A Trend Analysis of Information Management Research by Bibliometric Methodology, 1957 – 2008

Chi-Yen Yin*, Yan-Ping Chi
Department of Management Information Systems, National Chengchi University
Taipei, 116, Taiwan
97356509@nccu.edu.tw, ypchi@mis.nccu.edu.tw

Abstract

This paper mainly describes the trend analysis of international periodicals and literatures which titles as well-known "Information management" at SSCI database from 1957 to 2008. The result appeared that the literatures production within information management title tower onto the vibration period in the last decade. Most of document type is article, constituting 54.27% of the total literature and English is the most popular language (92.21%). The source title on information system does confirm the typical S-shape for the Bradford-Zipf plot. The distribution of author productivity is also followed by Lotka's Law. USA, England, and Canada; this three countries tops the contributing on information management literature which published 44.16%, 15.31%, and 4.27%, respectively. The applications of information management mainly follow by research aspects which in consisting of information science and library science; computer science, information systems; management, operations research and management science; and business. The literatures of information management were usually generated by multiple authors.

Keywords*: Information management; Bradford-Zipf plot; Lotka's law; Literature productivity.*

1.2 Introduction

Information management (IM) is the collection and management of information from one or more sources and the distribution of that information to one or more audiences. This sometimes involves those who have a stake in, or a right to that information. Management means the organization of and control over the structure, processing and delivery of information.

Throughout the 1970s this was largely limited to files, file maintenance, and the life cycle management of paper-based files, other media and records. With the proliferation of information technology starting in the 1970s, the job of information management took on a new light, and also began to include the field of data maintenance. No longer was information management a simple job that could be performed by almost anyone. An understanding of the technology involved, and the theory behind it became necessary. As information storage shifted to electronic means, this became more and more difficult. By the late 1990s when information was regularly disseminated across computer networks and by other electronic means, network managers, in a sense, became information managers. Those individuals found themselves tasked with increasingly complex tasks, hardware and software. With the latest tools available, information management has become a powerful resource and a large expense for many organizations.

In short, information management entails organizing, retrieving, acquiring and maintaining information. It is closely related to an overlapping with the practice of data management.

Following the behavioral science theory of management, mainly developed at Carnegie Mellon University and prominently represented by Barnard, Richard M. Cyert, March and Simon, most of what goes on in service organizations is actually decision making and information processes. The crucial factor in the information and decision process analysis is thus individuals' limited ability to process information and to make decisions under these limitations

2.2 Methodology

This research utilizes the Social Sciences Citation Index (SSCI) which supported by ISI, Web of Science, the product created by the Thomson Scientific, Philadelphia, PA, USA. Although other databases such as Business Source Complete (EBSCOhost), Library and Information Science Abstract (LISA), Scirus, CBCA Business (ProQuest), are also available for bibliometric analysis, SSCI is adopted because it is recognized as the leading English language supplier of literature services providing access to the published information in the multidiscipline fields of social science and research. Moreover, it is the only database that affords a comprehensive citation data of the published literature.

The ISI Web of Science SSCI database currently includes approximately 2,000 world leading scholarly social science journals and periodicals from 1957 to date which nearly 2,700 pens information is updated weekly. The database can not only search the database from the general way through the subject, title and author then to find the information, the most important features are through the author cited in the references, patents and so on, as what search terms to be found by the authors quoted in a certain specific articles or books, patent information. Cited reference searching is an unique tool can also be applied: to find who cited an article to be written a new paper published, which means that the findings of this article is affecting the younger research direction; ancestors based on the study path of evolution as a research guidelines; understanding of the situation and so on peer research.

For the present research the time span of the SSCI available is from 1957 through 2008. Each record at the SSCI database contains an English language title and descriptive abstract, together with full bibliographic information. The bibliographic information includes the periodicals or other publication title, the authors' name, funding agency, affiliation/institution and country/territory, document type, language and so on.

3.2 Research Finding And Discussion

The result is total 2,860 indexes of literature retrieved which titles are selected as "Information management" or "Management Information System" from 1957 through 2008 as well as a primary parameter for literature productivity analysis, shown as Figure 1. The other analyzed parameters for this research which include authorship, country/territory, funding agency, document type, institution name, language, publication year, source title and subject area. The abstract of literature, number of times cited, and reprint author's address are also acquired for citation analysis and historical review.
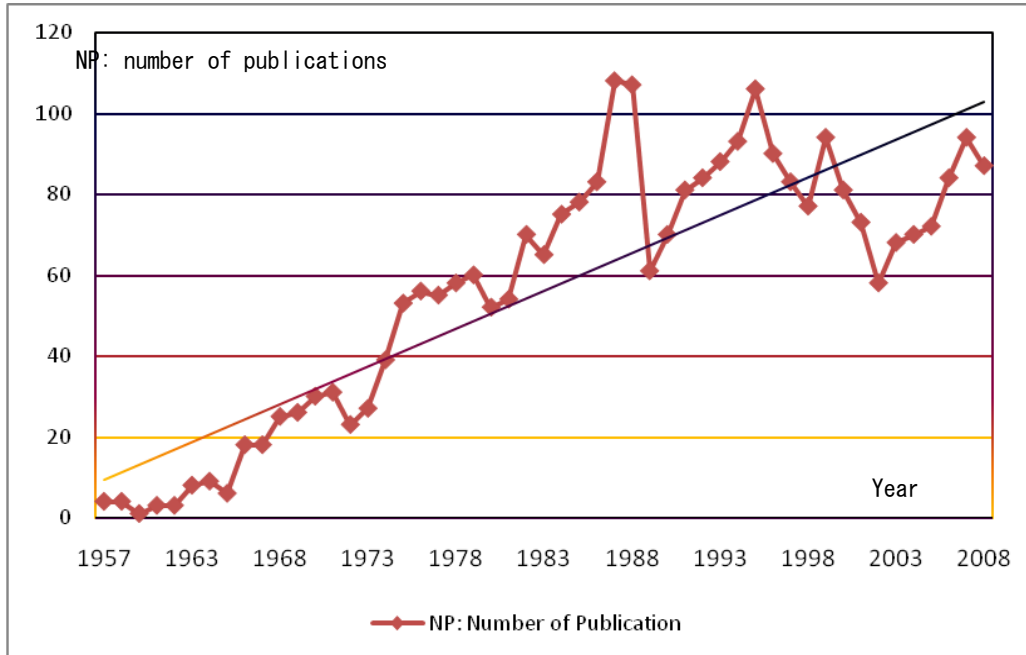
Fig. 1 distribution by publication year on information management and trend line

