

Analysis of Knowledge Management Trend by Bibliometric Approach

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Abstract—The analysis is mainly concentrating on the knowledge management literatures productivity trend which subjects as “knowledge management” in SSCI database. The purpose what the analysis will propose is to summarize the trend information for knowledge management researchers since core knowledge will be concentrated in core categories. The result indicated that the literature productivity which topic as “knowledge management” is still increasing extremely and will demonstrate the trend by different categories including author, country/territory, institution name, document type, language, publication year, and subject area. Focus on the right categories, you will catch the core research information. This implies that the phenomenon “success breeds success” is more common in higher quality publications.

Keywords—Knowledge Management, SSCI, Bibliometric, Lotka's Law

I. INTRODUCTION

KNOWLEDGE management (KM) comprises a range of practices used in an organization to identify, create, represent, distribute and enable adoption of insights and experiences. Such insights and experiences comprise knowledge, either embodied in individuals or embedded in organizational processes or practice.

An established discipline since 1991 [1], KM includes courses taught in the fields of business administration, information systems, management, and library and information sciences [2]. More recently, other fields have started contributing to KM research; these include information and media, computer science, public health, and public policy.

Many large companies and non-profit organizations have resources dedicated to internal KM efforts, often as a part of their 'business strategy', 'information technology', or 'human resource management' departments [3]. Several consulting companies also exist that provide strategy and advice regarding KM to these organizations.

KM efforts typically focus on organizational objectives such as improved performance, competitive advantage, innovation, the sharing of lessons learned, and continuous improvement of the organization. KM efforts overlap with organizational learning, and may be distinguished from that by a greater focus on the management of knowledge as a strategic asset and a

focus on encouraging the sharing of knowledge. KM efforts can help individuals and groups to share valuable organizational insights, to reduce redundant work, to avoid reinventing the wheel per se, to reduce training time for new employees, to retain intellectual capital as employees turnover in an organization, and to adapt to changing environments and markets [4] [5].

This analysis is utilizing bibliometric methodology toward onto productivity inspection. The purpose what the analysis will propose is to summarize the trend information for KM researchers to save their time since core knowledge will be concentrated in core categories. The result indicated that the literature productivity topic as “Knowledge management” is still increasing extremely and will demonstrate the trend by different categories including author, country/territory, institution name, document type, language, publication year, and subject area. Focus on the right categories, you will catch the core research information. This implies that the phenomenon “success breeds success” is more common in higher quality publications.

For verifying the analysis result, the paper will proceed Lotka's Law to check on literature record count versus accumulated authors between 1989 and 2009 to perform author productivity inspection for discovering historical vein and collecting the results for research tendency forecast in the near future.

II. LITERATURE REVIEW

A. Lotka's Law

Lotka's Law, named after Alfred J. Lotka, is one of a variety of special applications of Zipf's Law. It describes the frequency of publication by authors in any given field. It states that the number of authors making n contributions is about $1/n^a$ of those making one contribution, where a nearly always equals two. More plainly, the number of authors publishing a certain number of articles is a fixed ratio to the number of authors publishing a single article. As the number of published articles increases, authors producing that many publications become less frequent. There are 1/4 as many authors publishing two articles within a specified time period as there are single-publication authors, 1/9 as many publishing three articles, 1/16 as many publishing four articles, etc. Though the law itself covers many disciplines, the actual ratios involved (as a function of 'a') are very discipline-specific.

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III. RESEARCH FINDING AND DISCUSSION

This research is accessing the Social Science Citation Index (SSCI) on Web of Science created by ISL. The result is summarizing those 1393 paper indexes which title are “Knowledge management” from 1989 to 2009 as well as input datum for next stage analysis, shown as Fig. 1. Obviously, the literature production of knowledge management is rising since 1997 and citation is also increasing steady and gradually by every year. It shows the research of knowledge management is very popular and getting in the highly exploration period, referred to Fig. 2. The research of knowledge management reached the highest record in 2008.

