BIBLIOGRAPHY COMPLEX

Fundamentals of Librarianship and Knowledge Management

Edited by

Karl Min Ku

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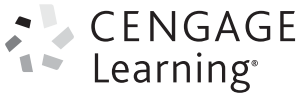

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7

Bibliometrics and Knowledge Behavior Studies

Chiao-min, Lin **[林巧敏]**

Bibliometrics was initially a statistical and mathematical study of the usage and publication type of published literature. It is now widely used in the analysis of volume, authors, and related research institutions of academic literature in a specific field of study, in order to provide an understanding of their scholarly productivity or growth and scatter of literature. More specifically, citation analysis can be used to study the connection between different literatures or disciplines. This will give us a mastery of the knowledge behavior in that field of study and enable us to study the trends in academic development.

Bibliometrics has become an essential method used to predict trends in academic development. In this chapter, we will explore the application of bibliometric methods in the analysis of social knowledge behavior. First, the significance and development of bibliometrics are reviewed. Thereafter, we will discuss knowledge production, growth, and distribution levels, including the prediction of social patterns of knowledge behavior alongside literature growth theory, and preplanning for the related trend in its development. In the next section, we will be dealing with topics pertaining to knowledge behavior,

including content and connection analysis. Here, citation and connection analyses are used to understand and construct the connection of knowledge content. In the last section, we will explore how bibliometrics is applied to social knowledge behavior analysis, and how this analysis, with its predictive capabilities, can be used in library information service planning.

BIBLIOMETRICS: SIGNIFICANCE AND DEVELOPMENT

There is no lack of material about the definition and development of bibliometrics. Here we have quoted discussions from relevant works and organized them as shown in Table 7-1.[1]

Terms such as librametrics, bibliometrics, scientometrics, and informetrics, are about statistical, mathematical, or logical analyses of bibliographies, catalogs, and subjects, and their coverage characteristics, individually or collectively.[2] As there have been debates on the boundaries between bibliometrics, scientometrics, and informetrics, for clarification on their differentiations, a list of the respective origins, goals, definitions, scopes, and application of these terms is listed in Table 7-2.

As a matter of fact, the characterizations of the types of information are included in the bibliographic descriptions. From this, author information can serve as an indicator for studies of the author's productivity, while subject information supplies material for analysis of

Table 7-1 Definition and development of bibliometrics

Year	Wording and Definition
1923	F.W. Hulme used the term "statistical bibliography" to describe the quantitative method of evaluating scientific progress with the quantity of books, a method used to evaluate the development and growth of civilization.
1948	S.R. Ranganathan coined the term "librametrics," placing emphasis on statistics and mathematical analysis as tools of analysis for all numbers directly related to the library.
1969	A. Pritchard was the first to use the term "bibliometrics" to replace other terms used to describe this concept, and defined it as the "application of mathematics and statistical methods to books and other communication media."
1976	New definitions emerged. The most common is by British Standards Institution: "the statistical and mathematical study of literature utilization and form of publication."
1969	G.M. Dobrov and A.A. Karennoi simultaneously proposed "scientometrics," which emphasized the quantitative assessment of the growth of fundamental science and the comparison of scientific research.
1980	At the Frankfurt seminar on bibliometrics, O. Nacke introduced the term "informetrics," emphasizing the measurement of information productivity in studying information-related scientific activities.

developmental trends. As the majority of bibliographic information is mostly occupied by achievements in scientific and technological research, it is no surprise that bibliometrics, as a tool, studies mostly scientific and technological developments. In addition, the fact that most bibliographies studied in bibliometrics are from scientific literature makes it difficult to discriminate between scientometrics and bibliometrics. Although informetrics is mostly about the measurement of information flow and utilization, its object of study remains bibliographies. Therefore, whether in terms of scope or application, bibliometrics, scientometrics, and informetrics have common elements. They can be differentiated mostly by the scope of application of measurement technology. In bibliometrics, measurement technology is used in bibliographic organization and services while scientometrics is used in scientific organization and scholarly communication. Informetrics is used in information systems and services. Patentometrics and webometrics, which were subsequently developed, can also be categorized by their scope of application.

Bibliometrics has progressed from its original state to manual calculations for results and analysis, and further evolved to automatic and fully automatic calculation. This has caused the function of bibliography to evolve from the analogy of an "individual particle structure" to a "continuous series," where knowledge is similar to the phenomenon of the electromagnetic spectrum. Thus, each bibliometric spectrum is a collection of a knowledge phenomenon. These collections, after being compiled and analyzed, have become important tools for public knowledge management. Be it bibliometrics, scientometrics, or informetrics, the key elements are similar: they all demonstrate knowledge behavior and show its developmental trends. They represent a major breakthrough in the ethics and practice of library knowledge management.

