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Citation Analysis and Trends in Knowledge Management

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ABSTRACT

This study presents a new citation analysis methodology that combines elements of classic methodologies dating back to very early “by-hand” citation analyses with modern technological tools that allow researchers to quickly organize and retrieve citation data and articles. The researchers examined nearly 13,000 citations from knowledge management articles published in the top MIS journals in order to establish both quality contributions to the field as well as to gain insight into where the field is heading. A steep decline in the number of articles cited after 2001 leads researchers to question why recent publications are not being cited more often. The researchers suggest that this decline might be due to a decrease in relevant research or changing dynamics in the field. The 25-most cited works in KM are presented along with a timeline of citations in the field.

Keywords

knowledge management, km, citation analysis, review, literature, trend, top authors, most cited, decline

INTRODUCTION

All researchers like to receive recognition for their hard work, and we all want to know the best place for our research to be published. Knowledge Management (KM) was derived as a subset of both Organizational Science and Information Systems through many years of research (Nonaka, 1994); it contains well known and important research streams for researchers to investigate. To date, Harman and Koohang (2005) published the only citation study specific to the field of Knowledge Management (KM). Their study detailed the frequency of books and dissertations published within the subject area of KM, but they did not report specifics about the field such as article or author citation information (Harman & Koohang, 2005). This study expands that research by reporting and analyzing citation patterns specific to the discipline of KM, including books, articles, and chapters. This citation analysis will provide a more complete and well-rounded picture of the KM discipline, where it has been and where it is headed.

A study of citations is important to researchers because it allows us to see how an author’s work is being used. When we know how many times an academic work is cited, we are able to examine trends in research and determine a research direction. Such work also allows us to find the most commonly cited sources of information for the subject we are exploring; this is a potential indication of how other researchers view the value and quality of the work (Wohlin, 2009).

Another way to determine quality and relevance is to examine the number of times an author was cited (Enger, 2009; Lim, Ma, Wen, Xu, & Cheang, 2009). A citation analysis is an appropriate method of determining these numbers and can indicate the change in popularity of a particular research stream, showing growth and decline in particular topics (Pilkington & Meredith, 2009).

This study is unique to most citation analyses in MIS in that we include both authored books and edited book chapters in our citation analysis. Books and chapters are often overlooked in citation studies because most concentrate on the impact of particular journals or include only article contributions (i.e. Grover, Ayyagari, Gokhale, Jaejoo, & Coffey, 2006; Hansen, Lyytinen, & Markus, 2006; Lim et al., 2009; Wade, Biehl, & Kim, 2006). Though we note that some top-tier academic institutions consider author’s contributions to books and chapters inferior to their contributions to articles, our results indicate that nearly 30% of citations in the field come from these sources. Citation analyses suffer when these references are not included because a complete picture of the field cannot be established without critical references of this type.

LITERATURE SUMMARY

There are several key points in the literature which have formed the basis for this study. First, the citation methodology is most appropriate to determine the seminal works in the area and the authors who are providing research leadership for a particular research stream. Citation analyses have been shown to alleviate many of the problems of biases associated with surveys and questionnaires seeking information of this nature (Aksnes & Rip, 2009; Pilkington & Meredith, 2009; Vokurka, 1996). Researchers are likely to rank journals in which they have published as more important or valuable to a discipline because they have had success there (Vokurka, 1996). This study will employ a citation methodology to determine the key literature and contributors of KM while avoiding the biases that may come from survey-based research.

Second, in recent years, researchers studying citations have been relying on popular online databases to do the work of citation collection (Kulkarni, Aziz, Shams, & Busse, 2009; Leydesdorff, 2009). Online programs such as Google Scholar, Web of Science, Citeseer, and Scopus have attempted to link authors with their published works and determine some sort of index or impact measure for the author's work (Levine-Clark & Gil, 2009; Leydesdorff, 2009; Meho & Rogers, 2008; Zhao & Andreas, 2007).