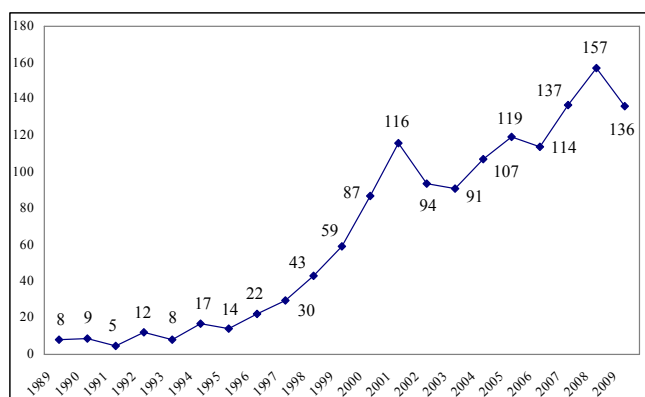


Fig. 1 The tendency chart of literature growth of knowledge management

Citations in Each Year

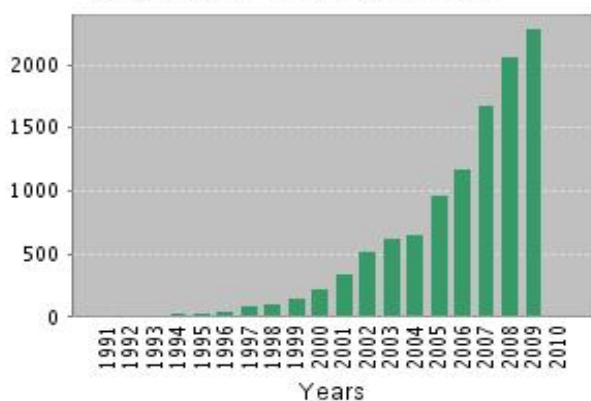


Fig. 2 Citation of knowledge management in each year (Source: SSCI database)

By viewing on Table I and Fig. 3, they displayed that the distribution of country/territory from 1989 to 2009, USA is a champion as well as 461 paper counts (33.09%), following by the England, Canada and Taiwan which achieved the record counts as 226(16.22%), 82(5.894%), and 76(5.46%) oppositely. Taiwan is ranking as No.4 (76 paper counts, 5.46%) in this research domain. Combining with the distribution of institution name (as Table II) for deeply observation, it showed that USA is still the most productivity country within the research aspect of knowledge management in the world.

TABLE I

DISTRIBUTION OF TOP 25 COUNTRY/TERRITORY FROM 1989 TO 2009

Ranking	Country/Territory	Record Count	% of 1393
1	USA	461	33.09%
2	ENGLAND	226	16.22%
3	CANADA	82	5.89%
4	TAIWAN	76	5.46%
5	AUSTRALIA	55	3.95%
6	PEOPLES R CHINA	47	3.37%
7	GERMANY	45	3.23%
8	NETHERLANDS	37	2.66%
9	SPAIN	35	2.51%
10	SWEDEN	31	2.23%
11	FRANCE	28	2.01%
12	NEW ZEALAND	22	1.58%
13	ITALY	21	1.51%
14	SOUTH AFRICA	21	1.51%
15	SOUTH KOREA	21	1.51%
16	SCOTLAND	20	1.44%
17	SINGAPORE	18	1.29%
18	NORWAY	17	1.22%
19	GREECE	16	1.15%
20	BRAZIL	15	1.08%
21	DENMARK	14	1.01%
22	FINLAND	13	0.93%
23	INDIA	12	0.86%
23	JAPAN	12	0.86%
25	SWITZERLAND	12	0.86%
	OTHERS	109	7.82%

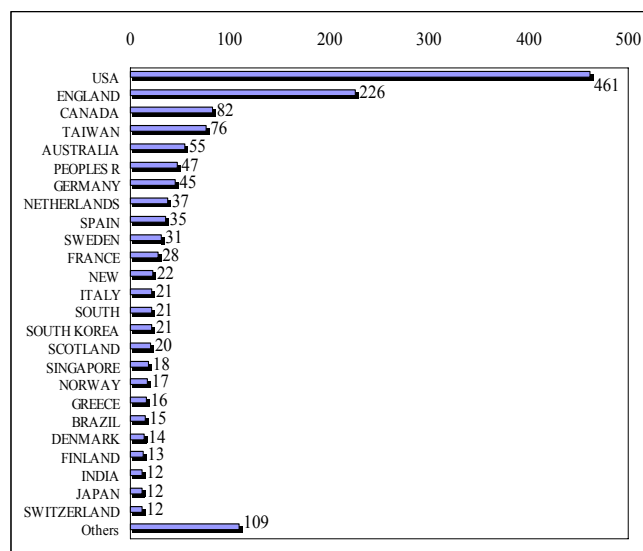


Fig. 3 Distribution of top 25 country/territory from 1989 to 2009

From the Table III, it indicated that the most publication document type is “Article” (894 record counts, 64.18%), and the most popular language for writing is using “English” (1327 record counts, 95.26%) in the research domain of knowledge management (see Table IV).