3.1 Information Management Historical Analysis

The earliest literature relates to information management topic was discovered at SSCI database which published on four journals in terms of College & Research Libraries, Special Libraries, Accounting Review and Personnel Psychology. The document type of publications is belonged to book review. The three titles are same as "Information for Administrator – A Guide to publications and Services for Management in Business and Government – Wasserman, P", and the other one is "Operations Research for Management, Vol. 2, (Case-Histories, Methods, and Information Handling) – Mccloskey, JF. Coppinger, JM". The authors are Bogardus, J., Mclaen, M.P., Emblen, D.J., and Cozan, L.W., respectively.
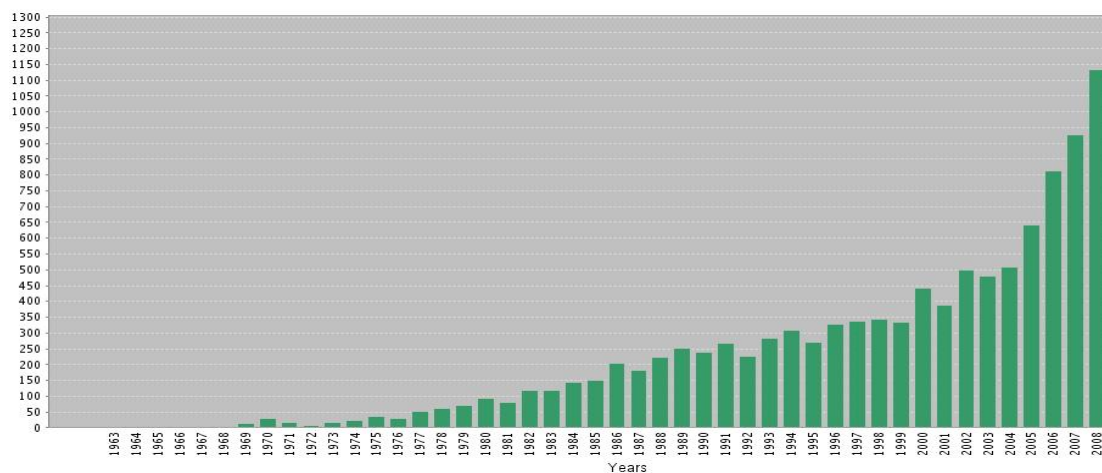

Fig. 2 distribution by citations in each year, 1957-2008

3.1.1   Distribution By Publication Year, Document Type And Language

Obviously, the literature production of information management increased up since 1980. It appeared that the research of information management is very popular and toward onto the highly mature period in last twenty years, shows as Fig. 1. The citation also increases steady and gradually by every year, displays as Fig. 2. In the recent five years, there are a lot of research publications between 2004 and 2008 which reached the record counts in terms of 70(2.45%), 72(2.51%), 84(2.93%), 94(3.28%) and 87(3.04%) respectively, shows as Table 1.

In SSCI database, it indicates articles (1,552, 54.21%) comprise as the majority published document type of information management. The major distribution of language segmentation, it observes English (2,640, 92.21%) is the most popular language for research publication on information management.

Table 1 distribution by publication year, document type and language

Publication Year	NP	PT	Document Type	NP	PT	Language	NP	PT
1957	4	0.14%	Article	1,552	54.27%	English	2,640	92.21%
1958	4	0.14%	Book Review	796	27.83%	German	115	4.02%
1959	1	0.04%	Editorial Material	158	5.52%	Russian	52	1.82%
1961	3	0.10%	Meeting Abstract	124	4.34%	French	21	0.73%
1962	3	0.10%	Proceedings Paper	74	2.59%	Czech	20	0.70%
1963	8	0.28%	Review	54	1.89%	Spanish	9	0.31%
1964	9	0.31%	Note	34	1.19%	Portuguese	2	0.07%
1965	6	0.21%	Letter	31	1.08%	Slovak	2	0.07%
1966	18	0.63%	News Item	9	0.31%	Dutch	1	0.03%
1967	18	0.63%	Discussion	7	0.24%	Slovenian	1	0.03%
1968	25	0.87%	Software Review	7	0.24%			
1969	26	0.91%	Bibliography	3	0.10%			
1970	30	1.05%	Correction	3	0.10%			
1971	31	1.08%	Database Review	3	0.10%			
1972	23	0.80%	Reprint	2	0.07%			
1973	27	0.94%	Chronology	1	0.04%			
1974	39	1.36%	Correction, Addition	1	0.04%			
1975	53	1.85%	Item About An Individual	1	0.04%			
1976	56	1.96%						
1977	55	1.92%						
1978	58	2.03%						
1979	60	2.10%						
1980	52	1.82%						
1981	54	1.89%						
1982	70	2.45%						
1983	65	2.27%						
1984	75	2.62%						
1985	78	2.73%						
1986	83	2.90%						
1987	108	3.78%						
1988	107	3.74%						
1989	61	2.13%						
1990	70	2.45%						
1991	81	2.83%						

1992	84	2.94%							
1993	88	3.08%							
1994	93	3.25%							
1995	106	3.71%							
1996	90	3.15%							
1997	83	2.90%							
1998	77	2.69%							
1999	94	3.29%							
2000	81	2.83%							
2001	73	2.55%							
2002	58	2.03%							
2003	68	2.38%							
2004	70	2.45%							
2005	72	2.52%							
2006	84	2.94%							
2007	91	3.18%							
2008	87	3.04%							

