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Research productivity of library scholars: Bibliometric analysis of growth and trends of LIS publications

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Research productivity of library scholars

Bibliometric analysis of growth and trends of LIS publications

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Abstract

Purpose – The purpose of this paper is to explore, by a quantitative analysis, growth rates of, and trends in, global publications in the field of library and information science (LIS) produced by library science professionals.

Design/methodology/approach – A survey approach was used in this paper. Journal Citation Reports 2010 was the major source for selecting 40 LIS core journals. A bibliometric analysis was conducted. Visualization and mapping software was utilized to present a picture of the growth in and trends relating to LIS publications.

Findings – A total of 18,371 research articles were published from 2003 to 2012. A significant growth rate (11.37 per cent) was found in 2009. Self-citation tendencies have been increasing, with an average rate of 38.56 per cent. Of all publication types, "article" was the most popular among LIS researchers. China has contributed remarkably in terms of collaborative publications.

Practical implications – The present study could be helpful for library professionals, subject specialists and policy makers. These findings may encourage library professionals to integrate and monitor library functions through bibliometric analysis.

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Originality/value – This paper identifies growth and trends in publications by LIS researchers through use of bibliometrics.

Keywords Web of science, Visualization, Bibliometrics, Citation analysis, Co-citation networks, Self-citation

Paper type Research paper

1. Introduction

Information and communications technologies (ICTs) have changed all aspects of human life. Libraries, education and research are all integrated through ICT. According to Sethi and Panda (2012), research and development are major activities in all scientific fields, especially in social sciences and library and information science (LIS). A remarkable number of publications have been produced by LIS researchers on different aspects of libraries and their functions.

Bibliometrics allow the research to evaluate publication rates in a given field, subject coverage, dominant forms of production, levels of international collaboration and particular publication genres over time (Erfanmanesh *et al.*, 2010).

In recent decades, there have been a number of studies conducted to evaluate research productivity in subject areas such as physics, medical science, biological science and LIS (Michalopoulas and Falagas, 2005; Kumasi *et al.*, 2013; Rahman and Fukui, 2003; Uzun *et al.*, 1993). Overall, the USA and Western Europe have made remarkable contributions to global research, although their comparative productivity varies across different fields of research (Sapa, 2007). Studies have been undertaken on the outputs from LIS work (Schloegl and Stock, 2004). Bibliometric techniques are considered to be the best approach to monitor research activities (Moed *et al.*, 1995).

Chang and Huang (2012) have used bibliometrics to evaluate an interdisciplinary approach in LIS studies from 1978 to 2007. Three bibliometric methods – direct citation, bibliographic coupling and co- authorship – were used as the basis of their analysis. Their findings indicated that library professionals prefer to cite their publications in the same field. Furthermore, half of the co-authors were affiliated with LIS-related institutes.

2. Literature review

Järvelin and Vakkari (1990) pointed out that more than 800 LIS articles published in 1985 were in two categories: research articles and professional articles. It was found that the most common topics were related to practical or applied aspects of libraries. Again, in 1993, they scrutinized LIS trends from 1965 to 1985 and ascertained that the most notable changes in those years were from traditional library approaches to information storage and retrieval.

In Poland, Sapa (2007) explored the international productivity of LIS communications during the period 2003-2005 in two respects:

(1) the direct contribution of foreign authors and the translation of their work into Polish; and

(2) the indirect contribution of cited articles by foreign authors.

His findings indicated that 37 per cent of the citations from foreign authors either in the original language or translated into Polish received 63 per cent of the citations by Polish

authors. The *Journal of Academic Librarianship* was the most cited journal by Polish authors. Only 6.9 per cent of the articles published in Poland were by foreign authors. The main thematic areas of most citations by Polish authors were the Internet, its use, services, resources and information retrieval.

Sethi and Panda (2012) analyzed articles from the *International Information & Library Review* and *Library & Information Science Research*, indexed in the *Science Direct* database (2000-2010), covering aspects such as author partnership, growth of the literature, the geographical distribution of LIS authors and citation patterns.

Davarpanah and Aslekia (2008) conducted a study on the characteristics and productivity of LIS publications in Iran and found that 894 papers from 2000 to 2004 were published in 56 journals found in the Social Science Citations Index (SSCI). Their study also revealed that 89.93 per cent of the authors (1,361 in total) published only one paper during that period. The average number of authors per paper remained 1.52 per cent. A large number of papers received few citations.

Larivière *et al.* (2012) carried out a bibliometric study of LIS literature published during the past hundred years and concluded that in 2010, more than 60 per cent of the authors published not only in the LIS field but also in other disciplines. From 1990 onward, LIS literature has included citations from outside the field, and especially from computer science and management.

Mukherjee (2010) studied the performance of Asian countries in LIS journals during the period of 2001-2007, as indexed by *Web of Knowledge*. She used several parameters to gauge the performance: volume of literature by publication types, authorship patterns, levels of national and international collaboration and citation patterns. Her findings showed that China played a leading role, followed by Taiwan and South Korea. There were collaborations between researchers in Asian countries and with those from other regions. Research articles produced by South Korean authors received the highest citation rate, followed by those from Taiwan (Park, 2008).

Cheng (1996) conducted a content analysis of LIS publications in China from 1979 to 1994. Research articles covering various topics were analyzed. A methodological research approach was developed and a relational analysis technique was used to compare the rest of the world with China. Chen found that a large number of articles were based on the basic theory of LIS (26-32 per cent) and information services (20-25 per cent). The most practical research strategies used were: historical method (25-19 per cent), experiments (0.2-0.5 per cent) and survey techniques (4-1.6 per cent). The major finding was that LIS studies in China tend to adopt a theoretical approach, while in the rest world, an applied approach is more prevalent.

Bibliometric visualization, mapping concepts and social network analysis techniques are very popular, especially with respect to patent research in information technology and management science (Liu *et al.*, 2014; Levitas *et al.*, 2006).

