth and stabilisation of both the dissertation and non-dissertation literature are shown. A listing of the top journals in the three fields are given, as well as a list of the major reviews and bibliographies that have been published over the years.

Introduction

There has been considerable confusion in the terminology of the three closely related metric terms: bibliometrics, scientometrics, and informetrics. At the Fourth International Conference on Bibliometrics, Informetrics and Scientometrics, *Glänzel* & *Schoepflin* (1994) presented a discussion paper which noted that the triumvirate field was in crisis. The crisis stems in part from the authors' use of 'bibliometrics' synonymously for all three metrics (as well as technometrics which is recognized as a separate field). Incidentally, that the triumvirate field is in crisis is not the majority view in the comments of 29 information scientists which follow *Glänzel* & *Schoepflin's* discussion paper (*Braun*, 1994). *Van Raan* (1997) states that a 'crisis-like' situation for scientometrics is groundless. The confusion is not principally with respect to

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scientometrics: information scientists with backgrounds in the hard sciences tend to view scientometrics as distinct from bibliometrics and informetrics. Confusion by other information scientists may lie in a failure to appreciate that there is more to science than its output of literature. This paper reviews the history, development, and interrelationships of the three metric fields primarily through the literature available in appropriate databases of the DIALOG information system.

Historical survey

Bibliometrics

This section deals with some of the literature on the history of the three metric fields, beginning with the earliest – bibliometrics. Bibliometric methods have been applied in various forms for a century or more (*Pritchard* & *Wittig*, 1981). *Sengupta* (1992) claims that *Campbell* (1896) produced the first bibliometric study, using statistical methods for studying subject scattering in publications. Some of the early work includes that of *Cole* & *Eales* (1917), which is claimed by *Lawani* (1981) and *Khurshid* & *Sahai* (1991a,b) to be the first bibliometric study (although using the older terminology of 'statistical bibliography'). *Cole* & *Eales* (1917) studied the growth of literature in comparative anatomy for the period 1550-1860. *Hulme*'s (1923) work is another early study, using document counts to provide insight into the history of science and technology.

Shapiro (1992) reminds us of the legal precedents of bibliometrics, a topic that has been otherwise neglected by information science historians. The use of citation indexes have been demonstrated as far back as 1743 and publication counts have also been located in legal writings since at least 1817. *Weinberg* (1997) shows that Hebrew citation indexes are even earlier still and date from about the 12th century.

The coining of the term 'bibliometrics' is frequently credited to *Pritchard* (1969b), who proposed the term 'bibliometrics' to replace the little used and somewhat ambiguous term of 'statistical bibliography'.* Authors who agree that *Pritchard* coined the term include *Fairthorne* (1969), *Lawani* (1980), *Hertzel* (1987), *Brookes* (1988), *White* & *McCain* (1989), *Soper* et al. (1990) and *Khurshid* & *Sahai* (1991a).

However, *Wilson* (1995) indicates that this term has a French precedent. *Fonseca* (1973), in a criticism of the tendency of English-language authors to ignore works in

* The ambiguity arises from the two possible interpretations of this phrase as either the statistics of bibliography or a bibliography about statistics.

Romance languages, draws attention to the use of the French equivalent of the term, 'bibliometrie', by Paul *Otlet* (1934) in his *Traitée de Documentation. Le livre sur le Livre. Theorie et Pratique* – hardly an obscure work. Section 124, pp.13-22, of this text is entitled 'Le Livre et la Mesure. Bibliometrie.'

Though *Otlet* (1934) had previously employed the term 'bibliometrie', *Pritchard* (1969b, p. 348) defined the new bibliometrics widely, to be "the application of mathematical and statistical methods to books and other media of communication". In the same year, *Fairthorne* (1969, p. 341) widened its ambit claim even further to the "quantitative treatment of the properties of recorded discourse and behaviour appertaining to it". (Other definitions are given below.) By 1970 bibliometrics had become a heading in both *Library Literature* and in *Library and Information Science Abstracts*, (*Peritz*, 1984) and by 1980 a Library of Congress Subject Heading (*Broadus*, 1987b).

Scientometrics

In 1969, Vassily V. Nalimov & Z. M. Mulchenko coined the Russian equivalent of the term 'scientometrics' ('naukometriya') (*Nalimov* & *Mulchenko*, 1969b). As the name would imply, this term is mainly used for the study of all aspects of the literature of science and technology. The term had gained wide recognition by the foundation in 1978 of the journal *Scientometrics* by Tibor Braun in Hungary. According to its subtitle, *Scientometrics* includes all quantitative aspects of the science of science, communication in science, and science policy (*Wilson*, 2001). Soon after its foundation, Nalimov became the (only) Consulting Editor.* Some other early papers by Nalimov which helped to nurture the nascent discipline of Scientometrics include: *Nalimov* (1970), *Nalimov* & *Mulchenko* (1969a) and *Nalimov* et al.(1971).