Studies indicate that these online programs have issues with both inclusion and accuracy (Dodson, 2009; Kousha & Thelwall, 2007; Kulkarni et al., 2009; Meho & Yang, 2007). Which journals are included makes a difference in the citation counts and ranking (Meho & Yang, 2007). Some databases are criticized for being too constrictive with their inclusion, leaving out what some researchers consider important journals or limiting the span of time covered. Others, such as Google Scholar, are said to be too inclusive, including everything from websites to peer-reviewed studies with no way to limit the results (Dodson, 2009). Both of these situations may affect the accuracy of the citation study (Kulkarni et al., 2009; Wohlin, 2009). As an example, the *Journal of Knowledge Management*, according to their website, was just recently added to the Social Sciences Citation Index and its analysis results are expected by 2012 ("Journal of Knowledge Management Information," 2009). However, this journal has been a research outlet since 1997.

Researchers using online databases such as those listed above have no control over the content they receive or ability to effectively limit a search. Combine that with not knowing exactly what materials, journals, or external sources are included in a search, and the data that is reported by these online systems becomes somewhat unreliable and possibly inaccurate. The current study proposes a combination of technology with a classic citation methodology. In this study, the researchers examine references from articles in the field (see White and White, 1977) for the source of data, thereby minimizing inclusion or accuracy problems associated with online citation programs.

Third, researchers have attempted to determine what the citation counts and indices provided by online programs mean or how they were calculated, often without success (Meho & Rogers, 2008). The most popular citation index, the h-index, has at least three variations and models that purport to improve it (Meho & Rogers, 2008). The g-index, e-index, and AR-index are several examples of indices that were designed to improve some of the issues with the h-index (Bihui, LiMing, Rousseau, & Egghe, 2007; Bornmann, Rudiger, & Daniel, 2008; Dodson, 2009). The h-index has been criticized because it does not take into account time (e.g. Albert Einstein would have a very low h-index even though he was arguably the most important researcher in his field) (Bihui et al., 2007). It also does not work across separate disciplines. Researchers who publish in both IS and Management would not have a high h-index because it is limited to only one field of analysis at a time (Meho & Rogers, 2008). The current study minimizes this by attributing counts to each author based on the number of times he or she was cited in the articles reviewed regardless of numbers and irrespective of the foundational discipline in which a knowledge management work appears.

METHODOLOGY

A number of methods have been used to perform citation analyses. According to Google Scholar, one of the most cited citation analysis article is the White and White (1977) article in psychology, and one of the most cited citation analysis guide is Garfield's (1979) *Citation Indexing - Its Theory and Application in Science, Technology, and Humanities*. These works were cited in nearly every previous citation study we examined. The researchers in the current study developed a new citation methodology that combines classic collection methods with new tools and technology. Many of the citation collection methods in our methodology were developed following classic methodologies presented by authors like White and Garfield. We combine these with online tools to assist and improve search results and utilize custom software algorithms for sorting and error correction, whereas the classic methodology had little support for error-checking. Methods from newer citation analysis studies utilizing database searches are also a part of our own methodology, which we consider to be hybrid of classic work and technologically-advanced processes.

Our area of interest for this study is knowledge management but particularly within the context of information systems. Therefore, we chose to examine KM articles from the top MIS journals, primarily as defined by Peachey, et. al. (2005) and

Peffer and Ya (2003). The top MIS journals publish the best of the best KM articles and often have special issues with topics such as KM. These key articles, through their citations, provide a picture of what the field of KM as a whole is doing. We examined the citations from these articles using the citation methodology we describe next.