Social networks are also used in bibliometric analysis to identify the global trends and reveal the collaboration rate of LIS publications (Chinchilla-Rodrgíuez *et al.*, 2012).

3. Objectives of the study

The purpose of this study is to investigate quantitatively the LIS research output by using bibliometric visualization and mapping techniques on the *Web of Science* database.

The core objectives of the study are as follows:

- Which countries have been producing a significant number of LIS publications?
- Which institutions have been producing a significant number of LIS publications?
- What are the trends in citation distribution, self-citation and collaboration patterns at international and national levels?
- Which people have been the most productive LIS researchers during the past decade?
- Which LIS journals are co-cited most?
- What trends have been focused on by Chinese LIS scholars, including their hot topics, journals and cited papers?

4. Research methodology

4.1 Data retrieval

The survey technique was used to collect quantitative data on LIS publications from 2003 to 2012.

Journal Citation Reports (*JCR*) 2010 contained 77 LIS journals, of which 40 core LIS journals were selected for the current study. Data were retrieved and downloaded in plain text format in batches of 100 from the *Web of Science*. The downloaded data were related to the articles published from 2003 to 2012 in all document types such as articles, book reviews, bibliographies, meeting abstracts, editorial material, letters and reprints.

The collection process was completed on June 20, 2013.

Table II shows all 105 countries/regions with their total number of publications and percentage.

4.2 Research methods and tools

Bibliometric techniques are applied to portray and predict the research trends on specific topics (Garfield, 1970).

The present study combines traditional bibliometric analysis and social network analysis (Zhao and Zhang, 2011).

The following steps were taken:

- *Domain discover*: 40 core LIS journals were selected from *JCR* 2010.
- *Data extraction*: Factual data were retrieved from the *Web of Science* by journal titles and publishing dates for the period 2003-2012.
- *Data collection and processing*: A database with references and abstract details was created.
- *Visualization and mapping*: The data were interpreted by using VantagePoint (a powerful text-mining tool for discovering meaningful results from raw data). The features provided by VantagePoint facilitated interpretation of what, where, when and who. VantagePoint helps to clarify relationships across complex datasets. CiteSpace II, a Java-based free visualization application, was used to analyze co-citation networks. Chen Chaomei developed its initial version in 2004 at Drexel University, USA. CiteSpace II combines the bibliometric, data mining and visualization methods with three basic concepts: Kleinberg's burst detection algorithm, Freeman's betweenness centrality metric and heterogeneous networks. CiteSpace II helps to identify the nature of query, revealing trends and changes in a field.

- *Analyzing results*: The data were incorporated and presented in tables and graphs according to the nature and type of data. Figure 1 described the five steps involved therein.

5. Findings and discussion

5.1 Trends and percentage of LIS publications by countries/regions

The contributions of all LIS publishing countries were investigated and calculated. CiteSpace II presents a visualization of LIS publications through a network of 78 nodes and 50 links (Figure 2).

CiteSpace II presents a visualization of LIS publications through a network consisting of 78 nodes and 50 links (Figure 2). Altogether, there were authors from 105 countries contributing to LIS publications from 2003 to 2012. Table I shows the top 13 countries/regions. The USA produced 7,818 (43 per cent) LIS publications and thus was ranked number 1, followed by the UK (1,607; 9 per cent) and Canada (890; 5 per cent). China was tenth, with 210 (1 per cent) publications (Aharony, 2012; Han *et al.*, 2014).

Figure 1.
Graphic presentation of research methodology

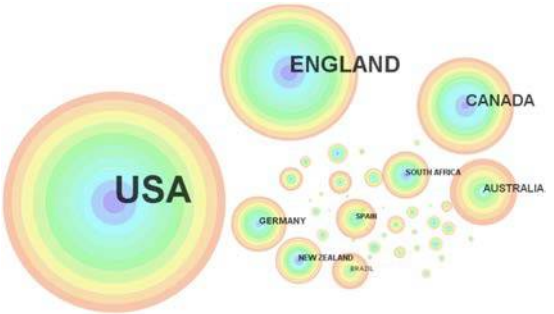

Figure 2.
A network of countries, with 78 nodes and 41 links

Country name	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total	(%)
USA	520	640	660	670	731	840	119	105	900	617	7,818	43
UK	118	124	139	155	172	187	205	193	175	139	1,607	9
Canada	70	78	81	85	88	98	126	105	94	65	890	5
Australia	50	59	58	58	59	58	75	65	62	51	595	3
Germany	40	43	44	45	49	51	67	53	53	49	494	3
South Africa	35	38	44	42	41	46	57	43	38	30	414	2
New Zealand	32	35	40	40	42	44	53	47	39	38	410	2
Spain	31	33	32	35	36	42	51	37	33	33	363	2
Brazil	25	27	29	30	33	36	41	39	33	27	320	2
China	16	17	19	19	19	23	29	25	23	20	210	1
Taiwan	15	17	18	21	23	23	31	25	17	14	204	1
India	12	13	14	15	16	17	25	23	17	16	168	1
Iran	12	12	14	15	18	16	21	16	16	13	153	1

Table I.
LIS contributions by top countries/regions

Figure 3 shows that from 2009 to 2010, China's citation burst position decreased with the abrupt citation burst (3.44), and increased after 2010 (Table II).

5.2 Contributions by institutions

Figure 4 shows the visualization distribution by LIS institution. The frequency analysis was based on a total of 3,393 institutions. The top LIS institutions were located in the USA, the UK, Canada, South Africa, China and Taiwan.

The top LIS institution of all was Victoria University, Wellington, New Zealand, which produced 317 publications during the 10-year period. The University of Illinois was second with 265 publications.

In the USA, the top LIS institutions included the University of Illinois, the University of Washington, Florida State University and Pennsylvania State University.

In Asia, the University of Malaya was most productive with 67 LIS publication, followed by Nanyang Technological University, Singapore (61), and National Taiwan University (21).

5.3 Growth rate of LIS publications, citations and self-citation distribution

An examination of the distribution of LIS publications and a citation analysis for 2003-2012 was also completed. The number of papers and citations were investigated by year. The annual citation per paper was also derived.