NP: Number of Publications

PT: Percentage of 2,860 Literatures

3.1.2 Distribution By Country/Territory And Institution Name

Table 2 completely shows the distribution of publication by country and territory. The USA (1,263; 44.11%), England (438; 15.30%), Canada (122; 4.26%), Scotland (60; 2.10%), Australia (57; 1.99%), Germany (55; 1.92%), Netherlands (39; 1.36%), Wales (29; 1.01%), Fed. Rep. Germany (23; 0.8%) and Taiwan (23; 0.8%) are the top ten countries which publish the most of information management articles in last fifty years. Taiwan, P.R. China (22; 0.77%), South Korea (10; 0.35%), Japan (9; 0.31%) and Singapore (8; 0.28%) are top five countries ranking in Asia on information management.

Listing publication by the institution name, it also indicates University of Sheffield (England; 39; 1.36%), Syracuse University (USA; 29; 1.01%), Indiana University (USA; 28; 0.98%), University of Minnesota (USA; 25; 0.87%), University of Illinois (USA; 23; 0.8%) and University of Maryland (USA; 23; 0.8%) are top five ranking institutions in information management publications.

Table 2 distribution by country/territory and institution name

Rank	Country/Territory	NP	PT	Rank	Institution Name	NP	PT
1	USA	1,263	44.16%	1	Univ. Sheffield	39	1.36%
2	England	438	15.31%	2	Syracuse Univ.	29	1.01%
3	Canada	122	4.27%	3	Indiana Univ.	28	0.98%
4	Scotland	60	2.10%	4	Univ. Minnesota	25	0.87%
5	Australia	57	1.99%	5	Univ. Illinois	23	0.80%
6	Germany	55	1.92%	5	Univ. Maryland	23	0.80%
7	Netherlands	39	1.36%	7	Univ. N. Carolina	20	0.70%
8	Wales	29	1.01%	8	City Univ. London	19	0.66%
9	Fed Rep. Ger.	23	0.80%	8	Penn. State Univ.	19	0.66%
9	Taiwan	23	0.80%	8	Univ. Calif. Los Angeles	19	0.66%
11	New Zealand	20	0.70%	8	Univ. Wisconsin	19	0.66%
11	Peoples R China	20	0.70%	12	Univ. Colorado	18	0.63%
11	South Africa	20	0.70%	12	Univ. Texas	18	0.63%
14	France	18	0.63%	12	Univ. Washington	18	0.63%

14	Sweden	18	0.63%	15	Harvard Univ.	17	0.59%
16	India	14	0.49%	15	Univ. Pittsburgh	17	0.59%
16	North Ireland	14	0.49%	17	Loughborough Univ. Technol	16	0.56%
18	Israel	13	0.45%	17	Univ. Nebraska	16	0.56%
18	Ussr	13	0.45%	17	Univ. Strathclyde	16	0.56%
20	Denmark	12	0.42%	20	Columbia Univ.	15	0.52%
20	Italy	12	0.42%	20	Univ. Calif. Berkeley	15	0.52%
22	Belgium	11	0.38%	22	Univ. Michigan	14	0.49%
22	Norway	11	0.38%	22	Univ. Stirling	14	0.49%
22	Spain	11	0.38%	24	IBM Corp.	13	0.45%
25	Finland	10	0.35%	24	Michigan State Univ.	13	0.45%
25	Greece	10	0.35%	24	Univ. Missouri	13	0.45%
27	Austria	9	0.31%	24	Univ. So. Calif.	13	0.45%
27	Czechoslovakia	9	0.31%	28	Arizona State Univ.	12	0.42%
27	Japan	9	0.31%	28	Cornell Univ.	12	0.42%
27	South Korea	9	0.31%	28	McGill Univ.	12	0.42%
31	Ireland	8	0.28%	28	Purdue Univ.	12	0.42%
31	Singapore	8	0.28%	32	Florida State Univ.	11	0.38%
31	Switzerland	8	0.28%	32	MIT	11	0.38%
34	Ger Dem Rep	7	0.24%	32	Univ. British Columbia	11	0.38%
34	Hong Kong	7	0.24%	32	Univ. Manchester	11	0.38%
34	Slovenia	7	0.24%	32	Univ. Toronto	11	0.38%
34	Turkey	7	0.24%	37	Kent State Univ.	10	0.35%
38	Brazil	6	0.21%	37	Queens Univ. Belfast	10	0.35%
39	Lithuania	5	0.17%	37	Rutgers State Univ.	10	0.35%
39	Malaysia	5	0.17%	37	Univ. Arizona	10	0.35%
39	Nigeria	5	0.17%	37	Univ. Calif.	10	0.35%
42	West Germany	4	0.14%	37	Univ. S. Carolina	10	0.35%
43	Botswana	3	0.10%	37	Victoria Univ. Wellington	10	0.35%
43	Bulgaria	3	0.10%	44	Duke Univ.	9	0.31%
43	Czech Republic	3	0.10%	44	Georgia State Univ.	9	0.31%
43	Hungary	3	0.10%	44	Tel Aviv Univ.	9	0.31%
43	Portugal	3	0.10%	44	Univ. Georgia	9	0.31%
43	Slovakia	3	0.10%	44	Univ. Loughborough	9	0.31%
43	Thailand	3	0.10%	44	Univ. Massachusetts	9	0.31%
50	Mexico	2	0.07%	44	Univ. Penn	9	0.31%
50	Uganda	2	0.07%	44	Univ. Warwick	9	0.31%
	Other Countries	540	18.88%		Other Institutions	1,428	34.12%

NP: Number of Publications
PT: Percentage of 2,860 Literatures

3.1.3 Distribution By Source Title

Table 3 shows that "*International Journal of Information Management*" (131; 4.58%), "*Journal of Documentation*" (70; 2.45%), "*Aslib Proceedings*" (53; 1.85%), "*Information Processing & Management*" (46; 1.61%), "*Electronic Library*" (42; 1.47%), "*Journal of Information Science*" (41; 1.43%), "*Nauchno-Tekhnicheskaya Informatsiya Seriya 1-Organizatsiya I Metodika Informatsionnoi Raboty*" (41, 1.43%), "*Nachrichten Fur Dokumentation*" (40; 1.40%), "*Proceedings of The American Society for Information Science*" (38; 1.33%) and "*Journal of Librarianship And Information Science*"

(36; 1.26%) are the top ten journals with the most publications in research aspect of information management.