GROWTH AND DISTRIBUTION OF KNOWLEDGE PRODUCTION

Literature can be seen as a record of all human information and knowledge. Through the analysis of literature's growth and distribution, predictions of social knowledge behavior patterns can be made, and planning can be done for knowledge behavior's route of development. By using bibliometrics to analyze bibliographic information, rules can be formed and used in predicting which channels literature will use to make its quantity growth. This will help researchers to have a clear idea of the trends in the field of knowledge and assist libraries in planning storage space and services. Particularly in terms of service, an understanding of literature growth and its distribution helps to review the preparation of subject bibliographies and selective bibliographies. Sampling knowledge management and knowledge quality has always been useful in the development of knowledge support and reference services, which are discussed in Chapter 9.

Table 7-2 A comparison of bibliometrics, scientometrics, and informetrics

Item	Bibliometrics	Scientometrics	Informetrics
Origin	1. In 1948, the Indian library scientist Ranganathan introduced the term "librametrics." 2. In 1969, Pritchard was the first to use the term "bibliometrics."	1. In 1969, Dobrov and Karennoi proposed "scientometrics" in the International Literature Association publications of the Soviet Science and Technology Information Center. 2. In 1978, a Hungarian professor, Tibor Braun, started the journal *Scientometrics*, for quantitative studies of individual, institutional, national, or global characteristics of science development mechanism.	1. In 1980, at the Frankfurt seminar on bibliometrics, O. Nacke introduced "informetrics." 2. In 1984, the International Federation for Information and Documentation (FID) set up the Committee for Informetrics.
Definition	The statistical and mathematical study of literature utilization and form of publication.	The study of the structure and properties of scientific information, and of rules in the scientific communication process. The quantitative assessment of the growth of any fundamental science and on the comparison of scientific research.	The measurement of various types of information productivity, mostly in order to study information-related scientific activities.
Goal	1. Description of document features for productivity calculation. 2. Calculation of document citation using reference bibliography or citations.	1. Collection of complete data with correct explanations to raise research efficiency. 2. Scientific analysis with mathematical methods.	1. Effective prediction of electronic information system development. 2. Increase efficiency of information processing, storage, and dissemination.
Scope	1. Descriptive bibliometrics: description of document features. 2. Evaluative bibliometrics: examining relationship between document content.	Scatter and aging of science information in anything from papers, patents to journals, structure of scientific document flow, and citation processing, are all within its scope.	Formed by information theory, cybernetics, decision theory, and application theory, borrowing on theories and technologies of mathematics, physics, and computer science, and applied to library management, science policies, information search, and so on.
Application	1. User characteristics and developmental trend of disciplines. 2. Identify core journals. 3. To understand relations between documents by citation analysis.	Covered in Scope.	1. Distribution and degradation of information. 2. Efficiency of information systems. 3. Information relevance and so on. 4. Subject content overlapping between journals. 5. Assessing relations between and within academic disciplines.

Growth in the quantity of literature represents the progress of human civilization and increases in knowledge levels. On a cumulative basis, the quantity of literature can only increase. When calculating its growth, the same standard or statistical basis must be applied to knowledge media within a certain time and space for total amount and preliminary analysis. The relationship between media curves should be displayed in time and space coordinates, forming a chart showing increases or decreases in order to give an idea of the overall trends of knowledge development. The literature increase phenomena are displayed in linear, exponential, or logistic distribution relationships, and at times, in non-linear dynamic chaos. These are further discussed in the following section.[3]

Linear Growth

Linear growth means that literature amount accumulates in a linear manner: it increases by the same amount each year. When M.R. Oliver analyzed literature on semi-conductor physics,[4] C.S. Fisher studied literature on mathematical non-variable theory,[5] and when A.H. Barton and E.D. Wilder analyzed literature on reading behavior, they all discovered that the literature grew at a fixed amount each year, following a linear pattern of growth. The growth of literature about reading behavior studies from 1881–1951 in Figure 7-1 shows that growth clearly followed a linear pattern after 1991.[6]

Chiao-min Lin [林巧敏] studied the increase curve in a number of theses and dissertations in the field of information organization from 1972–2008. He observed that the total volume increased with the number of schools as well as departments of library and information science. From 1996, the volume increased steadily year by year, peaking in 2006 and decreasing in the