Table III shows that there were 1,732 (9.43 per cent) publications and 3,980 (14.1 per cent) citations in 2003 and that the citation per paper was 2.29. In general, there was no

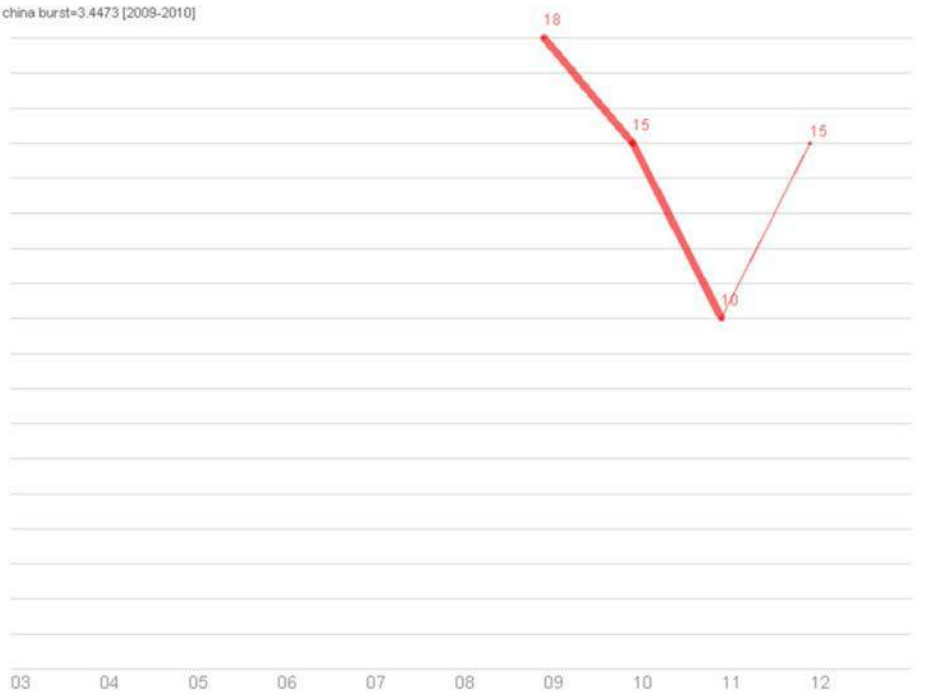

Figure 3.
China citation burst, 2009-2010

Serial no.	Countries	Publications	(%)
1	USA	7,818	42.56
2	The UK	1,607	8.75
3	Canada	890	4.84
4	Australia	595	3.24
5	Germany	494	2.69
6	South Africa	414	2.25
7	New Zealand	410	2.23
8	Spain	363	1.98
9	Brazil	320	1.74
10	China	210	1.14
11	Taiwan	204	1.11
12	India	168	0.91
13	Iran	153	0.83
14	Sweden	160	0.87
15	Lithuania	155	0.84
16	Finland	156	0.85
17	Nigeria	150	0.82
18	Denmark	160	0.87
19	South Korea	179	0.97
20	Malaysia	178	0.97
21	Japan	200	1.09
22	Singapore	170	0.93
23	France	164	0.89
24	Israel	100	0.54
25	The Netherlands	145	0.79
26	Ireland	100	0.54
27	Slovenia	100	0.54
28	Italy	100	0.54
29	Belgium	99	0.54
30	Turkey	88	0.48
31	Greece	99	0.54
32	Botswana	80	0.44
33	Norway	89	0.48
34	Portugal	78	0.42
35	Austria	78	0.42
36	Switzerland	90	0.49
37	Mexico	87	0.47
38	Kuwait	70	0.38
39	Pakistan	98	0.53
40	Poland	67	0.36
41	Serbia	56	0.30
42	Qatar	50	0.27
43	Slovakia	49	0.27
44	Russia	49	0.27
45	Bangladesh	22	0.12
46	Ghana	55	0.30
47	United Arab Emirates	56	0.30
48	Cuba	76	0.41

(*continued*)

Table II.
LIS contributions by all countries

Serial no.	Countries	Publications	(%)
49	Hungary	46	0.25
50	Iceland	45	0.24
51	Thailand	38	0.21
52	Croatia	39	0.21
53	Egypt	67	0.36
54	Uganda	50	0.27
55	Argentina	69	0.38
56	The Czech Republic	34	0.19
57	Saudi Arabia	40	0.22
58	Tanzania	30	0.16
59	Kenya	45	0.24
60	Colombia	50	0.27
61	Trinidad and Tobago	34	0.19
62	Chile	32	0.17
63	Indonesia	44	0.24
64	Jordan	42	0.23
65	Namibia	39	0.21
66	Oman	32	0.17
67	Zambia	34	0.19
68	Sri Lanka	42	0.23
69	The Philippines	41	0.22
70	Estonia	20	0.11
71	Jamaica	12	0.07
72	Peru	14	0.08
73	Zimbabwe	12	0.07
74	Algeria	8	0.04
75	Cyprus	8	0.04
76	Lebanon	8	0.04
77	Luxembourg	8	0.04
78	Romania	8	0.04
79	Sierra Leone	8	0.04
80	Sudan	8	0.04
81	Swaziland	4	0.02
82	Vietnam	4	0.02
83	Albania	4	0.02
84	Antigua & Barbu	4	0.02
85	Armenia	4	0.02
86	Bahrain	5	0.03
87	Benin	5	0.03
88	Burkina Faso	5	0.03
89	Costa Rica	7	0.04
90	Fiji	7	0.04
91	Honduras	1	0.01
92	Latvia	1	0.01
93	Malawi	1	0.01
94	Maldives	1	0.01

Table II. (*continued*)

Serial no.	Countries	Publications	(%)
95	Malta	1	0.01
96	Moldova	1	0.01
97	Mongolia	1	0.01
98	Montenegro	1	0.01
99	Mozambique	1	0.01
100	Nepal	1	0.01
101	Niger	1	0.01
102	Panama	2	0.01
103	Ukraine	1	0.01
104	Uruguay	1	0.01
105	Yemen	1	0.01

Table II.

