

KNOWLEDGE MANAGEMENT WITH WOS NETWORK OF CITATIONS

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Abstract:

In the last decade of previous century the concept of *knowledge management* (KM) was born. The phrase KM can be understand in different ways and since those days we have seen many definitions of KM. This paper deals with the most important articles in the concept of KM. For this purpose we initially identified and downloaded 7553 articles from the WoS on the KM topic. Until 1995 less than ten articles including “knowledge management” term in their topic were published each year in the WoS. However, from 1995 the number of articles rapidly increased with its peak in 2012 achieving exactly 654 articles. Articles on KM were published in 1593 different journals all of them indexed in the WoS. Journal of knowledge management (JKM) have published the highest number of downloaded articles (318 articles in total) on the KM topic in WoS. The most cited article was written by Alavi and Leidner (2001) and published in MIS Quarterly. Several methods from the network analytic field were used in the paper in order to find some interesting structure inside the network. In addition, a lot of interesting works were identified which are not a part of articles on the KM topic but were cited or were citing initial group of 7553 articles.

Keywords: knowledge management, networking, citation, k-core.

1. INTRODUCTION

In the last decade of previous century, the concept of *knowledge management* (KM) was born. The phrase KM can be understood in different ways and since those days we have seen many definitions of KM. One of the most frequently used is to identify knowledge management as the process of capturing, developing, sharing, and effectively using organizational knowledge (Davenport, 1994). Another definition by Duhon (1998) states: "Knowledge management is a discipline that promotes an integrated approach to identifying, capturing, evaluating, retrieving, and sharing all of an enterprise's information assets. These assets may include databases, documents, policies, procedures, and previously un-captured expertise and experience in individual workers."

There is no doubt that the KM field is multidisciplinary (Heisig, 2015). It includes many disciplines, such as organisational behaviour, human resources, strategy, management information systems and others (Holsapple & Wu, 2008).

Serenko & Dumay (2015a) classify KM discipline as at the pre-science stage with progression towards normal science. Furthermore, they created a list of KM citation classics using citations count and consequently a cut-off citation cut. It is argued that KM citation classics constitute the core of the KM body of knowledge (Serenko & Dumay, 2015b).

In this paper, we continue the research framework. We downloaded all articles in the Web of Science (WoS) on the KM topic. However, we firmly believe that not all citations are of the same value. Therefore we took into account how many authors were citing an article and also how many authors were cited using one citation.

The rest of the paper is constructed as follows. Section 2 presents the data and some descriptive statistics of downloaded articles on KM topic. Section 3 describes the methodology used in the paper, while Section 4 shows the results. The last section concludes.

2. DATA AND GENERAL STATISTICS

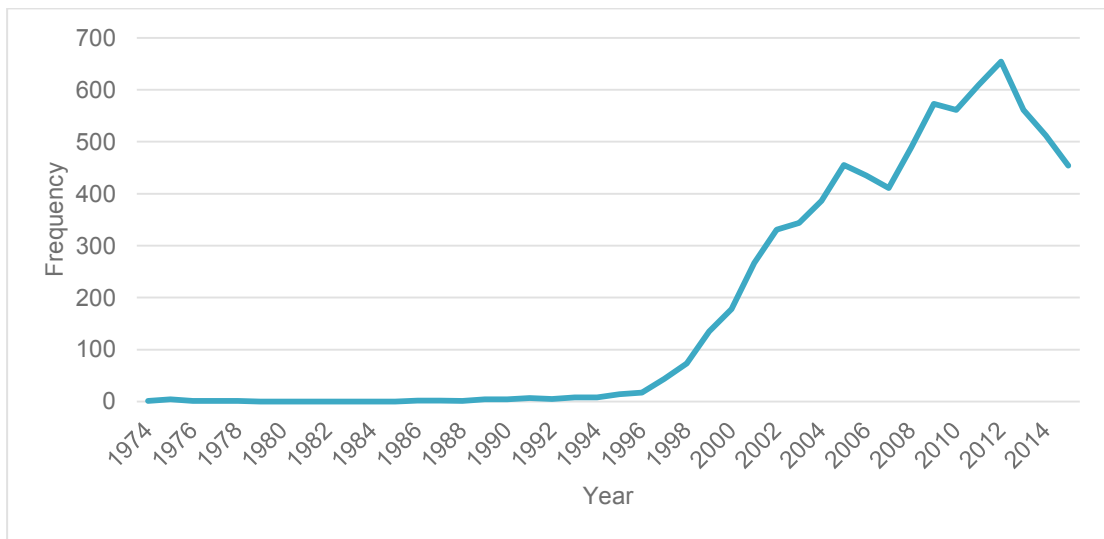
Web of Science (WoS) represents one of the most comprehensive and versatile research platforms available. Our first task was to search for all articles in WoS on the topic of *Knowledge management*. For this purpose we initially identified and downloaded 7553 articles from the WoS. The data obtained from the WoS include several pieces of information about each article. Some important 2-character identifiers are presented in Table 1.