TABLE II
DISTRIBUTION OF TOP 25 INSTITUTION NAME FROM 1989 TO 2009

Ranking	Institution Name	Record Count	% of 1393
1	UNIV WARWICK	16	1.15%
2	HARVARD UNIV	15	1.08%
3	RUTGERS STATE UNIV	15	1.08%
4	UNIV TORONTO	14	1.01%
5	UNIV ILLINOIS	13	0.93%
6	UNIV LOUGHBOROUGH	12	0.86%
7	UNIV SHEFFIELD	12	0.86%
8	HONG KONG POLYTECH UNIV	11	0.79%
9	UNIV MANCHESTER	11	0.79%
10	NAPIER UNIV	10	0.72%
11	NATL CHENG KUNG UNIV	10	0.72%
12	UNIV LEEDS	10	0.72%
13	UNIV PRETORIA	10	0.72%
14	UNIV TEXAS	10	0.72%
15	UNIV WASHINGTON	10	0.72%
16	CITY UNIV LONDON	9	0.65%
17	MCGILL UNIV	9	0.65%
18	MICHIGAN STATE UNIV	9	0.65%
19	NANYANG TECHNOL UNIV	9	0.65%
20	UNIV MINNESOTA	9	0.65%
21	UNIV N CAROLINA	9	0.65%
22	INDIANA UNIV	8	0.57%
23	KOREA ADV INST SCI & TECHNOL	8	0.57%
23	UNIV NEBRASKA	8	0.57%
25	UNIV NOTTINGHAM	8	0.57%
	OTHERS	118	8.47%
	Total	1393	100%

TABLE III
DISTRIBUTION OF DOCUMENT TYPE FROM 1989 TO 2009

Document Type	Record Count	% of 1393
ARTICLE	894	64.18%
BOOK REVIEW	211	15.15%
PROCEEDINGS PAPER	81	5.81%
EDITORIAL MATERIAL	73	5.24%
REVIEW	62	4.45%
MEETING ABSTRACT	51	3.66%
NEWS ITEM	7	0.50%
CORRECTION	5	0.36%
LETTER	3	0.22%
NOTE	3	0.22%
BIBLIOGRAPHY	1	0.07%
REPRINT	1	0.07%
SOFTWARE REVIEW	1	0.07%
Total	1393	100%

TABLE IV
DISTRIBUTION OF LANGUAGE FROM 1989 TO 2009

Language	Record Count	% of 1393
ENGLISH	1327	95.26%
GERMAN	32	2.30%
SPANISH	12	0.86%
PORTUGUESE	8	0.57%
FRENCH	5	0.36%
CZECH	3	0.22%
DANISH	1	0.07%
NORWEGIAN	1	0.07%
RUSSIAN	1	0.07%
SLOVAK	1	0.07%
SWEDISH	1	0.07%
TURKISH	1	0.07%
Total	1393	100%

In the Table V, it is important to summarize the trend information for knowledge management researchers since core knowledge will be concentrated in core categories and to get understanding about the distribution of top 25 subject areas in future research trend and research directions. Focus on the right categories, researchers will catch the core research information. The top three ranking of research domains are management (459 record counts, 32.95%), following by the information science and library science (366 record counts, 26.271%), computer science and information systems (270 record counts, 19.38%). Moreover, it also discovered that there are a lot of research domains for knowledge management literature production such as operations research and management science, business, engineering industrial, engineering and interdisciplinary, computer science and artificial intelligence, and computer science and interdisciplinary and so on.

TABLE V
DISTRIBUTION OF TOP 25 SUBJECT AREAS FROM 1989 TO 2009

Ranking	Subject Area	Record Count	% of 1393
1	MANAGEMENT	459	32.95%
2	INFORMATION SCIENCE & LIBRARY SCIENCE	366	26.27%
3	COMPUTER SCIENCE, INFORMATION SYSTEMS	270	19.38%
4	OPERATIONS RESEARCH & MANAGEMENT SCIENCE	178	12.78%
5	BUSINESS	165	11.84%
6	ENGINEERING, INDUSTRIAL	71	5.10%
7	ENGINEERING, MULTIDISCIPLINARY	71	5.10%
8	COMPUTER SCIENCE, ARTIFICIAL INTELLIGENCE	68	4.88%