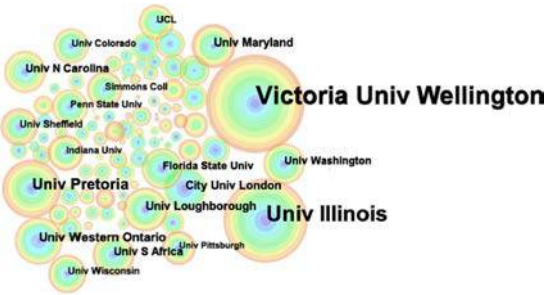

Figure 4.
An institution network of 94 nodes and 11 links

Years	Frequency of papers	% of papers	Frequency of citations	% of citations	Citation per paper (CPP)	% of citation per paper (CPP)
2003	1,732	9.43	3,980	14.1	229	2.29
2004	1,651	8.99	3,625	12.85	219	2.19
2005	1,777	9.67	4,245	15.04	239	2.6
2006	1,698	9.24	4,147	14.69	244	2.44
2007	1,941	10.57	3,604	12.77	185	1.85
2008	1,912	10.41	3,286	11.64	171	1.71
2009	2,088	11.37	2,390	8.47	114	1.14
2010	1,923	10.47	1,580	5.60	82	0.82
2011	1,997	10.87	1,050	3.72	52	0.52
2012	1,652	8.99	314	1.11	19	0.19
	18,371	100	28,221	100	1,553	1.53

Table III.
Distribution of LIS publications and citations

significant difference between frequencies of LIS publications in all years. But gradually, a slight difference was found during the period of 2007-2011 when the number of publications decreased. In 2012, only 1,652 articles were published with 314 citations.

Table III also shows that the highest number of citations was reached in 2005 (15.04 per cent). A significant difference was found between the distributions of citations in each year. Citations per paper gradually increased from 2003 to 2006 and

after that gradually decreased until reaching the lowest level of 1.11 (0.19 per cent) in 2012. The average number of citations for each publication was 1.53 during the past decade.

The results of correlation and regression analysis show that there was a positive relationship among publications and years, as shown in Figure 5(a). The value of the coefficient of determination for the number of publications remained as low as 0.179. This indicates an inverse, though not significant, trend with respect to time over years and, hence, leads to a *p*-value of 0.222. The value of the coefficient of determination was as high as 0.834, indicating how strong the trend might be in future years, with a highly significant *p*-value of less than 0.0001.

Self-citation is increasingly prevalent. The data collected were analyzed to determine the frequency of self-citation in LIS publications.

Figure 5(b) presents a clear trend line of self-citation. In 2012, 17.83 per cent of the 314 citations were self-citations (Table IV).

Table IV shows that the self-citations (87; 2.41 per cent) were made from a total of 3,604 citations in 2007 and that 38.56 per cent of the total citations (28,221) during the period 2003-2012 were self-citations.

Self-citation itself is not a bad thing (Glänzel *et al.*, 2006). There is no reason to condemn self-citations or discard them from citation statistics.

The value of coefficient of determination was as high as 0.869, which indicates how strong the trend would be in the coming years. This trend was highly significant with *p*-value of even less than 0.0001.

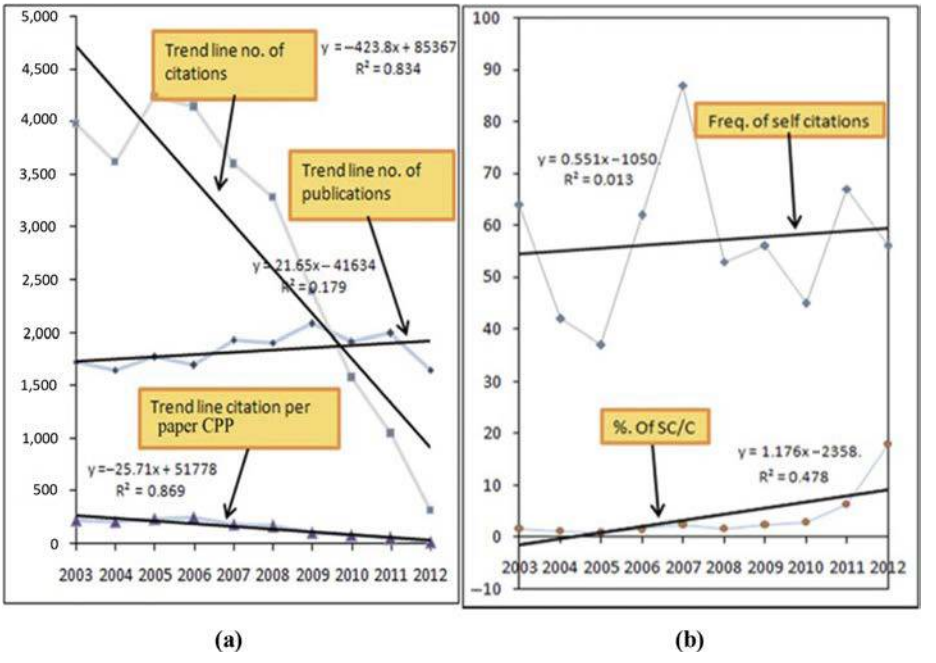

Figure 5.
(a) Growth rate of publications and citations; (b) growth rate of self-citations

Years	Frequency of self-citations (SC)	Frequency of citations (C)	SC/C (%)
2003	64	3,980	1.61
2004	42	3,625	1.16
2005	37	4,245	0.87
2006	62	4,147	1.50
2007	87	3,604	2.41
2008	53	3,286	1.61
2009	56	2,390	2.34
2010	45	1,580	2.85
2011	67	1,050	6.38
2012	56	314	17.83
	569	28,221	38.56

Table IV. Distribution of self-citations in LIS publications

5.4 Analysis of document co-citation network

Citation analysis has a long history in bibliometric study (Harter and Kim, 1996). Citing a particular article reflects its scholarly impact on current work (Zhai *et al.*, 2014).