Table 1: 2-character identifiers

2-character	Description
PT	Publication Type (conference, book, journal, book in series, or patent)
AU	Authors
TI	Document Title
SO	Publication Name
LA	Language
DT	Document Type
CR	Cited References
NR	Cited Reference Count
TC	Times Cited
PY	Year Published
VL	Volume
IS	Issue
PG	Page Count
SC	Subject Category

From Figure 1 we can see that the first article on knowledge management was published in 1974 (Henry, 1974). Until 1995 less than ten articles including "knowledge management" term in their topic were published each year in the WoS. However, from 1995 the number of articles rapidly increased with its peak in 2012 achieving exactly 654 articles. After the year 2012 the number of articles gradually reduced.

Figure 1: Appearances of articles in WoS on KM topic by their publication year



Articles on KM were published in 1593 different journals all of them indexed in the WoS. Journal of knowledge management (JKM) have published the highest number of downloaded articles (318 articles in total) on the KM topic in WoS. From Table 2, we further notice that there are only six more journals that published 100 or more articles during the period analyzed. Beside the Journal of knowledge management, the most important in this segment are the following journals: Knowledge management research and practice, Expert systems with applications, International journal of technology management, Decision support systems, Journal of universal computer science and International journal of information management. These seven journals published together almost one quarter (23.47 % exactly) of all articles on KM in the WoS. In other words each fourth article on the topic of KM in the WoS was published in one of these magazines.

Table 2: Names of journals that published more than 50 articles on topic of KM with their frequencies

Journal title	Frequency
JOURNAL OF KNOWLEDGE MANAGEMENT	318
KNOWLEDGE MANAGEMENT RESEARCH & PRACTICE	218
EXPERT SYSTEMS WITH APPLICATIONS	205
INTERNATIONAL JOURNAL OF TECHNOLOGY MANAGEMENT	145
DECISION SUPPORT SYSTEMS	114
JOURNAL OF UNIVERSAL COMPUTER SCIENCE	113
INTERNATIONAL JOURNAL OF INFORMATION MANAGEMENT	100
INDUSTRIAL MANAGEMENT & DATA SYSTEMS	88
JOURNAL OF THE AMERICAN SOCIETY FOR INFORMATION SCIENCE AND TECHNOLOGY	70
JOURNAL OF COMPUTER INFORMATION SYSTEMS	63
KNOWLEDGE-BASED SYSTEMS	63
INFORMATION & MANAGEMENT	62
JOURNAL OF INFORMATION SCIENCE	60
ONLINE INFORMATION REVIEW	52
ELECTRONIC LIBRARY	51
JOURNAL OF DOCUMENTATION	51

Very important information of descriptive statistics is the number of citations per each article. The most cited article was written by Alavi and Leidner (2001) and published in MIS Quarterly. The article was cited 1767 times. It is followed by Spender (1996) with 1087 citations and Dyer & Nobeoka (2000) with 941 citations.