Much of scientometrics is indistinguishable from bibliometrics, and much bibliometric research is published in the journal, *Scientometrics*. After all, the immediate and tangible output of science and technology into the public domain *is* literature (papers, patents, etc). In contrast, the focus of bibliometrics, despite many wide-ambit definitions, has always been preponderantly on the literature per se of science and scholarship, while there is more to science and technology for scientometricians to measure and analyze than its literature output; e.g., the practices of researchers, the socio-organizational structures, research and development management, the role of science and technology in the national economy, governmental policies

* Personal communication with M. Bonitz, 6th December, 2000.

towards science and technology, and so on (*Wilson*, 2001). *Nagpaul*, et al. (1999) present 13 papers on the emerging trends in scientometrics, categorized in three parts: scientometrics and science and technology policy, including an introduction to the subject of, scope of and methodology used in scientometrics; the structure and dynamics of science, including individual level up to international level of collaboration among scientists; and regional aspects of science in India. According to *Rousseau* (2000) this book supplements the papers in the journals, *Scientometrics* and *Research Policy*.

Informetrics

The most recent metric term, 'informetrics', comes from the German term 'informetrie' and was first proposed in 1979 by Nacke to cover that part of information science dealing with the measurement of information phenomena and the application of mathematical methods to the discipline's problems, to bibliometrics and parts of information retrieval theory, and perhaps more widely (see also *Blackert* & *Siegel*, 1979). Other definitions of Infometrics are given below. In the following year, *Nacke*, et al. (1980) nominated scientometrics as a sister field of informetrics within information science. *Bonitz* (1982) discusses the introduction of the term 'informetrics' and compares this term with 'bibliometrics' and 'scientometrics'. He sees the introduction of a new term as necessary to distinguish informetrics' main concerns (ie. with scientific communication) from the science of science and library science. In 1984, the All-Union Institute for Scientific and Technical Information (VINITI) established a Fédération Internationale de la Documentation (FID) Committee on Informetrics under Nacke's chairmanship, where 'informetrics' was taken as a generic term for both bibliometrics and scientometrics. This usage was adopted in the VINITI monograph by *Gorkova* (1988) with the Russian title *Informetriya* [Informetrics].

At the First International Conference on Bibliometrics and Theoretical Aspects of Information Retrieval in 1988, *Brookes* suggested that an 'informetrics' which subsumes bibliometrics and scientometrics, for both documentary and electronic information, may have a future. *Informetrics 87/88* was adopted as the short title for the published conference proceedings (*Egghe* & *Rousseau*, 1988), the editors noting that "in promoting a new name, it is a classical technique to use the new name together with the old one". By the second conference (*Egghe* & *Rousseau*, 1990a), *Brookes* (1990) endorsed 'informetrics' as a general term for scientometrics and bibliometrics, with

scientometrics taken as leaning to policy studies and bibliometrics conceded more to library studies. The status of the term 'informetrics' was enhanced in the third conference proceedings in the series, The Third International Conference on Informetrics (*Rao*, 1992), but reduced in the fourth conference title, International Conference on Bibliometrics, Informetrics, and Scientometrics. The proceedings of the fourth conference were published in four separate volumes, three of which were whole issues of regular journals in English (*Glänzel* & *Kretschmer*, 1992; 1994a,b). At this conference, the International Society for Scientometrics and Informetrics (ISSI) was founded, and subsequent conferences (*Koenig* & *Bookstein*, 1995; *Peritz* & *Egghe*, 1997; *Macías-Chapula*, 1999) have been held biennially under the society's auspices. A special issue on informetrics appeared in the journal *Information Processing & Management* (*Tague-Sutcliffe*, 1992b). In summary, by the early 1990s, the term 'informetrics' clearly enjoyed widespread recognition (*Wilson*, 2001).

Summary

An excellent overview of the history of bibliometrics is given by *Hertzel* (1987). She traces the development of bibliometrics from its roots in statistics and bibliography, paying particular attention to the development of the bibliometric laws. Another similar (but much briefer) article is given by *Broadus* (1987a); he discusses the early history of bibliometrics up until 1969 when the term 'bibliometrics' was adopted, and examines the development of the three bibliometric laws, citation analysis and library use studies. *Brookes* (1990) discusses the history and use of the different terminology of the three metrics. *Wilson* (2001) provides a section on the history of the three metric terms and of librametrics. Other articles with some historical content include *Wittig* (1978), *Griffith* (1979), *Roy* (1980), *Schmidmaier* (1984), *Schrader* (1984), *Deogan* (1987), *White* & *McCain* (1989), *Pierce* (1992), *Roman* (1994), *Tague-Sutcliffe* (1994), *Buckland* & *Liu* (1995), *Portal* (1995) and *Chongde* (1996).