By using CiteSpace II, most co-cited papers were identified. Figure 6 shows a time-span view of document citation networks from 2003 to 2012. The document co-citation network consisted of 53 nodes and 127 links. The most co-cited documents are highlighted with light purple rings. They are considered as the main bridges and strong connectors for other parts of the network. Most cited documents became a source for sharing knowledge across LIS research. Figure 6 shows the frequencies of the most cited documents, which include Wilson (1999) and Kuhlthau (1991).

Figure 7 shows the citation history graph of Wilson (1999). His highest citation point was reached in 2011 when his works were cited 18 times and then citations decline sharply in 2012.

5.5 Analysis of growth rate of LIS publications

Figure 8 shows the growth rate of LIS scholarly publications from 2003 to 2012. The productivity trend showed some variation during the period under scrutiny. To provide clarity, data interpretation was broken down into three phases. These phases provide a comprehensive picture of LIS publication growth.

Figure 6. A document co-citation network with 53 nodes and 127 Links, 2003-2012

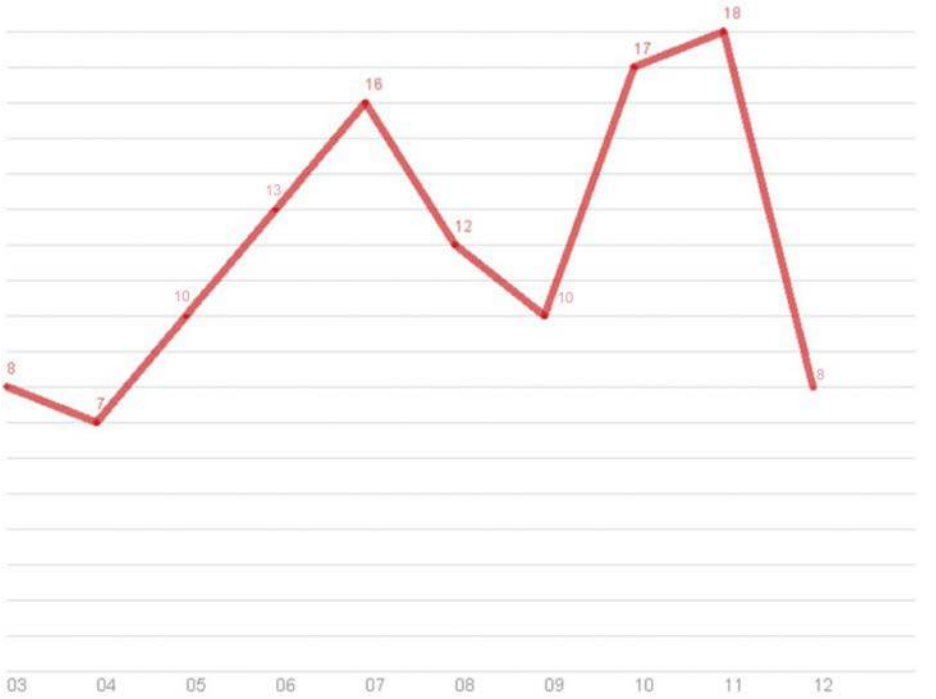

Figure 7.
Citation history of Wilson (1999)

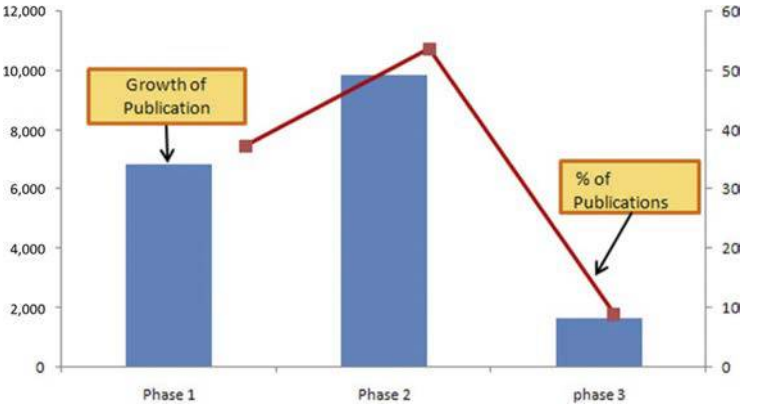

Figure 8.
Growth rate of LIS publications

Phase 1 (2003-2006) had a total of 6,858 (37.33 per cent) LIS publications. Its highest point was in 2005 when 1,777 (9.67 per cent) publications were produced.

Phase 2 (2007-2011) was the prime time period with 9,861 (53.68 per cent) LIS publications. Its maximum annual publications of 2,088 (11.37 per cent) were attained in 2009.

Phase 3 (2012) was recorded as a declining time period with 1,652 LIS publications (8.99 per cent) published.

5.6 Publications growth by document type

Table V shows publication growth by document type during the period 2003-2012. The data show great variations among all types of documents by frequency of publications in different years. The most prevalent types of publications are "article" (8,713; 47.4 per cent) and "book review" (6,102; 33.2 per cent).

Figure 9(a) is a visual representation of the publishing trends for all types of documents, based on the 8,371 documents from the 40 core LIS journals covered by the study. It shows that "article" is the most popular type of document across all LIS journals, which corroborates Sethi and Panda's finding that "article" (97 per cent) was the most frequent document type in the *International Information & Library Review* and (97.6 per cent) in the *Journal of Library and Information Science Research*. In another study, Khan *et al.* (1998) discovered that of a total number of 440 publications, 308 (71.30 per cent), were articles.

Figure 9(b) is a magnified form of Figure 9(a). In other words, Figure 9(b) shows more clearly the growth rates and publication trends of "article/proceeding paper", "meeting abstract", "review", "biographical item", "news item", "letter", "correction", "software review", "bibliography", "database review" and "reprint".