Table 3 distribution by source title

Rank	Source Title	NP	PT
1	International Journal of Information Management	131	4.58%
2	Journal of Documentation	70	2.45%
3	ASLIB Proceedings	53	1.85%
4	Information Processing & Management	46	1.61%
5	Electronic Library	42	1.47%
6	Journal of Information Science	41	1.43%
6	Nauchno-Tekhnicheskaya Informatsiya Seriya 1-Organizatsiya I Metodika Informatsionnoi Raboty	41	1.43%
8	Nachrichten Fur Dokumentation	40	1.40%
9	Proceedings of The American Society for Information Science	38	1.33%
10	Journal of Librarianship and Information Science	36	1.26%
11	Government Information Quarterly	34	1.19%
12	Interfaces	30	1.05%
12	MIS Quarterly	30	1.05%
14	Special Libraries	29	1.01%
15	Accounting Review	28	0.98%
15	Journal of Academic Librarianship	28	0.98%
15	Journal of The American Society For Information Science	28	0.98%
18	Education for Information	27	0.94%
19	Bulletin of The Medical Library Association	26	0.91%
19	Journal of Systems Management	26	0.91%
21	Information & Management	25	0.87%
22	Journal of The American Medical Informatics Association	24	0.84%
23	Journal of The Operational Research Society	23	0.80%
23	Library Journal	23	0.80%
25	Program-Electronic Library and Information Systems	22	0.77%
26	Operations Research	21	0.73%
27	College & Research Libraries	20	0.70%
27	Information Research-An International Electronic Journal	20	0.70%
27	Library Quarterly	20	0.70%
30	American Journal of Agricultural Economics	18	0.63%
30	Program-Automated Library and Information Systems	18	0.63%
32	Management International Review	17	0.59%
32	Management Science	17	0.59%
32	Online	17	0.59%
35	Harvard Business Review	16	0.56%
35	Information Technology and Libraries	16	0.56%
35	Proceedings of The ASIS Annual Meeting	16	0.56%
38	Annual Review of Information Science And Technology	15	0.52%
38	IEEE Transactions on Engineering Management	15	0.52%
38	International Journal of Technology Management	15	0.52%
38	NFD Information-Wissenschaft Und Praxis	15	0.52%
38	Public Administration Review	15	0.52%
43	Journal of Education for Library and Information Science	14	0.49%

43	*Online Information Review*	14	0.49%
45	*Journal of Management Studies*	13	0.45%
45	*Omega-International Journal of Management Science*	13	0.45%
47	*American Archivist*	12	0.42%
47	*Canadian Journal of Information and Library Science-Revue Canadienne Des Sciences De L Information Et De Bibliotheconomie*	12	0.42%
47	*Journal of Accounting Research*	12	0.42%
47	*Journal of Librarianship*	12	0.42%
47	*Journal of The American Society for Information Science and Technology*	12	0.42%
52	*Environmental Management*	11	0.38%
52	*Industrial Management & Data Systems*	11	0.38%
52	*RQ*	11	0.38%
55	*Behaviour & Information Technology*	10	0.35%
55	*Canadian Public Administration-Administration Publique Du Canada*	10	0.35%
55	*Database*	10	0.35%
55	*Datamation*	10	0.35%
55	*Educational Technology*	10	0.35%
55	*Journal of Accountancy*	10	0.35%
55	*Journal of Information Technology*	10	0.35%
55	*LIBRI*	10	0.35%
55	*Operational Research Quarterly*	10	0.35%
55	*Personnel Psychology*	10	0.35%
	Other Source Titles	1,381	48.19%

NP: Number of Publications

PT: Percentage of 2,860 Literatures

3.1.4   Distribution By Subject Category

Table 4 displays that "Information science & Library science" (1,344; 46.94%), "Computer science, Information systems" (671; 23.4%), "Management" (491; 17.15%), "Operations Research & Management Science" (202; 7.06%), "Business" (179; 6.25%), "Economics" (122; 4.26%), "Education & Educational research" (103; 3.6%), "Business, finance" (82; 2.86%) and "Computer science, Interdisciplinary applications" (74; 2.58%) are the top ten categories with the most frequently publications in research aspect of information management.

Table 4 distribution by subject area

Rank	Subject Area	NP	PT
1	Information Science & Library Science	1,344	46.99%
2	Computer Science, Information Systems	671	23.46%
3	Management	491	17.17%
4	Operations Research & Management Science	202	7.06%
5	Business	179	6.26%
6	Economics	122	4.27%
7	Education & Educational Research	103	3.60%
8	Business, Finance	82	2.87%
9	Computer Science, Interdisciplinary Applications	71	2.48%
10	Health Policy & Services	68	2.38%
11	Public Administration	58	2.03%
12	Engineering, Industrial	57	1.99%