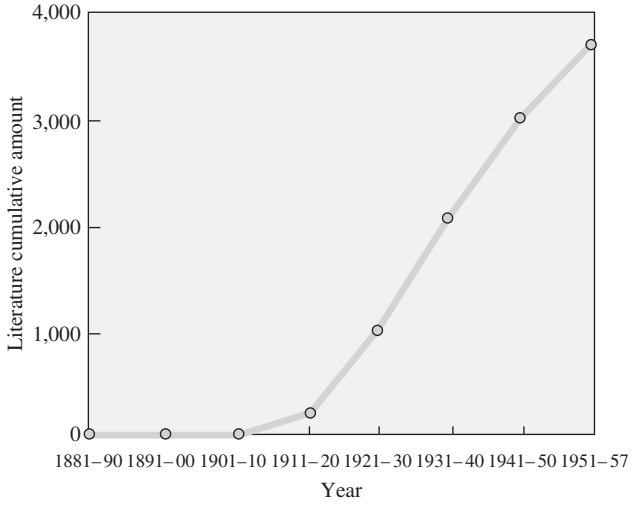

Figure 7-1 Linear growth of literature

Source: Barton & Wilder (1960), p. 1087; Quoted from Tsai (2003), p. 64.

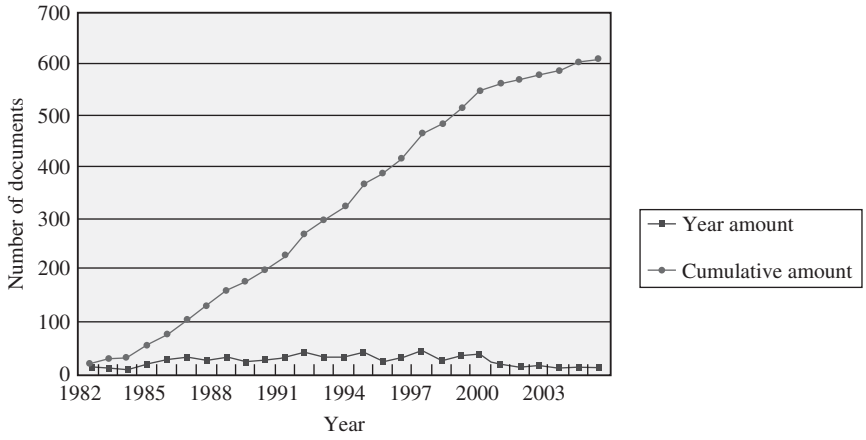

Figure 7-2 Linear Growth in the Number of Research Papers on Information Organization.

Source: Chiao-min Lin, "A Bibliometric Analysis on the Literature of Information Organization in the Taiwan Regional District," *Journal of Library and Information Studies* **7** (1/2) (2009): 110.

academic years of 2007 and 2008. If the yearly amounts and cumulative amounts of the theses are compared, it is apparent that the increase curve approximates a straight line from 1992 onwards, and the rapid growth in the academic year of 2006 declines in the 2008's academic year (*see* Figure 7-2).

Exponential Growth

The greater the total cumulative amount of literature, the larger the increase. In terms of the number of journal articles, its rate of increase rises as scientific research speeds up. An example is *Physics Abstracts*. Since it began publishing in 1900, the number of articles has increased in an almost exponential curve, doubling every 15 years.[7] The growth chart is as shown in Figure 7-3.

However, the increase in scientific research literature cannot be sustained at an exponential rate indefinitely. When this rate peaks, unless re-enforcement is made in the research field, research tends to slow down, and the rate of increase in the amount of literature will ease off. In reality, there is an eventual limit to any growth. Hence, the logistic growth theory is used to address the problem of natural limit in exponential growth.

Logistic Growth

The logistic growth theory recognizes that in the beginning, literature volume can grow exponentially and sustain this rate until it reaches the mid-point where the growth rate starts to moderate, forming a curve symmetrical to that the point before the mid-point, making the whole growth an "S" shaped curve. It means that when the growth rate reaches saturation at the

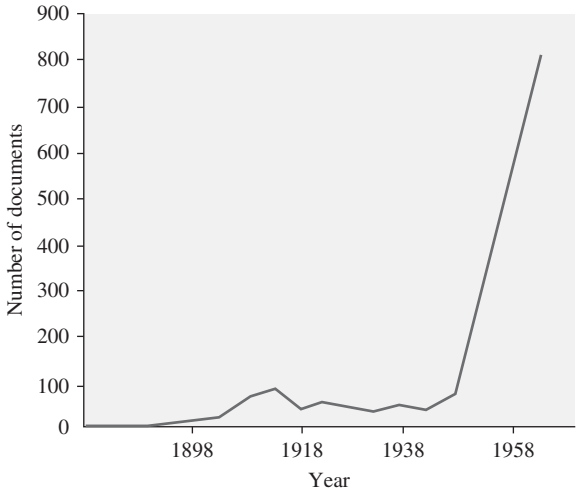

Figure 7-3 Exponential increase in quantity of literature

Source: W. Goffman, "Mathematical Approach to the Spread of Scientific Ideas: The History of Mast Cell Research," *Nature* **212** (1966): 29; Tsai (2003), p. 74.