Of fundamental importance to the development of the three metric fields, was the discovery of certain regularities, distributions or laws. The earliest of these was Lotka's law which provided a relationship between authors and papers (*Lotka*, 1926). Bradford's law dealt with the problem of the scatter of papers on a scientific subject through the scientific journals (*Bradford*, 1934). Zipf's law was concerned with word frequency or occurrences (*Zipf*, 1949). The recent *ARIST* review on informetrics by *Wilson* (2001) has a detailed discussion of the interrelationship of these three laws.

Frequency distribution of metric terms

A number of terms are used to describe the branch of Information Science that is of interest here. These terms have overlapping but not identical meanings, and also have experienced changing popularity. The main terms used are 'bibliometrics', 'scientometrics' and 'informetrics'. Related to these three terms are their various noun (e.g., 'bibliometry', 'bibliometrician'), adjectival (e.g., 'bibliometric', 'bibliometrical'), and adverbial (e.g., 'bibliometrically') forms. Other terms used includes 'statistical bibliography' which is now obsolete, and the rarely used terms 'librametrics' or 'librametry'. Various forms of 'technometrics' also appear; however, as mentioned earlier, technometrics is recognized as a separate area of study and will not be included in the analyses below.

Table 1
Number of documents with each of the different terms related to the metric fields in Information Science

Term	Frequency
BIBLIOMETRICS	5097
BIBLIOMETRIC	2653
SCIENTOMETRICS	1326
SCIENTOMETRIC	552
INFORMETRICS	418
TECHNOMETRICS	274
INFORMETRIC	197
BIBLIOMETRY	73
BIBLIOMETRICALLY	40
STATISTICAL BIBLIOGRAPHY	38
BIBLIOMETRICAL	24
TECHNOMETRIC	20
BIBLIOMETRICIANS	17
SCIENTOMETRY	17
LIBRAMETRY	16
SCIENTOMETRICAL	11
SCIENTOMETRICALLY	10
SCIENTOMETRICIANS	9
BIBLIOMETRICIAN	7
LIBRAMETRICS	7
SCIENTOMETRICIAN	6
INFORMETRICIANS	5
INFORMETRY	5
LIBRAMETRIC	5
TECHNOMETRICALLY	1

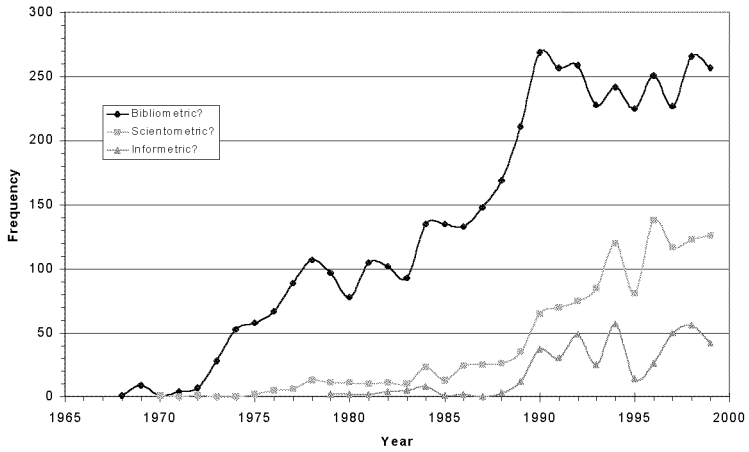

Figure 1. Frequency distribution of the three metric terms by publication year

Table 1 shows each of the terms as well as related terms (in English only), in decreasing order of occurrence in the Information Science (INFOSCI) subset of databases on DIALOG. The search was performed on 4th August, 2000. No attempt was made to remove duplicates as this table is meant to show in broad categories the usage of the different terms. The 12 databases in the INFOSCI category on that date were ERIC, INSPEC, NTIS, Social SciSearch, Dissertation Abstracts Online, Gale Group Magazine DB, LISA, British Education Index, Gale Group Trade & Industry DB, Information Science Abstracts, Education Abstracts, Library Literature.

Each of the three metric terms was also ranked by the publication year of the documents containing the term. Each term was truncated (using the symbol '?' for unlimited truncation in DIALOG), duplicates removed (using DIALOG's 'rd' command) and a ranking done by publication year (using DIALOG's 'rank py' command). Yearly frequencies were then ordered chronologically and plotted using Excel. The results of the distribution of terms by publication years are shown in Figure 1; note however that the frequencies for 1999 are most likely incomplete.