13	Computer Science, Theory & Methods	52	1.82%
14	Planning & Development	47	1.64%
14	Public, Environmental & Occupational Health	47	1.64%
16	Environmental Studies	45	1.57%
17	Geography	41	1.43%
17	Medical Informatics	41	1.43%
19	Ergonomics	40	1.40%
19	Psychology, Applied	40	1.40%
21	Health Care Sciences & Services	37	1.29%
22	Environmental Sciences	35	1.22%
22	Political Science	35	1.22%
24	Computer Science, Software Engineering	32	1.12%
24	Social Sciences, Interdisciplinary	32	1.12%
26	Computer Science, Cybernetics	30	1.05%
27	Agricultural Economics & Policy	29	1.01%
28	Urban Studies	24	0.84%
29	Psychology	22	0.77%
30	Psychology, Multidisciplinary	21	0.73%
31	Computer Science, Hardware & Architecture	19	0.66%
31	Sociology	19	0.66%
33	Engineering, Multidisciplinary	18	0.63%
33	Nursing	18	0.63%
33	Social Work	18	0.63%
36	Industrial Relations & Labor	17	0.59%
36	Law	17	0.59%
36	Medicine, General & Internal	17	0.59%
36	Psychiatry	17	0.59%
40	Communication	16	0.56%
40	Engineering, Civil	16	0.56%
42	Engineering, Electrical & Electronic	15	0.52%
43	Chemistry, Multidisciplinary	13	0.45%
43	History	13	0.45%
45	Computer Science, Artificial Intelligence	12	0.42%
45	Engineering, Manufacturing	12	0.42%
45	Social Sciences, Mathematical Methods	12	0.42%
48	Instruments & Instrumentation	11	0.38%
49	Chemistry, Analytical	10	0.35%
49	Oncology	10	0.35%
49	Pharmacology & Pharmacy	10	0.35%
49	Transportation	10	0.35%
49	Water Resources	10	0.35%
	Other Subject Areas	327	11.42%

NP: Number of Publications

PT: Percentage of 2,860 Literatures

Based on the above information shows that the current research of information management has been reached in the mature stage, the majority of publication outputs are in North America, UK, European countries. Taiwan, P.R. China, South Korea, Japan and Singapore, are the top five research ranking countries in Asia. The subject of information management has been research highly research

growth since year 2000. It is to strengthen the association of information management which accelerated by the popularization of clouding computing and internet. The subject of information management has become the most popular research topic in the world.

The United Nations (UN), the Organization of Economic Cooperation and Development (OECD), the World Bank (WB), the European Union (EU) and other international organizations are actively called on Governments, as well as highly developed countries should invest heavily in making such as social sciences and interdisciplinary, economics, and environmental studies research areas which applied information management subject to study various natural, social, political and economic phenomenon, and present their related finding in order to enhance vision and scope of human knowledge in near future.

4. **The Analysis of Literatures Productivity**

4.1 **Bradfort'S Law**

Bradford's law is a pattern first described by Samuel C. Bradford in 1934 that estimates the exponentially diminishing returns of extending a search for references in science journals. One formulation is that if journals in a field are sorted by number of articles into three groups, each with about one-third of all articles, then the number of journals in each group will be proportional to $1 : n : n^2$. There are a number of related formulations of the principle.

Generally, Bradford revealed a pattern of how literature in a subject is distributed in journals. "If scientific journals are arranged in order of decreasing productivity of articles on a given subject, they may be divided into a nucleus of periodicals more particularly devoted to the subject and several other groups of zones containing the same number of articles as the nucleus" (Drott, 1981). Bradford's Formula makes it possible to estimate how many of the most productive sources would yield any specified fraction p of the total number of items.

The formula is:

R(n) =3D N log n/s (1 $\leqq$ n $\leqq$ N)

Where

R(n) is the cumulative total of items contributed by the sources of rank 1 to n,

N is the total number of contributing sources,

And

s is a constant characteristic of the literature.

We then can describe that:

R(N) =3D N log N/s is the total number of items contributed by sources.

Over time, this is also a measure of the rate of obsolescence by distinguishing between the usages of the levels of items. Essentially, this is a method of clustering. For this paper, 130 journals have 1,910 articles, the next 217 journals have 548 articles, and the last 402 journals have 402 articles, and the total quantity of source is 749. Refer to Table 5. Researchers can roughly get three groupings of these articles. Bradford noticed this consistent number of titles it takes to contribute to each third of the articles. Display as Fig. 3.

Table 5 distribution of cumulative literatures on information management

NP	NS	CL	PT
1	402	402	14.06%
2	128	256	8.95%
3	64	192	6.71%
4	25	100	3.50%
$\geqq$5	130	1,910	66.78%
Total	749	2,860	100.00%

NP: Number of Publications

NS: Number of Source Titles

CL: Cumulative Number of Literatures

PT: Percentage of 2,860 Literatures
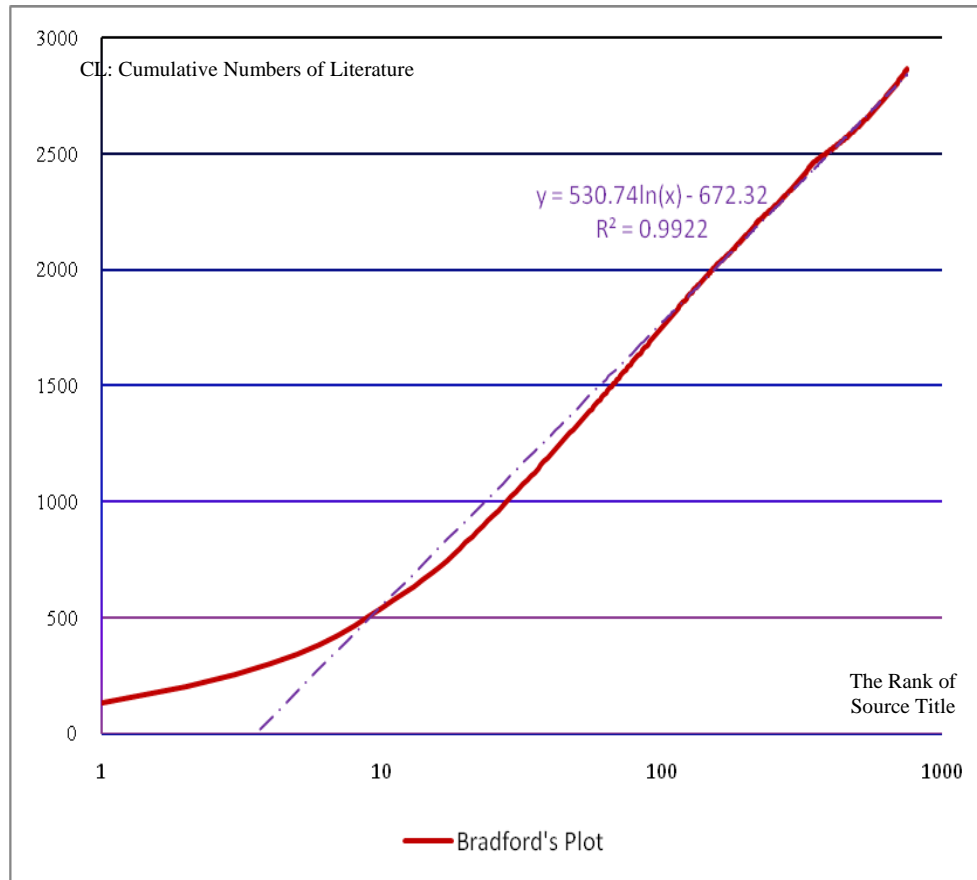
Fig. 3 the S-shape for Bradford-Zipf plot on information management, 1957-2008