Table 3: Top 15 articles that are the most cited on topic of KM with the number of their citations

Article author	Article title	Number of citations
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Alavi, M; Leidner, DE	Review: Knowledge management and knowledge management systems: Conceptual foundations and research issues	1767
Spender, JC	Making knowledge the basis of a dynamic theory of the firm	1087
Dyer, JH; Nobeoka, K	Creating and managing a high-performance knowledge-sharing network: The Toyota case	941
Hansen, MT; Nohria, N; Tierney, T	What's your strategy for managing knowledge?	898
Wasko, MM; Faraj, S	Why should I share? Examining social capital and knowledge contribution in electronic networks of practice	843
Studer, R; Benjamins, VR; Fensel, D	Knowledge Engineering: Principles and methods	763
Carlile, PR	A pragmatic view of knowledge and boundaries: Boundary objects in new product development	682
Davenport, TH; De Long, DW; Beers, MC	Successful knowledge management projects	664
Sanchez, R; Mahoney, JT	Modularity, flexibility, and knowledge management in product and organization design	650
Gold, AH; Malhotra, A; Segars, AH	Knowledge management: An organizational capabilities perspective	612
Simonin, BL	Ambiguity and the process of knowledge transfer in strategic alliances	576
Kankanhalli, A; Tan, BCY; Wei, KK	Contributing knowledge to electronic knowledge repositories: An empirical investigation	541
Argote, L; McEvily, B; Reagans, R	Managing knowledge in organizations: An integrative framework and review of emerging themes	517
Gertler, MS	Tacit knowledge and the economic geography of context, or The undefinable tacitness of being (there)	514
Hedlund, G	A model of knowledge management and the n-form corporation	503

In this study, we are not interested only in the absolute number of citations per observed article but we also want to include information which article is citing the article observed. Network analysis offers great tools to achieve our goal.

3. METHODOLOGY

3.1. Network of WoS papers

As usually, a network is defined with the set of actors (presented as nodes) and the set of relations (presented as links) between them (Wasserman & Faust, 1994). In this study, articles are naturally identified as actors, and relation is defined with citations between them. In other words, two articles are related (or linked on a graph) if at least one of them is citing the other. Links in the network of articles' citations are directed from the article that is citing to the article that is cited. Therefore we obtained directed and unweighted network of articles in the WoS on the topic of "knowledge management".

3.2. K-core

One of the most important issue in network analysis is searching for the denser parts of a network. There exists many methods to achieve this goal. Among the most important techniques is k-core method. By definition, a *k-core* is a maximal subnetwork in which each node has at least degree *k* within the subnetwork (de Nooy, Mrvar & Batagelj, 2011).