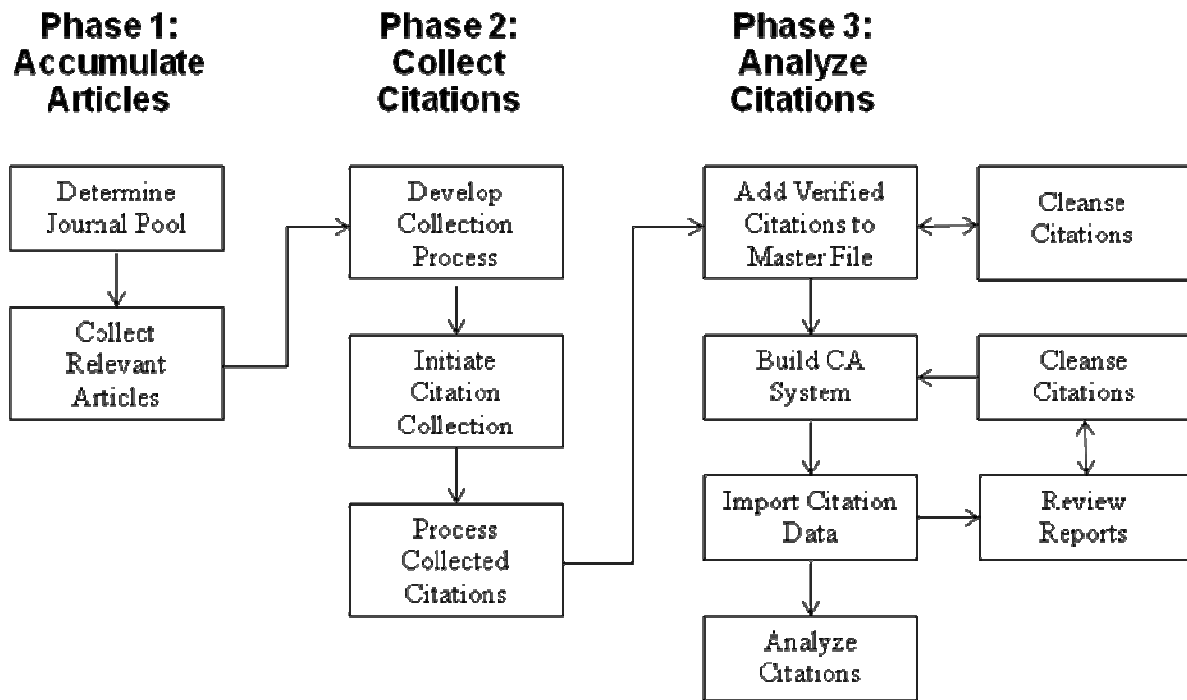


Figure 1. Overview of Citation Analysis Methodology.

Phase 1

In order to examine the current state of research on KM, these researchers conducted a citation analysis in three phases (see Figure 1). First, a representative pool of articles was accumulated. To limit our search, we followed procedures laid out by Peachey, et. al. (2005) and Peffer and Ya (2003) which dictate both how to and why we should exclude practitioner oriented material from this sort of study. Both studies also provide suggested journals from which to choose as well as a summary of other studies which have found the “top” journals in MIS.

To collect the citations, the classic citation methodology suggests we go back to the sources of articles. The articles were located by choosing a previously selected journal and using the “Search within this publication” feature built into the ABI/INFORM database. In addition to the term *knowledge management*, the search terms of *knowledge acquisition* (Ryu, Yong Jin, Chaudhury, & Rao, 2005), *knowledge sharing* (Bock, Zmud, Kim, & Lee, 2005; Wasko & Faraj, 2005), and *knowledge transfer* (Ko, Kirsch, & King, 2005; Lin, Geng, & Whinston, 2005) were included in the search for relevant KM research articles from which to gather citations. These terms were chosen because a pilot study, which included an issue-by-issue article search in MIS Quarterly, showed that these terms are frequently used in addition to *knowledge management* in the Key Words section of the journal articles found.

Phase 2

Citations were stored in a spreadsheet specifically developed for this study by the researchers. The spreadsheet consisted of several workbooks which contained the different type of works that could be cited. Each researcher was trained on and provided with a template of this spreadsheet on which to collect their citation data (similar to the one presented in Figure 2) prior to collecting articles and recording the citations therein. All selected articles were recorded by at least two different researchers to minimize error.

Phase 3

The goal of phase three was to analyze all of the citations from the in citation collection phase. To achieve that goal, all of the citations collected separately were combined into a master list of all citations. This allowed for extensive data cleansing. Algorithms were designed that detected bad formatting, illegal characters, and missing information and automatically

corrected this when possible. When not possible, the algorithms identified the problem citations so the researchers could manually correct them.

The citation analysis system itself consisted of a relational database tied to a simple online form for pulling in the collected citations. The citation data was added to this database so that the relationships between author and work (and between works) could be established quickly and easily. This was also helpful because it allowed for querying the data, generating reports, and calculating indices. Using a relational database not only made analyzing the data easier but also created the possibility for mapping of the relationships and establishing trends in the literature.