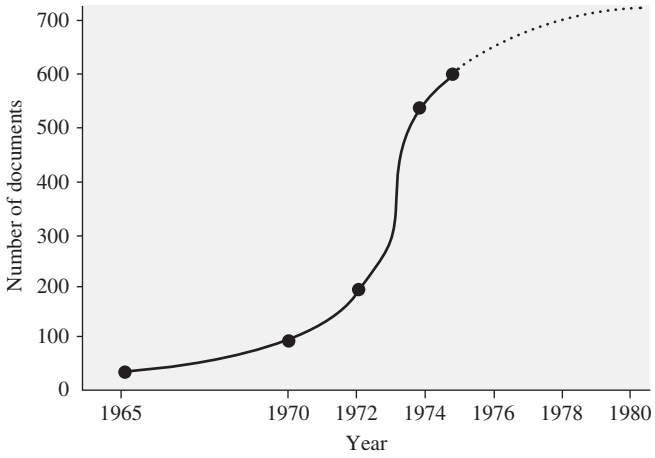

Figure 7-4 Logistic increase in the volume of literature

Source: J.D. Frame *et al.* "An Information Approach to Examining Developments in an Energy Technology: Coal Gasification," *Journal of the American Society for Information Science* **30** (1979): 195. Quoted from Tsai (2003), p. 84.

mid-point, it will lose momentum and growth will decelerate. Unless there is a new input of research topics or energy, the volume of research literature will not continue to increase. The growth chart is shown in Figure 7-4.

The logistic curve can adopt the shape profile of a continuous wave that is moving forward. This happens because there will be a big increase in research literature if research

sees new momentum when growth reaches saturation, and a new cycle begins. Repeated, the second and third "S" curves will continue in a staircase pattern, forming renewed logistic curves.

Irregular Growth

The growth models discussed in the previous section use time as the main variable, as well as the assumption of a fixed rate of growth. However, the amount of literature does not grow regularly along the time axis. Chaos theory holds that due to various external factors and internal mechanisms, the amount growth curve will show irregular distribution.[8]

Chiao-min Lin [林巧敏] has analyzed relevant published literature in journals on archive or bibliographic studies from 1959–2008, in Taiwan. There are 1,257 articles in total, with uneven growth in the amount of literature before 1983. From 1959–1961, more publications were distributed, and subsequently, were distributed at a lower rate. After 1983, the figure shows a clear upward movement, keeping this high rate through 2001. Gradual decline is seen after 2003. An observation of the growth curve in Figure 7-5 shows that literature growth follows an irregular pattern along the time line. This clearly non-linear, irregular dynamic growth is also called the chaos theory phenomena, which features an irregular growth curve.

In the future, more accurate statistical figures are needed in the analysis of literature growth, in order to examine how closely theoretical predictions match the numbers in reality, so as to modify and enhance these growth models for a more realistic description and prediction of literature and knowledge growth.

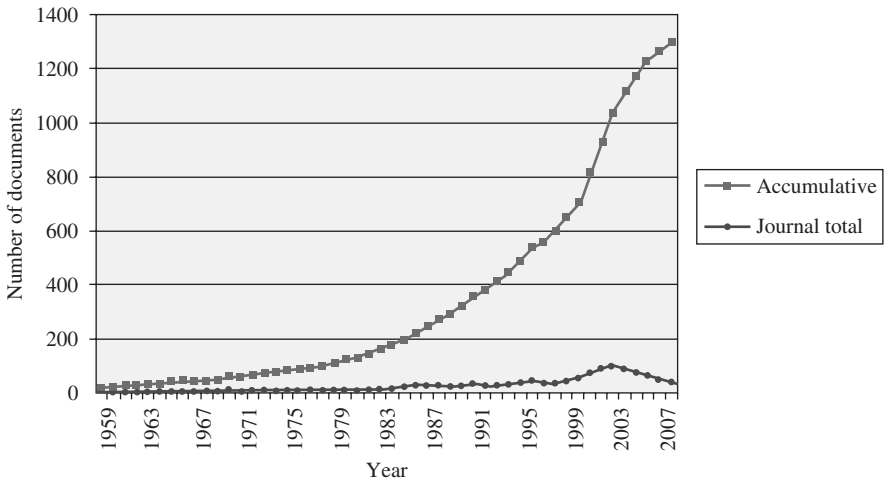

Figure 7-5 Archival science journals literature growth curve

Source: Chiao-min Lin and Weimin Fan, "A Bibliometric Analysis of Archival Science Literature in the Taiwan Region," *Journal of Librarianship and Information Studies* **72** (2010): 27.