We can see from Figure 1 that the usage of the term 'bibliometric?' has been steadily increasing from 1970 to 1990; however, since 1990 there has been a gradual decrease or levelling off. The term 'scientometric?' shows a slow increase from c.1975 until 1989; it nearly doubled in 1990 and has been increasing in usage since. 'Informetric?' shows

eratic usage in the 1980s; however, from 1990 it remains fairly constant in usage. It should be noted that in 1995, all three terms decreased markedly in usage. This phenomenon can't be readily explained in this paper. A check for total numbers of publications (duplicates included) in the INFOSCI group of 12 databases in DIALOG shows gradual increasing numbers of publications from 1994 to 1996; a marked decrease in 1997; and significant increases in 1998 and 1999. This check (of annual production of papers) suggests that the drop in 1995, as shown in Figure 1, does not relate with the overall drop in the number of documents in the 12 databases of the INFOSCI group.

Definitions of metric terms in Information Science

Bibliometrics

There are many definitions of the term 'bibliometrics' in the literature; only a few will be mentioned. Other definitions not discussed are provided by *Fairthorne* (1969), *Hawkins* (1977), *Khawaja* (1987), *Burton* (1988), *Egghe* (1988), *Khurshid* & *Sahai* (1991a,b) and *Tague-Sutcliffe* (1992a). An early definition is provided by *Pritchard* (1969b, pp. 348-349):

> "to shed light on the processes of written communication and of the nature and course of development of a discipline (in so far as this is displayed through written communication), by means of counting and analysing the various facets of written communication … the application of mathematics and statistical methods to books and other media of communication ...".

Broadus (1987b, p. 376) reviews various other definitions, and then provides the following:

> "... the quantitative study of physical published units, or of bibliographic units, or of surrogates of either ...".

In contrast to the other two terms (scientometrics and informetrics), Brookes (1990, p. 42) says:

> "I have no doubt that bibliometrics must now be conceded to library studies only. Its work is not yet ended as libraries continue to adapt to the changing world around them. And bibliometrics itself needs the continued interest of outside experts, statisticians and others, in developing and refining its techniques."

White & *McCain* (1989, p. 119) have the following definition and explanation:

> "Bibliometrics is the quantitative study of literatures as they are reflected in bibliographies. Its task, immodestly enough, is to provide evolutionary models of science, technology, and scholarship."

Scientometrics

Scientometrics has typically been defined as the "quantitative study of science and technology", as for example in the recent special topic issue of the *Journal of the American Society for Information Science* (JASIS) on science and technology indicators, edited by *Van Raan* (1998, p. 5). As noted earlier, technometrics is recognized as a separate field; thus, the journal, *Technometrics*, founded in 1959 in the U.S., takes as its scope the development and use of statistical methods in the physical, chemical and engineering sciences.

Brookes (1990, p. 42) gives further insight into the use and definition of scientometrics:

> "The term scientometrics, nurtured by Tibor Braun, has become fruitful in science policy studies. Its techniques have been developed by small groups of scientists working with single-minded enthusiasm in compact research units notably in Budapest and Leiden. But other research units in Europe, East and West, are beginning to make contributions to scientometric studies. The term has now established a significant role in the social sciences. Applications have so far been restricted to exploitation of the citation data provided by ISI but further refinements are now being critically examined. Though the techniques of scientometrics and bibliometrics are closely similar their different roles are distinguished by their very different contexts."

Another definition is provided by *Tague-Sutcliffe* (1992a, p. 1):

> "Scientometrics is 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".

Informetrics

The term 'informetrics' is perhaps the most general of the three terms. Informetrics *may* subsume scientometrics and more especially, bibliometrics; however, workers in the three metric areas will continue to use the term they feel most closely describes their understanding of their work. In particular, researchers outside the information science discipline will continue to use the more familiar (and established) term, bibliometrics.

A brief definition is implicitly provided by *Egghe* & *Rousseau* (1990b, p. iii) in the subtitle of their book:

> "Informetrics: Quantitative Methods in Library, Documentation and Information Science."

Informetrics covers the empirical studies of literature and documents, as well as theoretical studies of the mathematical properties of the laws and distributions that have been discovered. *Tague-Sutcliffe* (1992a, p. 1) provides the following definition:

> "Informetrics is the study of the quantitative aspects of information in any form, not just records or bibliographies, and in any social group, not just scientists. Thus it looks at the quantitative aspects of informal or spoken communication, as well as recorded, and of information needs and uses of the disadvantaged, not just the intellectual elite. It can incorporate, utilise, and extend the many studies of the measurement of information that lie outside the boundaries of both bibliometrics and scientometrics. … Two phenomena that have not, in the past, been seen as a part of bibliometrics or scientometrics, but fit comfortably within the scope of informetrics are: definition and measurement of information, and types and characteristics of retrieval performance measures."