Bradford discovered this regularity of calculating the number of titles in each of the three groups: 9 titles, 9x5 titles, 9x5x5 titles. Drott suggests that we can apply this widely, as long as we account for sample sizes, area of (journal) specialization and journal policies (Drott ,1981).

This section is mainly discussing the distribution situation of literature productivity of author which certificated by Lotka's law. Table 6 shows that the distribution of top 15 ranking author's contribution. Meanwhile, it calculates the quantity of author by the equality method from 2,860 literatures which retrieved by indexes on SSCI database. That is indicated that the degree of contribution of each author in one literature is equivalent, which could be calculated separately. Thus, it obtained altogether 3,512 of authors on information management research aspect. Refer to Table 7.

Table 6 distribution by top 15 authors

Rank	A	AA	INS	NP	PT
1	WILSON, TD	England	Univ. Sheffield	14	0.49%
2	BAWDEN, D	England	City Univ. London	11	0.38%
3	CRONIN, B	USA	Indiana Univ.	8	0.28%
4	BROADBENT, M	Australia	Univ. Melbourne	7	0.24%
4	FOURIE, I	South Africa	Univ. Pretoria	7	0.24%

4	KOENIG, MED	USA	Long Isl. Univ.	7	0.24%
4	LEDERER, AL	USA	Univ. Kentucky	7	0.24%
4	ROBERTS, N	England	Univ. Sheffield	7	0.24%
4	ROWLEY, J	Wales	Univ. Wales	7	0.24%
4	VAZSONYI, A	USA	Univ Rochester	7	0.24%
11	BEAUMONT, JR	Scotland	Univ. Stirling	6	0.21%
11	CARTER, MP	England	N Staffordshire Polytech	6	0.21%
11	OPPENHEIM, C	England	Loughborough Univ. Technol	6	0.21%
11	WILSON, T	England	Univ. Sheffield	6	0.21%
15	BEAUMONT, CD	England	Coopers & Lybrand	5	0.17%
15	COPLER, JA	USA	Indiana Univ	5	0.17%
15	HUIRNE, RBM	Netherlands	Univ. Wageningen & Res. Ctr.	5	0.17%
15	IVES, B	USA	So Methodist Univ.	5	0.17%
15	MACEVICIUTE, E	Lithuania	Vilnius Univ.	5	0.17%
15	MCCLURE, CR	USA	Syracuse Univ.	5	0.17%
15	MCGEE, WC	USA	IBM Corp.	5	0.17%
15	PHILIP, G	Ireland	Queens Univ. Belfast	5	0.17%
15	RATZEK, W	Germany	Verlag Hoppenstedt & Co.	5	0.17%
15	SCHMIDTREINDL, KM	FED. REP. GER.	Gesell Math & Datenverarbeitung MBH	5	0.17%
15	SPREHE, JT	USA	Sprehe Informat. Management Associates Inc.	5	0.17%
15	STREATFIELD, D	England	Principal Informat. Management Associates	5	0.17%
15	ZHANG, P	USA	Syracuse Univ.	5	0.17%

A: Author

AA: Author Affiliation

INS: Institution

NP: Number of Publication

PT: Percentage of 2,860 Literature

Table 7 distribution by literature productivity on information management

P	NP	A	CA	CNP	PTCNP
1	14	1	1	14	0.31%
2	11	1	2	25	0.55%
3	8	1	3	33	0.73%
4	7	7	10	82	1.82%
5	6	4	14	106	2.35%
6	5	13	27	171	3.79%
7	4	22	49	259	5.74%
8	3	69	118	466	10.32%
9	2	269	387	1004	22.23%
10	1	3512	3512	4516	100.00%

P: Rank

NP: Number of Publication

A: Author(s)

CA: Cumulatvie Author(s)

CNP: Cumulative Number of Publication

PTCNP: Percentage of CNP

4.2 Lotka'S Law

The research of discipline literature author distribution and productivity, may utilize the Lotka's law to discuss on it. The Lotka's law is called "a reverse square law of the scientific productivity", its connotation is: the number of author which published x literature is the number of author which published one literature total to divide x^2. By performing Lotka's law to carry onto the analysis, which confirms the literature productivity of information management, whether to be suitable or not; the criterion should also follow by five procedures:

1) Collecting data.
2) Listing the distribution of publication via author.
3) Calculate the slope n value.
4) Calculate the slope c value.
5) By using the Kolmogorov-Smirnov examination determination (K-S test) whether the distribution is conform to or not.