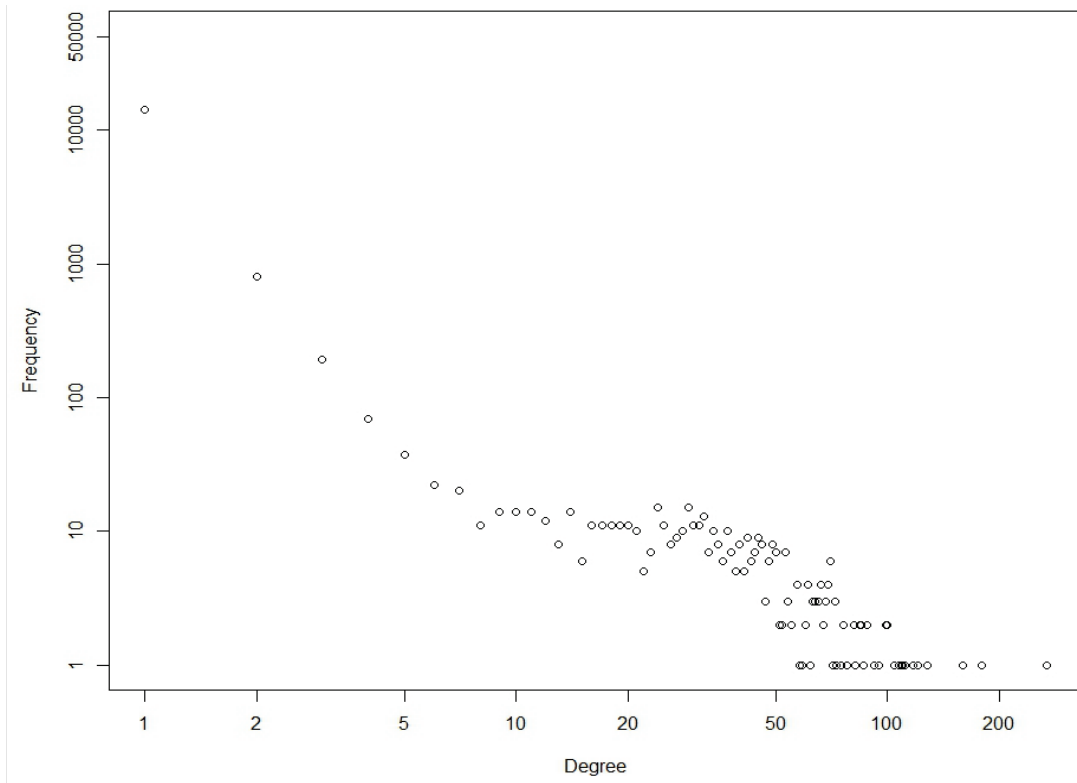
4. RESULTS

4.1. Network analysis of cited articles

Node degree is simply the number of its links in a network. In Figure 2 we displayed a degree distribution of all articles (including only cited ones). Only cited articles are articles in our network that were not included initially (i.e. are not articles from the WoS database on the KM topic). However, they were cited at least once from the initial group of 1753 articles. In this way, we obtain directed network of 15733 articles. We can observe that the majority of articles are only linked once (exactly 14085

articles contain only one link). There is significantly less articles with two links (796), three links (192) etc. Degree distribution of these articles follows exponential law since in log-log scale the relationship is almost linear (it almost follows the straight line).

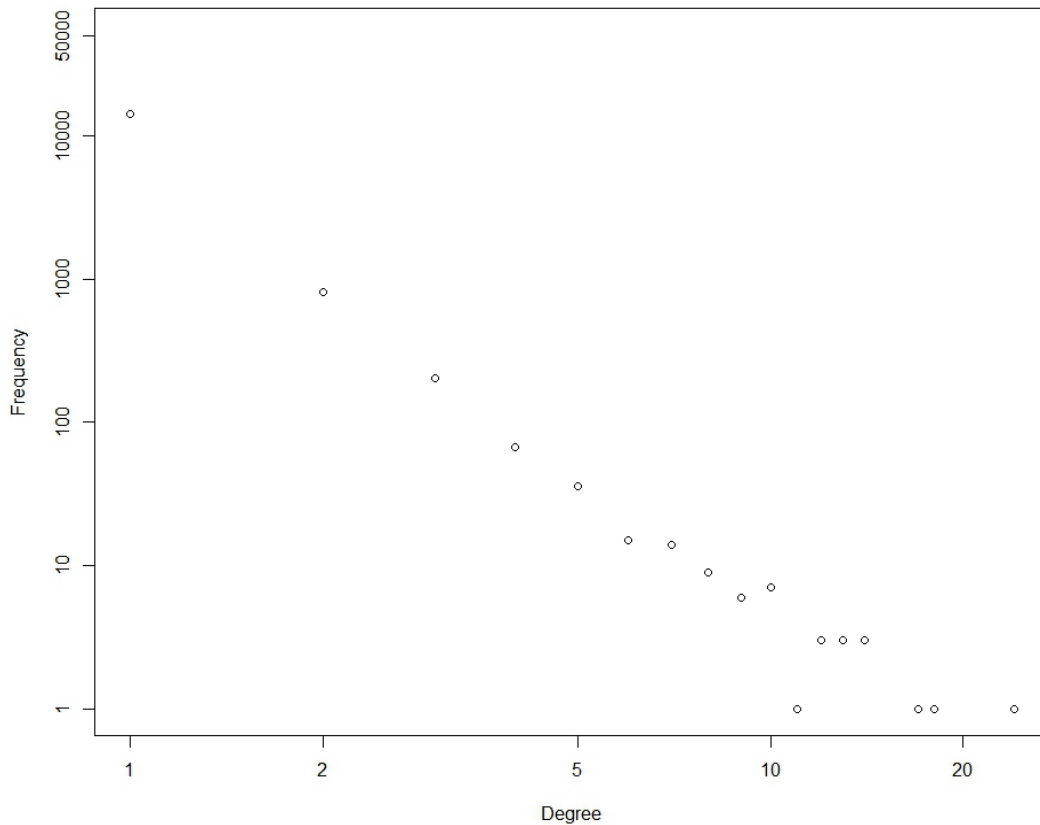
Figure 2: All degree distribution in log-log scale



The article by Archambault *et al.* (2013) is paper with the highest degree (connected with 269 links). However, more depth analysis revealed that most of links are out-going, i.e. authors cited many other works. In this way, more appropriate is to analyze an in-degree distribution. In-degree of a node counts only directed links that have final points at the node observed. In other words, it counts the number of papers that cited an article which is represented by a node.