Publications name	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	Total	(%)
Article	630	690	710	880	879	1,010	1,350	950	890	724	8,713	47
Book review	480	500	550	544	597	690	850	707	650	534	6,102	33
Editorial material	145	139	169	160	179	175	330	188	162	99	1,746	9.5
Article proceeding paper	39	48	41	49	50	59	72	59	40	26	483	2.6
Meeting abstract	25	33	35	39	31	28	51	35	33	25	335	1.8
Review	17	19	24	22	26	29	41	22	24	19	243	1.3
Biographical-item	14	17	19	21	22	21	36	28	22	14	214	1.2
News item	13	10	14	16	16	17	36	20	21	19	182	1
Letter	7	6	8	10	9	11	23	11	12	10	107	0.6
Correction	4	6	8	8	6	5	19	10	9	4	79	0.4
software review	6	5	5	5	6	6	11	8	9	5	66	0.4
Bibliography	3	4	4	4	4	5	14	6	5	3	52	0.3
Database review	3	2	0	0	3	3	8	4	4	1	28	0.2
Reprint	1	0	3	1	2	2	8	2	1	1	21	0.1

Table V.
Publications growth by document type

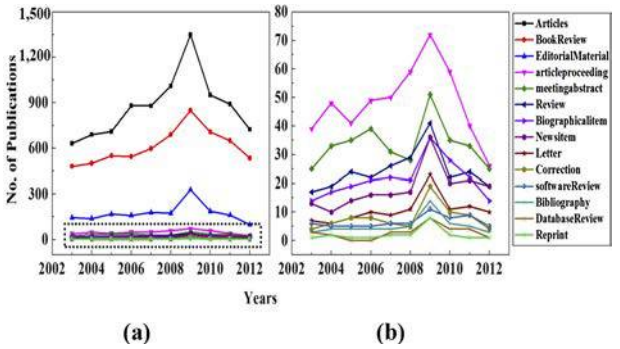

Figure 9.
(a) and (b) Publications growth by document type

5.7 Analysis of journal co-citation network

One of the core objectives of this study is to find out the most co-cited LIS journal by the number of citations during the period of 2003-2012.

Figure 10 shows a network of the 53 most cited LIS journals. "J ACAD LIBR" (*Journal of Academic Librarianship*) tops the list as the most co-cited journal of the decade with a frequency of 1,401 times and a centrality of 0.21, followed by "J DOC" (1,773), "J AM SOC INF SCI TEC" (1,333), "J AM SOC INFORM SCI" (1,314), "COLL RES LIBR" (1,334) and "LIBR INFORM SCI RES" (1,039). As a core journal in the LIS profession, the *Journal of Academic Librarianship* shows strong node connections with other nodes in the co-citation network.

Figure 11 shows that *Library Hi Tech* attained its high burst detection point of 29.99 and an increasing trend line from 2010 to 2012, indicating that library researchers are focusing on research into ICT-related issues.

5.8 Analysis of keywords

Figure 12 shows a network of keywords co-occurred in title, abstracts, author and keywords in LIS publications. The red ring circles indicate the burst detection level of the term.

The burst detection point of "World Wide Web" was 10.9 with a drastic development between 2007 and 2009 (Figure 13). Later on, the interest of LIS researchers has shifted toward other aspects of librarianship. Overall, it is evident that information technology (IT)-based theories and applications played a pivotal role in generating research in librarianship during the period of 2003-2012.

The top 20 keywords or terms co-occurred with the burst detection point more than 150 times. The most frequently used keyword or term is "Internet", which occurred 692 times and with a burst detection of 11.22 times. It shows a strong link among other keywords, and especially "Internet", "information retrieval", "digital libraries", "World Wide Web" and "information" (Figure 12).

5.9 Collaborated research articles, 2003-2012

Research productivity can be analyzed to determine the level of collaborated research in the world. Altogether, 105 countries participated in LIS research with each other during