Ingwersen & *Christensen* (1997, p. 13) have the following definition:

> "The term informetrics designates a recent extension of the traditional bibliometric analyses also to cover non-scholarly communities in which information is produced, communicated, and used."

Wilson (2001) concludes the latest *ARIST* review with the following definition:

> "… informetrics is the quantitative study of collections of moderate-sized units of potentially informative text, directed to the scientific understanding of informing processes at the social level."

Librametrics

The term 'librametry' was proposed by Ranganathan in 1948 as the application of mathematical and statistical techniques to library problems (*Sengupta*, 1992). This term has not been widely adopted as shown in Table 1. However, *Wilson* (2001) indicates that:

> "There may be value in retaining the terms 'librametrics' or 'librametry' for such studies not specifically analyzing literatures, or at least not specifically directed to the goals of bibliometrics and of information retrieval. These include analyses of book circulation … , of library collection overlap … , of library acquisitions … , of fines policy … , and of shelf allocation … – frequently using optimization techniques from operations research."

Metrics on the Web

There is also an emerging literature adapting the methodologies and techniques of the three metric fields to electronic information on the World Wide Web. *Wilson* (2001) identifies three additional metric terms entering the literature of information science.

> "In 1995 Bossy introduced the term *Netometrics* to describe Internet-mediated scientific interaction, which she sees as becoming the main source of data for studies of 'science in action'. In 1997 Almind & Ingwersen suggested *Webometrics* for the study of the World Wide Web, and all network-based communication, by informetric methods. A similar, but not necessarily identical, subfield is suggested by the title of the new journal *Cybermetrics*, established in 1997 by the Centro de Información y Documentación Científica (CINDOC) in Madrid, under the editorship of Isidro Aguillo. The journal, appropriately electronic-only, covers research in scientometrics, informetrics and bibliometrics – a regrettable triumvirate – but with special emphasis on their interrelations with the Internet, on the evaluation of electronic journals on the web, and on the application of informetric techniques to cyberspace communication in general."

Literature of bibliometrics, scientometrics and informetrics

To give an overview of the triumvirate metric literature, a search was undertaken using the rank feature of DIALOG. The search statement (s informetric? or

bibliometric? or scientometric?) was used to get an overall picture of the size of the metric literature.* A more comprehensive search could have truncated the terms earlier (e.g., informetr?) in order to retrieve additional non-English versions of the terms (e.g., 'informetrische') and some English terms (e.g., 'bibliometry'). A search conducted on the 13th of October, 2000 using a more generous truncation (e.g., informetr?) of the metric terms over the same databases in the INFOSCI subject category of DIALOG retrieved only 48 more documents out of c. 7530 documents, duplicate documents included. A further truncation (e.g., informet?) of the metric terms resulted in 14 more documents; however, upon inspection, 10 of these were not relevant (e.g., Informetal, a company).

The search was carried out on the 4th August, 2000, initially on the *Dissertations Abstracts* database (one of the 12 databases included in the INFOSCI subject category), and then on the INFOSCI subset of Information Science related databases. Note that the results for 1999 are likely to be incomplete as the databases are continually being updated.

Frequency distributions

Dissertations. The numbers of dissertations in the three metric fields (per *Dissertations Abstracts Online*) are shown in Figure 2. Making amendments for the earlier truncation of the metric terms adds five more dissertations. *Dissertations Abstracts Online* includes dissertations from American universities from 1861; however, from 1988 the database includes dissertations from 50 British universities and sections of *Worldwide Dissertations* (formerly *European Dissertations*).** The language distribution of the 143 dissertations, though largely English (105), includes Spanish (34), Catalan (1), Dutch (1), French (1), and Swedish (1). No doubt there are many more dissertations not included in this database, especially written in languages other than English; however, Figure 2 does show a slow increase in numbers of dissertations from the mid 1970s to the mid 1980s. Since 1990, there has been a levelling off in the numbers of dissertations.

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* This search statement will search for any of the three terms, truncated, in the 'basic' index of each database searched. The basic index consists of all the fields that DIALOG regards as being subject-related. For example, in File 61 - LISA, the basic index currently consists of the title (TI) field, the abstract (AB) field, the references (CR) field (for Current Research in Library and Information Science records only), and the descriptor (DE) field. This statement will also only retrieve documents using the newer terminology; hence, earlier documents using the older term 'statistical bibliography' for example will not be retrieved.