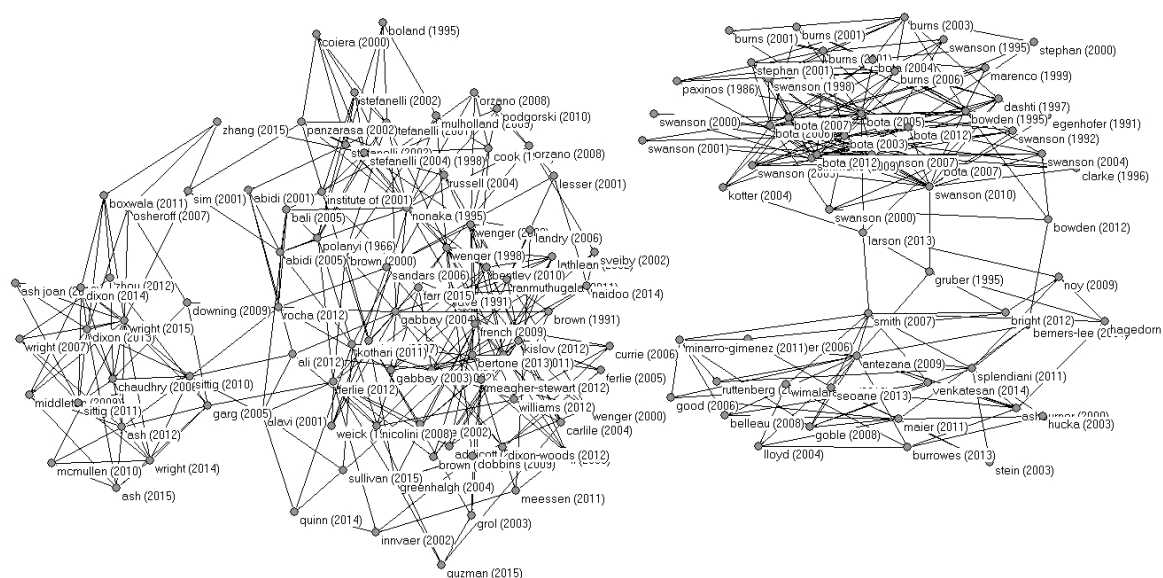
Using in-degree category things change dramatically. As we can observe from Figure 3, there is only one node with in-degree over 20. This node represents a classic book of Nonaka & Takeuchi (1995). A book of Wenger (1998) is second and received 18 citations inside our network. Similarly to degree distribution observed in Figure 2, in-degree distribution follows exponential law properties.

Figure 3: In-degree distribution in log-log scale



The highest k-core of the network of the WoS citation of articles on KM topic is 6-core. However, only 22 articles are included in the 6-core. Therefore we choose to analyze 4-core with 146 articles. From definition of the 4-core, in this type of subnetwork each article is linked with at least 4 other articles. We can observe from Figure 4 that 4-core subnetwork decomposes into two separate weak components. Left component consists also two important book that were mentioned before: Nonaka & Takeuchi (1995) and Wenger (1998). However, more in-depth analysis is needed to discover a structure in the both components.

Figure 4: 4-core of articles on KM topic in WoS



5. CONCLUSIONS

The KM concept was presented in this paper using network of citations in WoS on the KM topic. Several methods from network analytic field were used in order to find some interesting structure inside the network. In addition, a lot of interesting works were identified which are not a part of articles on the KM topic but were cited or were citing initial group of 7553 articles.

We should stress that network analytic procedures here offer a great tool for analyzing such an important phenomena.

The programs for data editing and producing networks were written in R (R Development Core Team, 2016). Likewise, program R was used for statistical analysis. For analysis of networks we used the Pajek program (Batagelj & Mrvar, 1996-2016) and CitNetExplorer (Waltman & Van Eck, 2014).

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