KNOWLEDGE BEHAVIOR: ANALYSIS AND EVALUATION

In the era of digital libraries, literature growth has entered a state of massive development, or multimedia development. The study of the growth of literature in archival science from 2000–2010 is an example of this. In addition to studies of traditional journals, conference proceedings, and theses and dissertations, there was more rapid growth in studies of digital electronic publications, as well as audio-visual publications. Due to the possible differences in statistical bases, accurate figures of growth or negative growth must exist in order to correctly reflect a society's degree of investment in every field of study during a specific period. They also construct a basis for general knowledge management and influence investment in education as well as attention to literacy.

Knowledge behavior can be divided into three categories: individual knowledge behavior, group knowledge behavior, and community knowledge behavior. Community knowledge behavior studies trends in development, whereas group behavior studies the interconnection, interaction, and mutual growth among a certain group, the scope of which may be a group of scholars or a group of subjects. By analyzing and evaluating of knowledge behavior, through citation and connection analysis, among other methods, bibliometrics provides an understanding of developments in disciplines and knowledge content, of the complex connections between the fields of social knowledge, and scientific and technological achievements.

Citation Analysis

Citations show the connections between research literatures. Citation analysis reveals the degree of interconnectivity between research literatures and fields. Citation analysis systematically organizes literature and relevant citations, and using these links to reveal the links between documents, and as a further step, explores models of knowledge dissemination among different branches of learning.

The motives and objectives in citing literature can be complicated. According to M. Weinstock[9] and E. Garfield,[10] all motives for citing literature are summarized as follows:

1. Paying homage to pioneers;

2. Giving credit for related work;

3. Identifying methodology, equipment, and so on;

4. Providing background reading;

5. Correcting one's own work;

6. Correcting the work of others;

7. Criticizing previous work;

8. Substantiating claims;

9. Alerting researchers to forthcoming work;

10. Highlighting poorly disseminated, poorly indexed, or uncited work;

11. Authenticating data and classes of fact and physical constants, and so on;

12. Identifying original publications in which an idea or concept was discussed;

13. Identifying the original publication describing an eponymic concept or term;

14. Disclaiming the work or ideas of others;

15. Disputing the priority claims of others.

Karl Min Ku's [顧敏] (2001) article "Knowledge Management and Knowledge Navigation: Library Science's Strategic Mission in the New Century" is a good example.[11] According to the citation analysis made by the China Journals Full-text Database, in 10 years, the article was directly cited by 73 authors in 68 documents, of which 6 are theses and dissertations, and 62 are journal articles. These 68 documents are cited in 253 articles in 10 years, forming a second level of citations.[12] If the original article is called A, first level citations A1, and second level citations A2, then they can be described in Figure 7-6.

Whether with positive or negative intentions, citations are made for their interconnectivity. An analysis of the possible relationships between the citing and cited literature should show that citations, although most are confirmatory and are as homage to pioneers, are clues to research connections between the two. However, some scholars hold different opinions as to whether citation analysis truly offers an insight into intellectual development. The major reasons for this arise from disputes in the motives and nature of citations. Examples of these include: differing objectives and varying degrees of citation, second level citations and mistakes in citation, and so on. These can all contribute to errors in citation analysis results.

Despite their limitations, citations do have some reference values. Therefore, in citation analysis, basic knowledge of disputable assumptions is necessary. Without complete mastery of the background factors for the citation, citation analysis can be considered one of several relevant factors for evaluation, and only with this can more complete and reliable results be obtained.

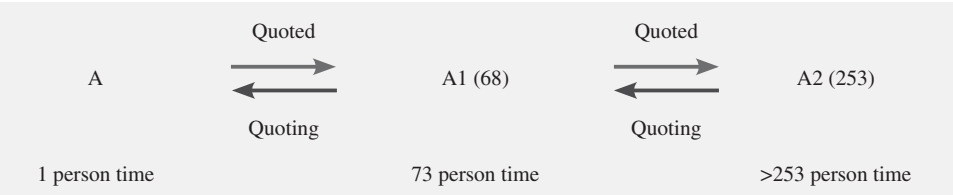

Figure 7-6 Citation analysis

In connection with the characteristics revealed by citation analysis, Chiao-min Lin [林巧敏] made a study of all 2,728 research papers and 8,400 citations from these papers, published from 1981–2003 in Taiwan's 27 university departments and institutes in the field of mathematics. The data used came from the "Taiwan Citation Report" database prepared by the US Institute for Scientific Information (ISI), spanning 20 years (1984–2003). It shows that, in terms of published papers, five-year cumulative figures displayed an upward trend, especially in the five years from 1999–2003, which saw the largest growth.

The figures of papers being cited, however, displayed an upward trend from 1984–1998, but declined in the years from 1999–2003. Yearly distribution during these five years shows a sharper trend of decline. This demonstrates that a period of accumulation is needed for the number of papers being cited to increase. The more recent the literature, the more difficult it is to have an accurate account of how much it is cited.