** See the DIALOG Bluesheet for File 35, *Dissertations Abstracts Online*, http://library.dialog.com/bluesheets/html/bl0035.html accessed on 17 October 2000.

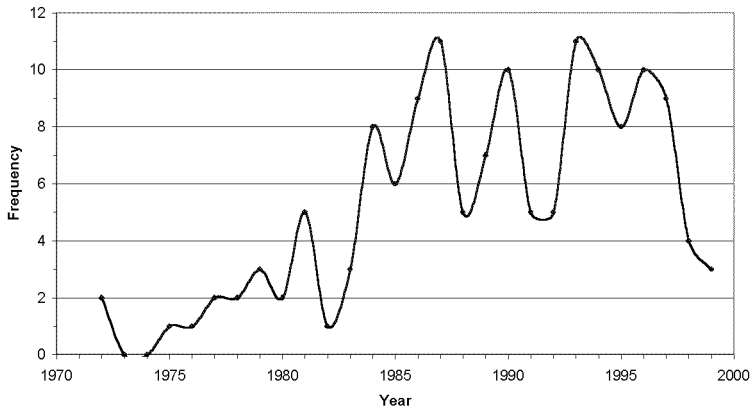

Figure 2. Dissertations by publication year in the three metric fields

*Non-dissertations***.** The INFOSCI subset of the DIALOG databases were used to give a rough guide to the size of the metric literature *other* than dissertations. The same search statement was used as above, and the set restricted to articles published after 1950.* The 'remove duplicates' (rd) feature of DIALOG was used to reduce this to a unique set of records (as far as this procedural algorithm is accurate). The resulting set was ranked (and plotted) by publication year (Figure 3) and ranked by journal name (Table 2). The results from the ranking were manually adjusted and some categories were collapsed to cater for differences in journal name and publication year representation.

The total number of 'unique' records from 1968 to August 2000 is 4857. The yearly numbers are plotted in Figure 3, excluding the year 2000. The figure shows strong growth of the number of non-dissertation publications, with the 1980s being particularly productive. In the 1990s there appears to be no increases in the number of publications, with numbers around c.250-300 for each year in the 1990s. The 1990s appears to be a period of stability with a steady number of publications for each year. It is not surprising that the yearly distribution profile for the non-disssertations of the three metrics parallels the profile for the term 'bibliometric?' in Figure 1.

* This was necessary as the original set contained more than 5000 records - which is too many for the 'remove duplicates' command. In fact, the earliest starting date for the INFOSCI files is 1964, so we would not expect any records with a publication year prior to this date. By including the restriction 'py>1950', we are also removing all the records without a PY field. In addition, the non-dissertation records (43) retrieved with the more generous truncation of the terms are not included in this section.

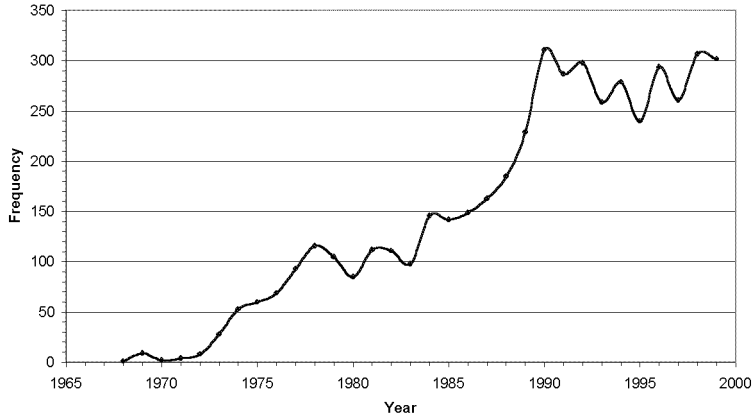

Figure 3. Non-dissertations by publication year in the three metric fields

Top journals. The DIALOG 'rank jn' command produced a list of 737 unique entries for the Journal Name (JN) field, out of 4357 records with a valid JN field (although this produced 4697 journal names). Many of these 'unique' entries represent various representations for the same journal title. All entries with a frequency of five or more were downloaded, and these entries were manually collapsed where necessary. The top 20 journals, and the languages of the publications are listed in decreasing frequency order in Table 2. These top 20 journals, each with a frequency of 35 or more articles represent c. 61% of the total number of documents with a valid JN field in the INFOSCI category of DIALOG from 1950 to August 2000. The ranking closely resembles ones found in other studies (*Peritz*, 1990; *Wilson*, 2001). A Bradford-type plot (Figure 4) shows a concentration of c. 39% of the total literature in seven journals without manual collapsing of journals; with collapsing of journal titles as shown in Table 2, the concentration rises to c. 49%. *Peritz*'s (1990) study over two time periods (1960-1978 and 1979-1983) showed concentrations of c. 28% and 30% (respectively) in seven journals for each of the two time periods. Our study shows a trend towards further concentration of publications in the top-producing journals. It should be noted that in *Peritz*'s (1990) study, the journal *Scientometrics* (founded in 1978) did not feature in the first time period; however, it ranked first in the second time period.