Table 8 collecting data by literature productivity on information management

P	NP	A	X=log NP	Y=log A	XY	XX		
1	1	3512	0.000000	3.545555	0.000000	0.000000	Σ X =	6.793041
2	2	269	0.301030	2.429752	0.553549	0.090619	Σ Y =	11.717680
3	3	69	0.477121	1.838849	0.640498	0.227645	Σ XY =	2.943144
4	4	22	0.602060	1.342423	0.670661	0.362476	Σ X Σ Y =	79.59868314
5	5	13	0.698970	1.113943	0.420822	0.488559	Σ (X)² =	5.702689
6	6	4	0.778151	0.602060	0.657614	0.605519	(Σ X)² =	32.520660
7	7	7	0.845098	0.845098	0.000000	0.714191	N =	10
8	8	1	0.903090	0.000000	0.000000	0.815572	n =	-2.04712223
9	11	1	1.041393	0.000000	0.000000	1.084499		
10	14	1	1.146128	0.000000	0.000000	1.313609		

P: Rank

NP: Number of Publication

A: Author(s)

Viewing on the datum of Table 8, author has only 1 literature is 77.77%, which is not matched of primitive c value 60.79%, which afforded by Lotka's law. After that, it can follow the calculation to get n and c value by the least squares law, carry onto the further proceeding examination for Lotka's law compliance.

By the result of calculation on Table VII, it could bring into the following equation.

The $n = -2.04712223$

$$n = \frac{N\sum XY - \sum X \sum Y}{N\sum X^2 - \left(\sum X\right)^2}$$

After that, we also found c= 0.7391789, the equation is shown as below:

$$c = \frac{1}{\sum_{1}^{P-1}\frac{1}{x^n} + \frac{1}{(n-1)\left(p^{n-1}\right)} + \frac{1}{2p^n} + \frac{1}{24(p-1)^{n+1}}}$$

p=10, (Maximum Value of x)

$x = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10$

While we got $n = -2.0471223$, $c = 0.6204498$, it explored, f(x) = $0.6204498/x^{2.0471223}$. The distribution chart is shown as Fig. 3. Discussing on the n and c value, primitive n approximately is -2, c is 0.6079, which provided by Lotka's law, it demonstrated that the distribution of literature productivity of author in information management research aspect and the primitive Lotka's law has

not tallied completely. But actually it may observes the two datum distribution disparity which not too big on Fig. 4. In order to examine the theoretical value and the observation value whether to tally. Regarding the n and c value which gained by the formula, it is possible to calculate the expected value and the accumulation value of author, following by Kolmogorov-Smirnov examination determination (K-S test).

According to Kolmogorov-Smirnov examination determination (K-S test), Table 9 demonstrated $D_{max}=0.0125$, but the sampling number is bigger than 35, therefore the threshold value is $1.63/3512^{1/2} = 0.02897$. Because D_{max} is smaller than the threshold value, the result is this research author productive forces distribution and the Lotka's law matched exactly, which means the Lotka's law is suitable for the analysis of distribution of literature productivity of author in information management research aspect.

Table 9 collecting data by literature productivity on information management

| P	OVA	COVA Sn(X)	EMA	CEMA Fo(X)	ABS CEMA-CEVA $\mid$ Fo(X) - Sn(X) $\mid$
1	0.6204	0.6204	0.6079	0.6079	0.0125　　　$=D_{max}$ Value
2	0.1501	0.7706	0.1520	0.7599	0.0107
3	0.0655	0.8360	0.0675	0.8274	0.0086
4	0.0363	0.8724	0.0380	0.8654	0.0070
5	0.0230	0.8954	0.0243	0.8897	0.0057
6	0.0158	0.9112	0.0169	0.9066	0.0046
7	0.0116	0.9228	0.0124	0.9190	0.0038
8	0.0088	0.9316	0.0095	0.9285	0.0031
9	0.0069	0.9385	0.0075	0.9360	0.0025
10	0.0056	0.9440	0.0061	0.9421	0.0019

P: Rank
OVA: Observed Value by Author
COVA: Cumulative OVA
EMA: Expected Value by Author
CEMA: Cumulative EMA
ABS: Absolute Value
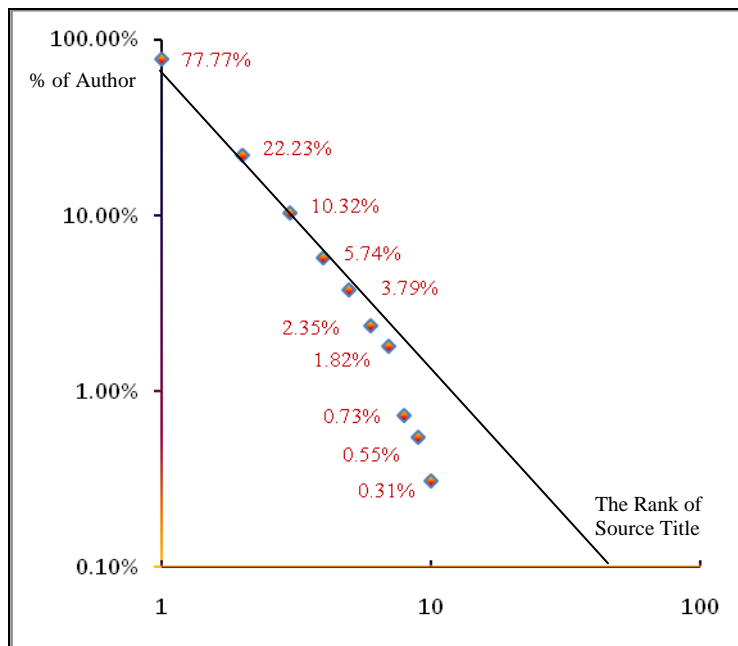
Fig. 4 distribution of lotka's law on information management, 1957-2008

5. Conclusion

Information management is one of fast growing discussion subjects in recent years, this historical review and trend analysis of this research field were determined by each kind of literature characteristic and the distribution of author productivity is getting into the highly mature period, it inferred that the present information management literatures are still continually to grow, the main research development facility with delivered the large production is United States, but England, Canada, Australia, and some Asia countries such as China, Taiwan, Japan and South Korea, these non-US individual authors literature production actually are also very popular. The distribution of literature productivity of author didn't follow by Lotka's Law. The applications of information management mainly were performed by the following research aspects which in consisting of information science and library science; computer science, information systems; management, operations research and management science; and business. The literatures of information management were usually generated by multiple authorships.