In terms of the average number of papers being cited, five-year cumulative figures also show a trend of decline, representing an inversely proportional relationship between the value of this indicator and time (*see* Figure 7-7).

The empirical citation analysis in Figure 7-7 displays an inversely proportional relationship between the volume of literature being cited and time. This indicates that it takes time for literature to be cited; it is also related to the availability of literature and citation characteristics in different disciplines, which may also affect literature citation.

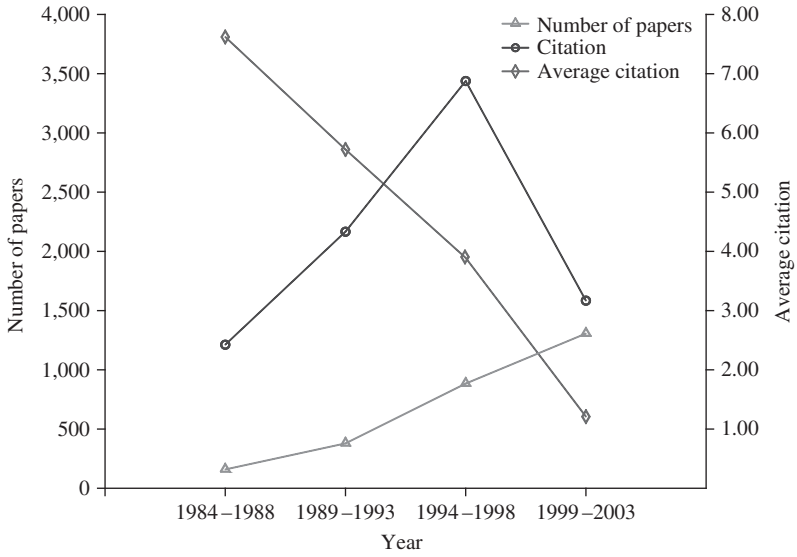

Figure 7-7 Literature development in the mathematical field: 1984–2003, Taiwan

Source: Chiao-min Lin

Literature Interconnectivity Analysis (Bibliographic Coupling, Co-Citation)

Citation analysis uses literature's bibliographic units as a measurement unit and makes analyses by using their citation relationships. However, apart from direct citation relationships between literature items, indirect citation relationships established by a third literature item also exist. These relationships, which can serve as objects for analysis, include bibliographic coupling, co-citation, literature cluster, and so on.[13]

1. Bibliographic Coupling

The concept of bibliographic coupling was introduced by M.M. Kessler in 1963. It states that when a group of research papers cite from more than one of the same articles, a meaningful relationship must exist between these papers, and this common citation relationship is called bibliographic coupling.[14] When papers A and B both cite from article C, papers A and B share a bibliographic coupling relationship. The more of the same literature they cite, the closer the relations, and the stronger the subject interconnectivity between the two. As illustrated in Figure 7-8, papers A and B are bibliographic couplings for citations in *a, b, c, d*; papers A and C are bibliographic couplings for citations in *a, b, e, f*; and papers B and C are bibliographic couplings for citations in *a, b, g, h*.

Using Karl Min Ku's [顧敏] article "Knowledge Management and Knowledge Navigation: Library Science's Strategic Mission in the New Century" as an example, China Journals Full-text Database shows a total co-citing literature volume of 315.[15] This means that there are 315 bibliographic couplings which share reference literature with this article, or 315 articles which share a common research background and are interconnected. With a comparative analysis of the relationships between bibliographic couplings, the contexts and

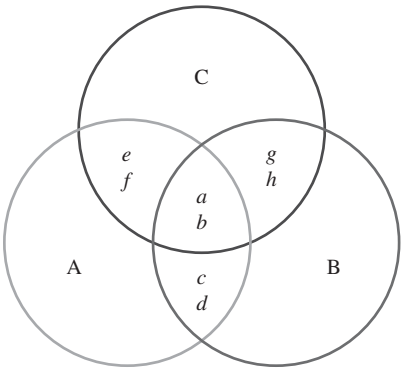

Figure 7-8 An illustration of "bibliographic couplings"

origins of an academic subject can be traced out. This method of tracing the development of an academic school by using modern bibliographic indexes resonates with the bibliographic function of textual relationship studies in ancient bibliographic management, which was discussed in Chapter 2.

2. Co-Citation

Co-citation theory was introduced by H. G. Small in 1973. It denotes a relationship in which two documents are both cited in a later document.[16] When documents A and B are cited at the same time by a later document C, documents A and B share a co-citation relationship. The amount of co-citations is also used as a measurement of the interconnectivity between documents. In other words, the more a group of documents are cited at the same time, the closer the interrelation of their content. What is important is the similarity of the co-cited documents, which is an indicator of changes in the subject themes of an academic specialty between the documents. This quantitative technique helps to gather literature groups by their interconnectivity and display these relationships in a chart. Through co-citation cluster charts, the structure and evolution of academic research can be observed, and the core thrust of research identified. In the bibliographic coupling illustration in Figure 7-9, both a and b are co-citations of articles A, B, and C; both *c* and *d* are co-citations of articles A and B; both *e* and *f* are co-citations of articles A and C; both *g* and *h* are co-citations of articles B and C; *a* and *b* are the most significant literature in the field of study, while "*c, d*", "*e, f*", "*g, h*" are three derivative groups of literature respectively.