Table 2
Top twenty most productive journals in the literature of the three metric fields
based on DIALOG's ranking *with* collapsing of journals due to variant forms of representation

Rank	No. records	Journal name (JN)	Language
1	1197	SCIENTOMETRICS	English
2	319	JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE	English
3	285	NAUCHNO- TEKHNICHESKAYA INFORMATSIYA SERIES 1 & 2*	Russian & (Eng. Transl)
4	128	INFORMATION PROCESSING & MANAGEMENT	English
5	127	JOURNAL OF INFORMATION SCIENCE	English
6	109	JOURNAL OF DOCUMENTATION	English
7	95	REVISTA ESPANOLA DE DOCUMENTACION CIENTIFICA	Spanish
8	67	CIENCIA DA INFORMACAO	Portuguese
9	66	ANNALS OF LIBRARY SCIENCE AND DOCUMENTATION	English
10	59	LIBRARY AND INFORMATION SCIENCE RESEARCH	English
11	55	BULLETIN OF THE MEDICAL LIBRARY ASSOCIATION	English
12	50	LIBRARY SCIENCE WITH A SLANT TO DOCUMENTATION	English
13	49	INTERNATIONAL FORUM ON INFORMATION AND DOCUMENTATION	English
14	48	ZENTRALBLATT FÜR BIBLIOTHEKSWESEN	German
15	43	COLLEGE AND RESEARCH LIBRARIES	English
16	42	LIBRARY TRENDS	English
17	39	IASLIC BULLETIN	English
18	38	NACHRICHTEN FÜR DOKUMENTATION	German
19	37	FINANCIAL POST	English
20	35	LIBRARY AND INFORMATION SCIENCE	Japanese
lower ranks	1809		
Total	4697		

* This represents five different journals: three in Russian and two in English. *Nauchno-Teknicheskaya Informatsiya* was one journal before 1966, and then split into two series. It was not always possible to determine from the RANK listings which of the three journals a particular entry belonged to; hence, they have been put together into one journal. There are also two English translations of selected articles from these journals; the translation for Series 1 has the title *Scientific and Technical Information Processing* and the translation for Series 2 has the title *Automatic Documentation and Mathematical Linguistics*; the later added 14 documents to the total number listed.

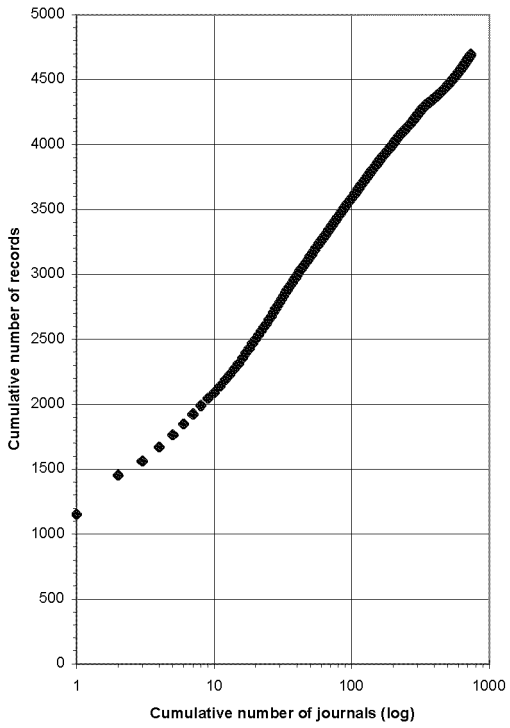

Figure 4. Bradford-type distribution of journals in the literature of the three metric fields based on DIALOG's ranking *without* collapsing of journals due to variant forms of representation.

*Bibliographies and reviews***.** Over the years, a number of reviews and bibliographies of the bibliometrics, informetrics and scientometrics literature has been published; some are general in their scope whereas others cover specific sub-topics. A listing of some of these is given in chronological order in Table 3. The most comprehensive of these are the reviews of *Pritchard* (1969a) and *Hjerppe* (1980). Due to the significant growth in the literature that has occurred since these bibliographies, subsequent works have had to be significantly more selective in their scope and coverage. With an annual publication level of about 300 publications, the whole field has become too large for a comprehensive bibliography. However, authors who examine, select and review the literature in a particular subfield of the general metric field will continue to provide a useful service to both novice and seasoned researchers and practitioners.