9	COMPUTER SCIENCE, INTERDISCIPLINARY APPLICATIONS	55	3.95%
10	ECONOMICS	51	3.66%
11	NURSING	51	3.66%
12	PLANNING & DEVELOPMENT	40	2.87%
13	ENVIRONMENTAL STUDIES	39	2.80%
14	EDUCATION & EDUCATIONAL RESEARCH	36	2.58%
15	SOCIAL SCIENCES, INTERDISCIPLINARY	36	2.58%
16	ENGINEERING, ELECTRICAL & ELECTRONIC	35	2.51%
17	SOCIOLOGY	28	2.01%
18	HEALTH CARE SCIENCES & SERVICES	24	1.72%
19	PSYCHOLOGY, APPLIED	24	1.72%
20	ANTHROPOLOGY	23	1.65%
21	PSYCHOLOGY, MULTIDISCIPLINARY	22	1.58%
22	PUBLIC, ENVIRONMENTAL & OCCUPATIONAL HEALTH	22	1.58%
23	COMPUTER SCIENCE, CYBERNETICS	20	1.44%
23	MEDICAL INFORMATICS	20	1.44%
25	COMPUTER SCIENCE, THEORY & METHODS	19	1.36%

IV. THE LITERATURES PRODUCTIVITY ANALYSIS OF KNOWLEDGE MANAGEMENT

The section is mainly discussing the author distribution situation of the rule which certificated by Lotka's Law. It calculated the author quantity by the equality method from 1393 literatures which retrieved by index on SSCI. Thus, it is obtained altogether 2549 of authors on research aspect of knowledge management (see the Table VI).

The analysis of literature author distribution by productivity may apply the Lotka's Law to discuss on it. The Lotka's Law is called a reverse square law of the scientific productivity, its significance is the number of author which published x literature is the number of author which published one literature total to divide x². By utilizing Lotka's Law for the analysis, it confirms the knowledge management literatures if suitable or not, it should also calculate the slope n value and the constant c value by using the K-S examination determination whether the distribution is conform to or not. [6].

TABLE VI
DISTRIBUTION OF AUTHOR PRODUCTIVITY OF KNOWLEDGE MANAGEMENT FROM 1989 TO 2009

Record Count	Author(s)	Record Count%	Accumulated Record	Accumulated Record%	Accumulated Author(s)	Accumulated Author(s)%
15	1	15	15	0.51%	1	0.04%
9	1	9	24	0.81%	2	0.08%
7	2	14	38	1.29%	4	0.16%
6	1	6	44	1.49%	5	0.20%
5	8	40	84	2.84%	13	0.51%
4	16	64	148	5.01%	29	1.14%
3	41	123	271	9.17%	70	2.75%
2	204	408	679	22.99%	274	10.75%
1	2275	2275	2954	100.00%	2549	100.00%

TABLE VII
PRODUCTIVITY ANALYSIS OF AUTHOR VIA RECORD COUNT OF KNOWLEDGE MANAGEMENT FROM 1989 TO 2009 (A)

Record Count (x)	Author(y)	X=log(x)	Y=log(y)	XY	XX
15	1	1.18	0.00	0.00	1.38
9	1	0.95	0.00	0.00	0.91
7	2	0.85	0.30	0.25	0.71
6	1	0.78	0.00	0.00	0.61
5	8	0.70	0.90	0.63	0.49
4	16	0.60	1.20	0.72	0.36
3	41	0.48	1.61	0.77	0.23
2	204	0.30	2.31	0.70	0.09
1	2275	0.00	3.36	0.00	0.00
Total	2549	5.83	9.69	3.08	4.78

By the result of calculation on Table VII, it could bring into the following equation as below to calculate n value:

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

Then n = -3.194592051

After that, we also found c = 0.85645291, the equation is shown as below:

$$c = \frac{1}{\sum_{i=1}^{p-1} \frac{1}{x_i^n} + \frac{1}{(n-1)(p^{n-1})} + \frac{1}{2p^n} + \frac{n}{24(p-1)^{n-1}}}$$

P = 14 (max(x)-1),

x = 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

When we got n = -3.194592051 and c = 0.85645291, it explored:

$$f(x) = 0.85645291/x^{3.194592051}$$

According to Pao [7] suggestion, the absolute value of n should be between 1.2 and 3.8 which formed by the generalized Lotka's Law, but the result is not matched the reference data by observation. The distribution chart is shown as Fig. 4.