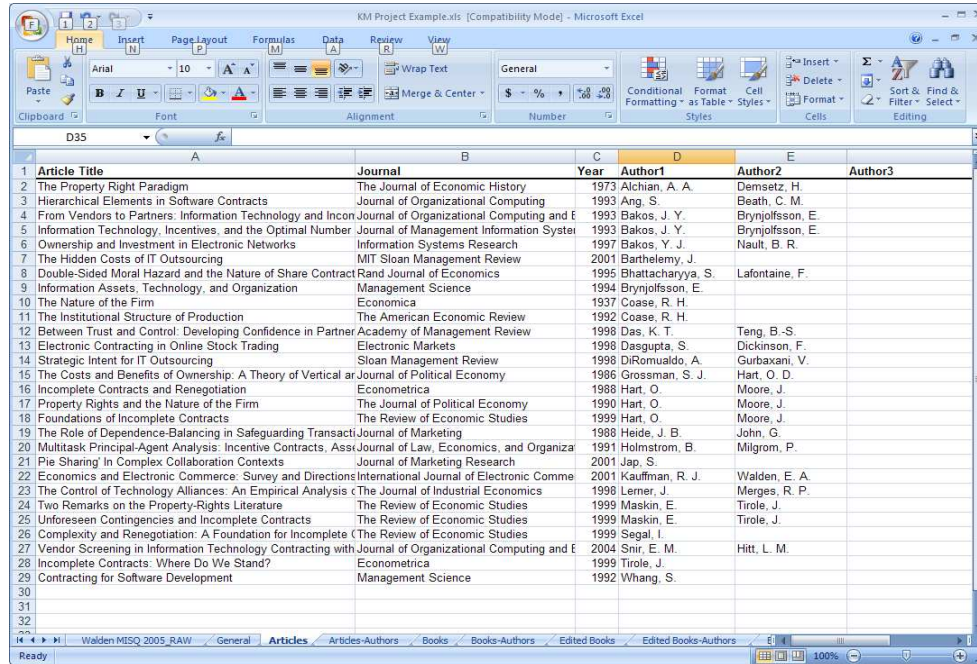


Figure 2. Example spreadsheet for citation data collection.

The system recorded all of the authors and editors first, then the journals. After that, it began recording each article (or book) and establishing relationships between these entities. As it created these relationships, the system incremented the number of times cited for the journal (where applicable) and the author/editor associated with that piece. It also calculated an index for each author which it added to each associated author’s record.

We performed independent and iterative “runs” of the data. In each instance, we put all of the data into the system. Each run of the data also generated a report of errors or problematic data identified by the algorithms. After each run, we viewed these reports made corrections to the system to reduce these errors for the next run. Any problematic data left on our reports were those that the system was unable to resolve. These were resolved by hand-checking and correcting the data. The algorithms were run simultaneously as the data was being entered into the system.

Source	Total Cited Authors	Preliminary	Run 2	Run 3	Run 4	Final Run Error Rate
Articles	17426	983	625	632	456	2.617%
Authored Books	2917	2871	1138	166	59	2.023%
Book Chapters	3658	952	664	424	105	2.870%
Total	24001	4806	2427	1222	620	2.583%

Table 1. Author matching errors detected for hand-checking each run.

We made iterative runs of the data until the error rates for each entity we examined were less than 5%. It took four “runs” of the data to achieve this rate. Each time we ran the data, we reviewed the reports generated and made changes to our system to ensure that we were maximizing our automatic data cleansing. We also corrected missing or problematic data not previously caught by the citation verification stage. This stage represents the second feedback loop in our diagram.