Table 3
Selected bibliographies and reviews of bibliometrics, scientometrics, informetrics, and related literatures

Author(s) and publication date	Type of publication	(Main) Topic	No. of refs.[a]	Years covered	Indexes
Pritchard (1969a)	Bibliography	Statistical bibliography	700	1881-1969	
Narin & Moll (1977)	*ARIST* Review	Bibliometrics	132	1923-1977	
Vlachy (1978)	Bibliography	Lotka's law and related phenomena	437	1892-1978	
Vlachy (1979)	Bibliography	Nobel prizes: a bibliography of scientometric papers and data sources	140	1901-1978	
Hjerppe (1980)	Bibliography	Bibliometrics and citation indexing & analysis	2032	up to 1979	Keyword
Pritchard & Wittig (1981)	Bibliography	Bibliometrics	624	1874-1959	Author, citation, subject
Hjerppe (1982)	Bibliography (supplement to Hjerppe (1980))	Bibliometrics and citation indexing and analysis	518	up to 1982	Keyword
Schubert (1983-1991)	Bibliography	Quantitative studies of science	varies	varies	Various in Schubert (1995)
Stowe (1986)	Annotated bibliography	Qualitative and quantatitive indicators of the quality of science	475	up to 1986	
White & McCain (1989)	*ARIST* Review	Bibliometrics	340	mainly 1977-1988	
Lockett (1989)	Review	Bradford distribution	79	1934-1987	

Table 3 (continued)

Author(s) and publication date	Type of publication	(Main) Topic	No. of refs[a]	Years covered	Indexes
Gluck (1990)	Review	Journal coverage overlap	145	up to 1989	
Khurshid & Sahai (1991a, 1991b)[b]	Bibliography	Bibliometric distributions and laws	425	1917-1990	
Sellen (1993)[c]	Annotated bibliography	Bibliometrics	858	1970-1990	Author, subject
Harsanyi (1993)	Review	Bibliometrics and scholarly collaboration	113	1963-1993	
Herubel & Buchanan (1994)	Annotated bibliography	Citation studies in humanities and social sciences	214	up to 1994	
Osareh (1996a & 1996b)	Review (in two parts)	Citation and co-citation analysis	136	up to 1995	
Schubert (1996a, 1996b, 1996c, 1996d, 1999)	Citation based bibliography	Scientometrics	varies	1990-1996	Author, Geographical & Corporate, Permuted Title, Cited Paper (1994-1996)
Ding (1998a & 1998b)	Review (in two parts)	Scholarly communication & bibliometrics	163	up to 1997	
Wilson (2001)	*ARIST* Review	Informetrics	346	(mainly) 1989-1999	

[a] This column provides the approximate number of references in the review or bibliography.
[b] Apart from the title, these two articles appear to be almost identical in content.
[c] This work is reviewed in *Peritz* (1994); the content and organisation of the bibliography are reviewed unfavourably, however the annotations receive a favourable mention.

Conclusions

One of the interesting features of the bibliometrics /scientometrics / informetrics discipline, is the fact that there are three related terms used to describe part or all of this discipline. Each of these terms has a particular historical origin which is generally well documented. In addition, each of these terms has a range of definitions that have been applied to them by the authors who are working in this field. These definitions indicate considerable overlap in meaning of the terms, but they are not necessarily synonymous. Over time, the popularity (or usage) of the terms has changed, with the older term 'bibliometrics' fairly stable and the newer terms, 'informetrics' and 'scientometrics' gaining in usage. The growth rate of the literature of this combined field has also stabilised over the last five years with an annual publication count of about 300 records. As the interests of researchers in this field turn to the measurement of webpages or websites, new terms have been coined to describe the application of measurement techniques to the internet, web and cyberspace pages or sites (i.e., netometrics, webometrics, and cybermetrics). As with the mostly print-based metric terms, we can expect to see researchers choosing terms which they feel most accurately describe their work. In all likelihood, these electronic-based metric terms will co-exist for a time. A search of the INFOSCI subject category in DIALOG shows no records for 'netometr?'; nine records for 'webometr?' (six in 1997, one in 1998 and two in 1999); and 14 for 'cybermetr?' (two in 1991, one in 1993, three in 1998, and four each in 1999 and 2000). No doubt a search for the frequency of occurrences of these terms would best be conducted using one or more of the search engines on the internet.

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Received February 19, 2001.

Address for correspondence:
W.W. HOOD
School of Information Systems, Technology and Management
The University of New South Wales
Sydney, NSW 2052, Australia
E-mail: W.Hood@unsw.edu.au

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