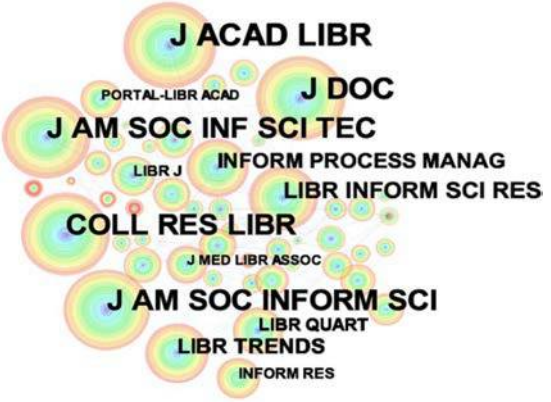

Figure 10.
A journal co-citation network with 52 nodes and 420 links

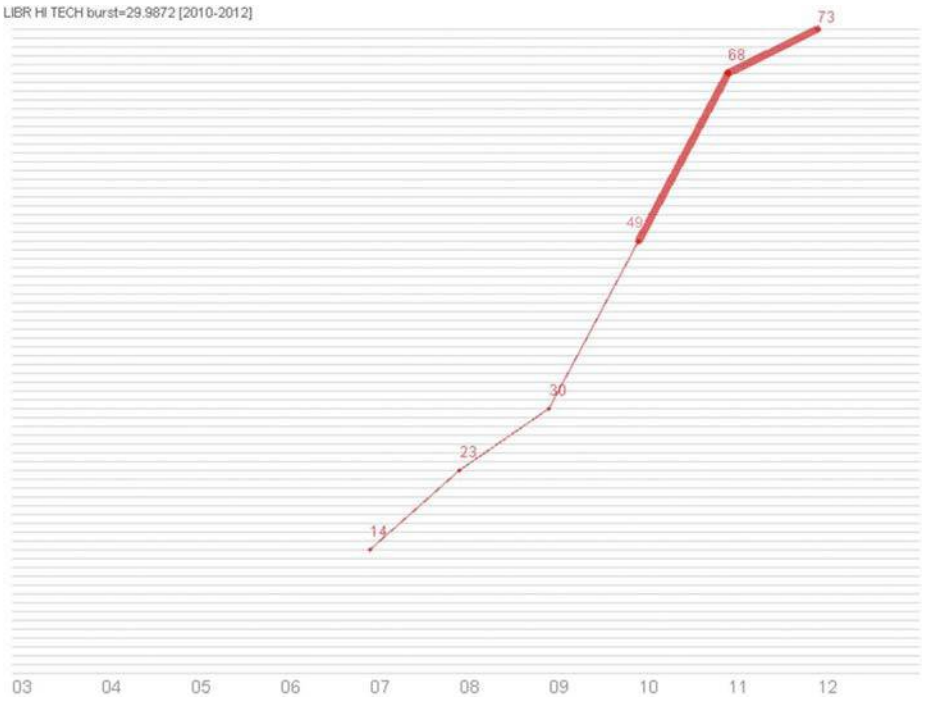

Figure 11.
Library Hi Tech graphical presentation of burst detection, 2010-2012

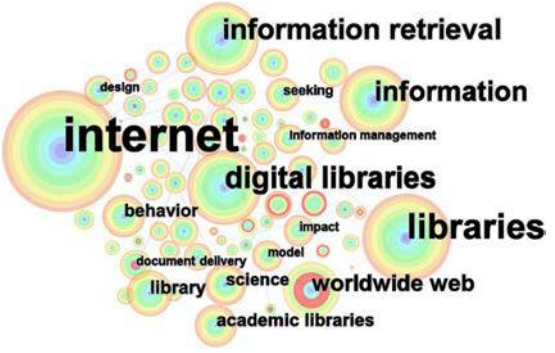

Figure 12.
A co-occurrence network of key words with 73 nodes and 205 links

the period 2003-2012. Gephi, an open source graph visualization and manipulation software, was used to illustrate the contributions of all these countries along with the links and nodes to each other.

In Figure 14, a strong connection can be seen by a dark blue link. China had a strong link with the USA, the UK and Canada. The dark blue link between USA and UK illustrated their strong collaboration in research. China has a strong position in producing collaborative research with the USA, the UK and Canada. In addition, China maintained its position in research collaboration with other countries, followed by Taiwan and South Korea.

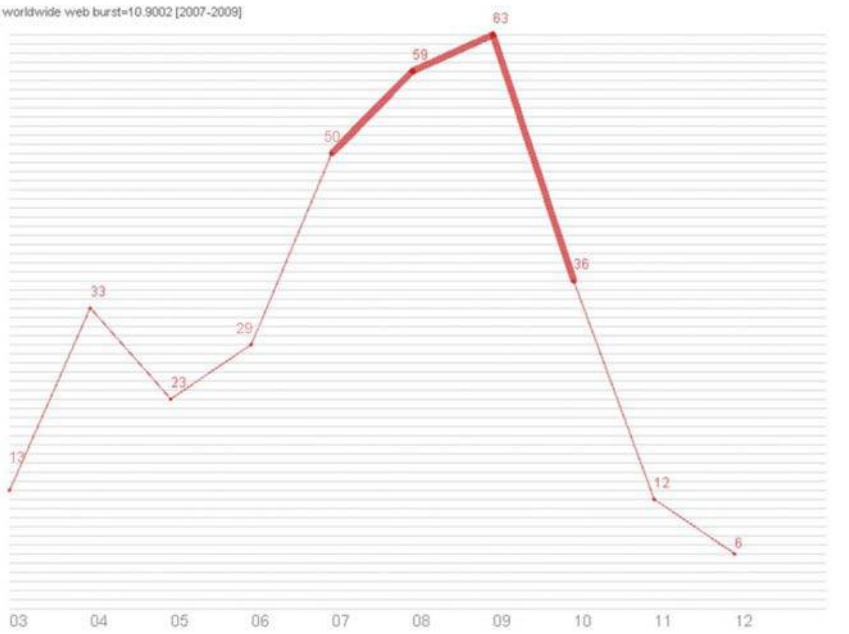

Figure 13.
World Wide Web burst detection (2007-2009)

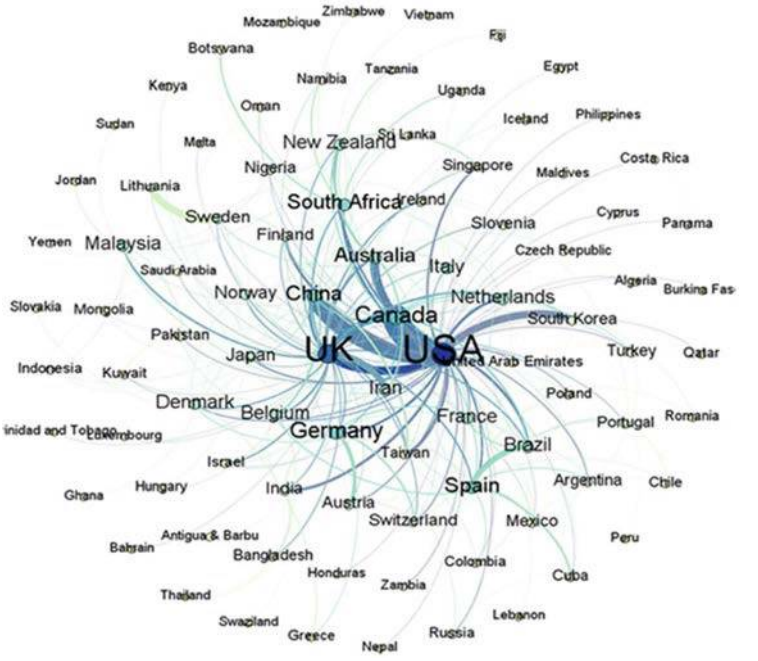

Figure 14.
LIS research collaborative countries

The USA tops the list with 7,818 (42.56 per cent) publications, to which the UK has contributed 23 (0.29 per cent) in collaboration. The USA participated substantially in research with China, resulting in 42 (0.54 per cent) articles published as a joint venture. The UK produced 1,607 (8.75 per cent) publications in total, of which 23 (1.43 per cent) were in collaboration with the USA and 19 (1.18 per cent) with Canada. Australia was in number four position with 595 publications, but did not produce any collaborated research papers with Germany, South Africa, Spain or Brazil. The collaboration among the top six countries shows that the USA is in a strong position to undertake collaboration in the world, while China collaborates more with the developed countries in LIS research.