6. References

[1]   Bornmann, L., & Marx, W., Schier, H., Rahm, E., Thor, A., Daniel, H.D., "Convergent validity of bibliometric Google Scholar data in the field of chemistry-Citation counts for papers", Journal of Informetrics, Volume: 3, Issue: 1, pp. 27-35, 2009.
[2]   Chao, C.C., Yang, J.M., & Jen, W.Y., "Determining technology trends and forecasts of RFID by a historical review and bibliometrics analysis from 1991 to 2005", Technovation, 27(5), pp. 268-279, 2007.
[3]   Chiu, W.T., & Ho, Y.S., "Bibliometric analysis of homeopathy research during the period of 1991 to 2003", Scientometrics. Vol. 63, No. 1, pp. 3-23, 2005.
[4]   Chuang, K.Y., Huang, Y.L., & Ho, Y.S., "A bibliometric and citation analysis of stoke-related research in Taiwan", Scientometrics, Vol. 72, No. 2, pp. 201-212, 2007
[5]   Drott, M. C., Bradford's Law: Theory, Empiricism and the Gaps Between, Library Trends, Summer (Special Issue on Bibliometrics), pp. 41-52, 1981.
[6]   Egghe, L., & Rousseau, R., Introduction to informetrics: quantitative methods in library, documentation and information science. New York: Elsevier Science Publishers, USA, 1990.
[7]   Glanzel, W., "Characteristic scores and scales - A bibliometric analysis of subject characteristics based on long-term citation observation. Journal of Informetrics", Volume: 1, Issue: 1, pp. 92-102, 2007.
[8]   Ho, Y.S., "Citation review of Lagergren kinetic rate equation on adsorption actions", Scientometrics, Vol. 59, No. 1, pp. 171-177, 2004
[9]   Ho, Y.S., "Comments on Determining technology trends and forecasts of RFID by a historical review and bibliometrics analysis from 1991 to 2005", Technovation, 29 (10), pp.725-727, 2009
[10] ISI Web of Science, SSCI database. <http://scientific.thomson.com/product/ssci>, accessed by 2009/12/17.
[11] Jarneving, B., "Bibliographic coupling and its application to research-front and other core documents", Journal of Informetrics, Volume: 1, Issue: 4, pp. 287-307, 2007.
[12] Journal Citation Reports, on-line version. http://admin-apps.isiknowledge.com/JCR/, 2009.
[13] Kretschmer, H., & Kretschmer, T., "Lotka's distribution and distribution of co-author pairs' frequencies", Journal of Informetrics, Vol.:1 (4), pp. 308-337, 2007
[14] Li, L., Ding, G., Feng, N., Wang, M.H., & Ho, Y.S., "Global stem cell research trend Bibliometric analysis as a tool for mapping of trends from 1991 to 2006", Scientometrics, Vol. 80, No. 1, pp. 39-58, 2009.
[15] Luo, X.Y., "Management Development and its Practice in Chinese Library And Information-Services", International Library Review, Volume: 17, Issue: 2, Pages: 129-149, 1985
[16] Turnbull,   D.,   "   Bibliometrics   and   the   World-Wide   Web", <http://www.ischool.utexas.edu/~donturn/research/bibweb.html>, 2005

[17] Tian, Y.G., Wen, C., & Hong. S., "Global scientific production on GIS research by bibliometric analysis from 1997 to 2006", Scientometrics, Volume: 2, Issue: 1, pp. 65-74, 2008

[18] Tsay, M.Y., "Journal self-citation study for semiconductor literature: Synchronous and diachronous approach", Scientometrics, 42, pp.1567-1577, 2006

[19] Tsay, M.Y., "A bibliometric analysis of hydrogen energy literature, 1965-2005", Scientometrics, Vol. 75(3), pp. 421-438, 2008.

[20] Voos, H., "Lotka and information science", Journal of the American Society of Information Science, 25: 270-273, 1974.

[21] Wu, W.J., Shen, H.S., & Wee, L., "A Chinese agricultural information management-system", Proceedings of the American Society for Information Science, Volume: 18, Pages: 62-64, 1981.

[22] Xie, S., Zhang, J., & Ho, Y.S., "Assessment of world aerosol research trends by bibliometric analysis", Scientometrics, Vol. 77, No. 1, pp.113-130, 2008.

[23] Yi, H., Ao, X., & Ho, Y.S., "Use of citation per publication as an indicator to evaluate pentachlorophenol research. Scientometrics", Vol. 75, No. 1, pp. 67-80, 2008.

[24] Yin, C.Y., & Chi, Y.P., "A historical review and trend analysis of ubiquitous computing research using bibliometric methodology during 1993 to 2009", Paper ID: JDCTA4-260032IP, International Journal of Digital Content Technology and its Applications, accepted and forthcoming published in 2010.

[25] Yin, C.Y., & Chiang, J.K., "Social capital: the literature productivity review and trend forecast using bibliometric methodology from 1959 to 2009", Paper ID: NCMRT2S06-301006O, In Proceeding(s) of 5th Network Computing and Advanced Information Management; international joint conference on INC, IMS and IDC, Seoul, Korea, 2009.

[26] Yin, C.Y., Lin, J.S., & Yang, J.M. "A study on the productivity review for management of technology using bibliometric methodology", Paper ID: ACMICCITRT1S02-802038P, In Proceeding(s) of ICCIT 2009 International Conference on Computer Sciences and Convergence Information Technology, Seoul, Korea, 2009.