In the previous example of Karl Min Ku's [顧敏] article "Knowledge Management and Knowledge Navigation: Library Science's Strategic Mission in the New Century," the China Journals Full-text Database showed a co-cited literature volume amounting to 447, meaning

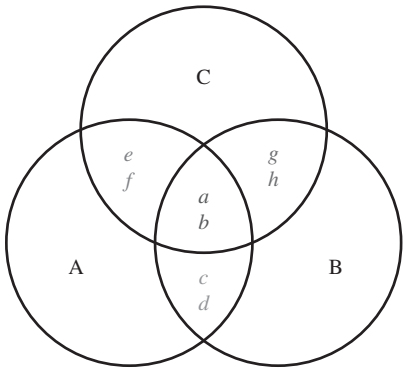

Figure 7-9 An illustration of literature co-citation

that there are 447 articles that are cited together with Ku's [顧敏] article as references in knowledge management studies.[17] This means that these 447 articles can theoretically be used together with Ku's [顧敏] article as research bases for further studies in knowledge management and knowledge navigation.

3. Cluster Analysis

Literature cluster analysis describes a quantitative study that analyzes the academic connections among cited literature with the intensity of bibliographic coupling or of co-citation as its basic unit of measurement. When closely connected literature items are aggregated into clusters, cluster interconnection values can be calculated, and interrelation charts between different fields can be created. The more interrelated the subjects, the closer their positions to one another in the chart. For example, from the literature cluster chart drawn by Y. Ding *et al*., the user's information seeking and retrieving behaviors appears to share a close relationship with information retrieval (IR) techniques and IR models, and a more distant relationship with basic IR theory and computerized IR systems (*see* Figure 7-10).[18]

The object of study of cluster analysis is community and group knowledge behavior. From a measurement perspective, it explores the trend of research and knowledge behavior among a group of researchers of similar subjects via analysis. It can further delineate the distribution status of their common research achievements. Such analysis can form a map of knowledge status and also serves as important reference for public knowledge management and service.

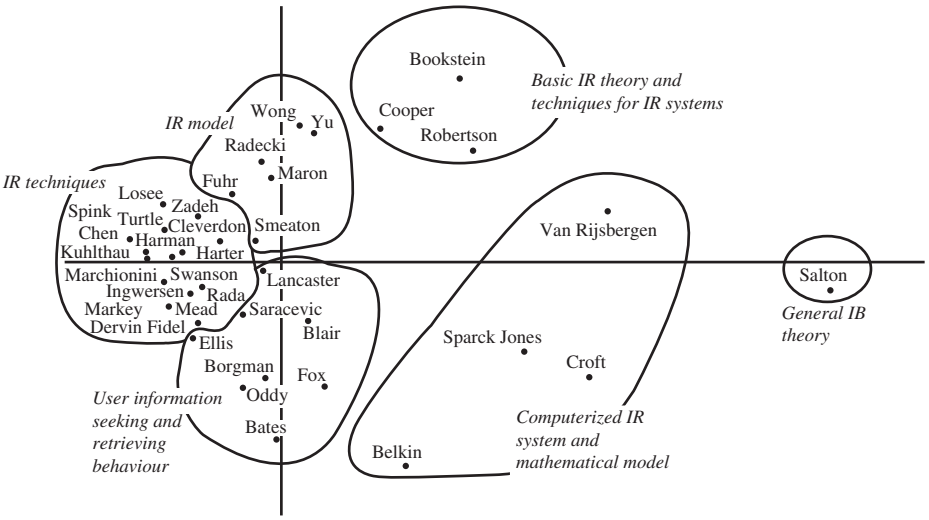

Figure 7-10 A two-dimensional chart of literature clusters

Source: Ding *et al*. (1999), p. 69.

BIBLIOGRAPHY AND KNOWLEDGE BEHAVIOR: QUANTITATIVE STUDY

In terms of knowledge dissemination theory, knowledge behavior consists of two interactive components: knowledge consumption and knowledge production. Individual bibliographies can be considered signs of knowledge, and the collection of bibliographies as abridgment and manuals of knowledge. When knowledge behavior becomes quantifiable, bibliographies become indispensable elements of analysis. In particular, the bibliographic system for mega media libraries advocated in this book can provide more comprehensive, trans-media and in-depth background and materials for quantified studies of knowledge. It will help knowledge behavior studies become more three-dimensional, make better use of bibliometric theories and relevant research achievements, and upgrade bibliographies and bibliographic systems in terms of their application in scholarly communication and library information services. This will not only be helpful in understanding the characteristics of academic research and development, but will be of value to libraries in planning specialized holdings and providing knowledge services. These are discussed in the following sections.