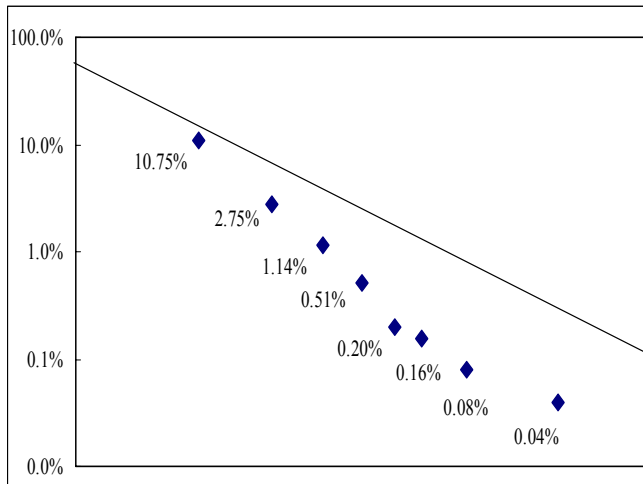


Fig. 4 Distribution of literature productivity of author on knowledge management research aspect

For discussing the value of both n and c , ideal n approximately is -2, c is 0.6079 generated by Lotka's Law, the result demonstrated that the knowledge management literature author distribution and the primitive Lotka's Law are not matched approximately. In order to examine whether the theoretical value and the observation value are tallied, the paper use K-S test to evaluate the suitability of Lotka's Law. 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 K-S test examination.

TABLE VIII
 PRODUCTIVITY ANALYSIS OF AUTHOR VIA RECORD COUNT OF KNOWLEDGE MANAGEMENT FROM 1989 TO 2009 (B)

Record Count	Observation by Author(s)	Accumulated Value $S_n(x)$	Expected Value by Author(s)	Accumulated Value $F_o(x)$	ABS Value $ F_o(x) - S_n(x) $
1	0.8925	0.8925	0.8565	0.8565	0.0361
2	0.0800	0.9725	0.0935	0.9500	0.0225
3	0.0161	0.9886	0.0256	0.9756	0.0130
4	0.0063	0.9949	0.0102	0.9858	0.0091
5	0.0031	0.9980	0.0050	0.9908	0.0072
6	0.0004	0.9984	0.0028	0.9936	0.0048
7	0.0008	0.9992	0.0017	0.9954	0.0039
9	0.0004	0.9996	0.0011	0.9965	0.0031
15	0.0004	1.0000	0.0008	0.9972	0.0028

According to K-S test, $D_{max} = 0.0361$ in Table VIII, therefore the threshold value is $1.63/\sqrt{2549} = 0.033285$.

Because D_{max} is larger than the threshold value, the result also indicated that the distribution of author productivity is not matched by the Lotka's Law. The result means the Lotka's Law is not suitable for the literature author productivity distribution in knowledge management research domain.

V. CONCLUSION

Knowledge management is one of fast growing research topics in recently years, this historical review and trend forecast of this research field by each kind of literature characteristic and author productivity distribution is also in growing period. In this analysis, it demonstrated that the current knowledge management literatures are still continuously to grow, the main research development facility with delivered the largest production is USA, but England, Canada, Taiwan, Australia and Peoples R China also have potential to deliver more literatures in the future. The analysis indicated the problem that knowledge management authors with high productivity were not certainly followed by Lotka's Law. The applications of knowledge management are mainly following by research aspects which in term of management, information science and library science, computer science and information systems, operations research and management science, business, engineering industrial, engineering and interdisciplinary, computer science and artificial intelligence and computer science and interdisciplinary. Focus on the right categories, you will catch the core research information. This implies that the phenomenon "success breeds success" is more common in higher quality publications.

REFERENCES

- [1] Nonaka, Ikujiro, "The knowledge creating company", Harvard Business Review, vol. 69, no.6, pp. 96-104, Nov-Dec 1991.
- [2] Alavi, Maryam; Leidner, Dorothy E., "Knowledge management systems: issues, challenges, and benefits", Communications of the AIS, vol. 1, issue 2, February 1999.
- [3] Addicott, Rachael; McGivern, Gerry; Ferlie, Ewan, "Networks, Organizational Learning and Knowledge Management: NHS Cancer Networks", Public Money & Management, vol. 26, no. 2, pp. 87-94, April 2006.
- [4] McAdam, Rodney; McCreedy, Sandra (2000). "A Critique Of Knowledge Management: Using A Social Constructionist Model", New Technology, Work and Employment, vol. 15, no. 2, September 2000.
- [5] Thompson, Mark P.A. & Geoff Walsham, "Placing Knowledge Management in Context", Journal of Management Studies, vol. 41, no. 5, pp. 725-747, July 2004.
- [6] Tsai, Ming-Yue, The characteristic of informetric and bibliometric, Taiwan: Hwa-Tai, 2003, ch. 6.
- [7] Pao, M. L., Concept of Information Retrieve, Englewood, Colorado: Libraries Unlimited, pp. 23-25, 1989.