Table VI shows the top-cited LIS research publications by Chinese authors and their affiliated institutions. There were 11 top-cited articles by authors from 11 institutions of China. Overall, China produced 210 (1 per cent) LIS publications during 2003-2012.

The article "Management: A scientific discipline for humanity" authored by Xu Shoubo and Xu Li Da from Beijing Jiaotong University and published in *Information Technology & Management* in 2011, tops the list with 17 citations. *Journal of Academic Librarianship*, *Serial Review* and *Information Technology & Management* emerged as the preferred journals of Chinese authors. More than 80 per cent of papers were produced by university faculty and staff. Many highly cited papers were published in 2011. Hong Kong universities have contributed articles with more citations than from Mainland China (He and Wang, 2006). As far as individual institutions are concerned, Beijing Jiaotong University, Wuhan University and Hong Kong University are top producers of quality LIS publications.

6. Conclusion

There were 18,371 articles published in 40 core LIS research journals during the period 2003-2012, according to the *Web of Science*. Visualization and mapping software were utilized to present a real picture of the growth and trends of LIS publications. There was no significant difference found between frequencies of LIS publications in different years. The most productive year was 2009 (11.37 per cent). The growth of LIS citations showed a decrease during the period. The average citation per paper is 1.53. A trend toward self-citation was found during the period. The percentage of self-citation was 2.01 of the total citations.

More than 43 per cent of LIS publications were authored in the USA. The UK and Canada also made great contributions. The performance of Chinese researchers leaves much room for improvement. The USA has not only produced 7,818 (42.56 per cent) publications but also participated in collaborative research with Canada, the UK and Australia.

Among all LIS research organizations and institutions, Victoria University in New Zealand is the most productive institution that has generated 317 (1.73 per cent) publications. It is worth noting that the *Journal of Academic Librarianship* has received the highest number of citations (1,401) and the greatest centrality (0.21) among all LIS core journals. The research papers by Wilson (1999) have received 119 citations. *Library Hi Tech* is regarded as a major vehicle for sharing IT-based research findings in the LIS community.

Table VI.
China's contribution by number of citations, authors and affiliation

Serial no.	Author name	Affiliation to Institute	Title	Journal name	Published year	Citation
1	Xu, Shoubo, Xu, Li Da	Beijing Jiaotong University	Management: a scientific discipline for humanity	*Information Technology & Management*	2011	17
2	Xu, Chen	Wuhan University, China	The academic library meets web 2.0: applications and implications	*Journal of Academic Librarianship*	2009	15
3	Shan, Siqing	Beihang University China	Research on e-government evaluation model based on the principal component analysis	*Information Technology & Management*	2011	10
4	Xie, Kefan; Chen, Gang	Wuhan University of Technology	Research on the group decision-making about emergency event based on network technology	*Information Technology & Management*	2011	7
5	Churchill, Daniel; Wong, Wing; Law, Nancy	The University of Hong Kong,	Using wikis in academic libraries	*Journal of Academic Librarianship*	2009	6
6	Churchill, Daniel; Wong, Wing; Law, Nancy	The University of Hong Kong, Hong Kong SAR, China	Social bookmarking-repository-networking: possibilities for support of teaching and learning in higher education	*Serial Review*	2009	6
7	Ching, Steve H.; Tai, Alice	City University of Hong Kong, Hong Kong, China	HF RFID versus UHF RFID - Technology for Library Service Transformation at City University of Hong Kong	*Journal of Academic Librarianship*	2009	5
8	Wu, JZ; Huang, RH	Shanghai Library, Wuhan University, Wuhan, P. R. China	International perspectives - the academic library development in China	*Journal of Academic Librarianship*	2003	5
9	Wong, Shun Han Rebekah	Hong Kong Baptist University Library	Uncovering meaningful correlation between student academic performance and library material usage	*College and Research Libraries*	2011	5
10	Wong, Gabrielle; Chan, Diana	The Hong Kong University of Science and Technology Library	Assessing the enduring impact of library instruction programs	*Journal of Academic Librarianship*	2006	3
11	Zha, Xianjin; Li, Jing; Yan, Yalan	Wuhan University, Wuhan, China	Understanding usage transfer from print resources to electronic resources: a survey of users of Chinese University libraries	*Serial Review*	2012	2

China, Taiwan, India and Iran have each produced 1 per cent of LIS publications in the period. The journal article (47 per cent) was the most popular type of LIS publications, and reprint (0.1 per cent) was the least.

The hot topics for Chinese LIS researchers include "information technology", "information management" and "library management". Overall, China has published 210 LIS publications, of which 70 publications were authored by individual Chinese authors and 140 were produced in collaboration with others. It is worth noting that more than half of the papers were produced through international collaboration. The major countries that Chinese researchers have collaborated with are the USA, the UK and Canada.

There are two major reasons behind the lower number of publications by Chinese authors than those by researchers in the developed countries. Firstly, there is a language barrier. The Chinese language is used as an official language in China. The medium of instruction is also in Chinese. So teachers and students feel more comfort writing in Chinese rather than in English. Secondly, the data used for this study are based on only those journals indexed in SSCI. There are many complexities such as rapid technology changes, language, culture differences and growth of knowledge (Hara *et al.*, 2003; Russell, 2001). Articles indexed in Engineering Index and non-*JCR*-cited articles have not been included in this study, although they contain a lot of scientific data (Mukherjee, 2010).

LIS professionals have produced substantial publications on IT theories and applications during the period 2003-2012. Now librarianship is an amalgam with elements from IT and management. The interdisciplinary approach in LIS research is flourishing.

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