Quantitative Analysis of Literature: Application

Research in literature growth is done so that accumulated experiences give rise to theories, which help predict literature growth patterns. Researchers in a specific discipline use growth analysis to help them to predict trends in the discipline; librarians use it to assist them in planning the distribution of library holdings budgets and re-adjusting shelf spaces, in consideration of the dynamic developments in space and holdings. It also provides libraries with a tool for self-examination and assessment in terms of holdings management, manpower and resource planning, information system design, and so on. For example, the bibliometric framework and functions of Taiwan's theses and dissertations network are shown in Figure 7-11.

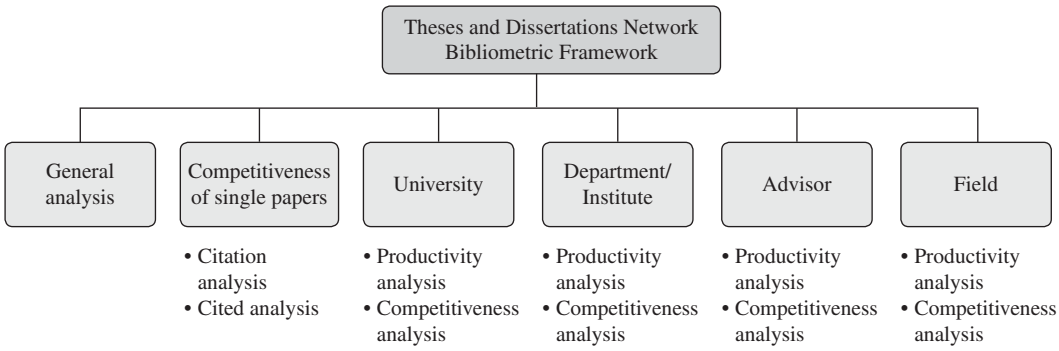

Figure 7-11 Theses and dissertations network bibliometric framework

Citation Interconnection Analysis: Application

The main function of literature growth models is to provide a tool for the scientific observation and analysis of knowledge output. With accumulated past experience and analysis of present status, predictions can be made of the trends and future of knowledge growth development. Scholarly communication models constructed by citation analysis will be helpful in observing and organizing the past routes of scholarly development, and to provide reference for planning future information services. Heavily cited material, from the results of citation analysis, for example, is information that libraries cannot ignore in planning collection development, and will help in establishing core periodicals or core holdings for libraries.

The results of citation analysis can also provide a knowledge map of a subject's development to better help us gain an understanding of it. With citation analysis, scholars interested in a particular subject can learn about its development and paradigm transformations before choosing their direction of research. The connection between the citing and cited literature provides information about the relationships between relevant knowledge and literature, and thus, also serves as a basis for information retrieval.

Cluster analysis is the presentation mode of bibliographic couplings and co-citations. It helps uncover the phenomena associated with and accompanied by scholarly knowledge behavior, and the origin, context, and distribution thereof. Cluster analysis can be used in:

1. Analyzing how strongly literature items are connected;
2. Analyzing the structure and evolution of sciences, by specifying the boundaries between disciplines and sub-disciplines and their main structural units;
3. Analyzing the status of a scientific research in different countries and regions;
4. Describing the development history of an academic discipline and predicting its future trends;
5. Appraising authors and journals, for example, core authors and journals which can be identified by high co-citation rates, and serve as demonstrations of prestige.

SUMMARY

By using bibliometric observations of the quantity and distribution of bibliographic information, we are able to trace a subject's development and foretell its future by analyzing its past. Bibliometrics' scope of application is not limited to the study of literature itself. It also supplies information for libraries to examine and evaluate knowledge management, human and other resource planning, information system design, and so on. In terms of bibliographic content analysis, citation analysis establishes connections between literatures and constructs knowledge maps of a subject's development. By using citation analysis, core authors and journals can be identified, which can serve as important basis for libraries to develop knowledge support reference services. Bibliometrics is at the lower end of the library's bibliographic information and bibliographic system, and its results are a type of knowledge product in a reader-oriented knowledge market. The bibliographic system for mega media libraries advocated in this book will provide a solid research base for bibliometric studies and increase the capacity of its products in terms of knowledge management and dissemination. Bibliometrics has unlimited potential in future bibliographic information services. It is expected to bear more fruit in continued theoretical studies and development as well as in empirical research and analysis.

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