FINDINGS

In total, 12,748 actual citations were examined. This total includes articles, authored books, and chapters from edited books. Table 2 provides a breakdown of the total number of citations gathered and their represented source. There were a total of 24,001 authors cited within the citations previously identified, with the number of distinctly identified authors falling to 9,236. The system also identified 1,157 distinct journals being cited by authors of KM articles. This count, as with the authors is a close approximation. The system did identify many possible erroneous entries, such as one author who cited *Annals of Operation Research* rather than *Annals of Operations Research*. Many of these errors were corrected automatically; others, we corrected by hand. We corrected this particular entry, but we recognize that without unlimited resources, it is nearly impossible to identify all of these errors. Our error rate was 2.583%. In other words, by utilizing the algorithms in the system and hand-checking, we were able to correctly identify or repair all but 2.583% (620 total) references. These errors were unable to be matched to an actual work or author and may be partially responsible for the inconsistencies displayed by major databases used in other citation analyses.

Source	Number Cited	Percent of Total Citations
Articles	9031	70.842%
Books	2775	21.768%
Chapters of Edited Books	942	7.389%
Total Citations	12,748	100%

Table 2. Counts of citations included in this study by Source.

Table 3 shows the 25 most-cited works cited by KM articles published in the top MIS journals, as discussed previously. One will note that no book chapters made this list, as they are cited too infrequently by comparison. It is interesting to note that the citation count is highest around a few articles and books and quickly diminishes. After these twenty-five publications, the total citation count falls to one for every work very quickly.

The third most-cited work is cited over 20 times more than the fourth most-cited work. The 25th most-cited work is not even cited one-third as many times as the most cited *article* in this list. Because our findings only apply specifically to KM, this list clearly demonstrates an interesting trend that seems to be developing in KM: Researchers have been citing a few key theoretical pieces developed over fifteen years ago and are citing little else.

This is illustrated very well by the trend line’s sharp decline in Figure 3. We expected to see a large pool of citations surrounding the “critical” pieces in the KM discipline, but we did not expect to see such a sharp decline in citations. At most, we expected *some* decline and then a leveling off or perhaps a more rounded decline rather than a sharp, steep one. However, the trend seems to be that researchers are not citing more modern sources and are continuing to go back to the core articles and books.

Literally, this means that the citation counts of works published after this point is diminishing rapidly (falling very quickly to one citation per work). Figure 3 indicates that works published in 1999 were cited most frequently (657 citations) by the articles we examined in the current study. However, the articles we reviewed seem to cite works published in the subsequent years less and less. This could be an indication that relevant research in the field is decreasing. We initially included articles up to 2007 to ensure that works had time to circulate and gain readership. We also noted that many paper journals take some time to be added in electronic repositories and databases and including the latest issues of journals in our search would have left out many quality articles that might not have been circulated yet. Even with those steps in mind, the data indicate that newer works are not being cited.

One could make several conclusions from this. It is possible that field is not growing and developing, meaning little theoretical development is occurring. Alternatively, if theoretical development is occurring, it is possible that MIS researchers and editors consider it to be of less relevance and value and are thus not citing articles that present it or publishing those studies in journals where readership is highest. It could also be that KM is spreading out into more specialized areas. The data may indicate that top MIS journals are no longer publishing KM-related articles and thus it is losing popularity

and/or readership. KM has been complicated by the myriad of alternative terms and could be developing more toward another field outside MIS such as Organizational Behavior or Operations Management, both closely related to KM.

Rank	Title	Year	Cited	Type
1	The Knowledge Creating Company How Japanese Companies Create The Dynamics Of Innovation	1995	94	Book
2	Working Knowledge How Organizations Manage What They Know	1999	86	Book
3	A Dynamic Theory Of Organizational Knowledge Creation	1994	78	Article
4	What S Your Strategy For Managing Knowledge	1999	53	Article
5	Review Knowledge Management And Knowledge Management Systems Conceptual Foundations And Research Issues	2001	42	Article
6	Successful Knowledge Management Projects	1998	41	Article
7	The Tacit Dimension	1966	35	Book
8	Absorptive Capacity A New Perspective On Learning And Innovation	1990	31	Article
9	Knowledge Management And Knowledge Management Systems Conceptual Foundations And Research Issues	2001	30	Article
10	The State Of The Notion Knowledge Management In Practice	1998	28	Article
11	Toward A Knowledge Based Theory Of The Firm	1996	27	Article
12	The Role Of Tacit Knowledge In Group Innovation	1998	26	Article
13	Knowledge Management An Organizational Capabilities Perspective	2001	26	Article
14	Knowledge Of The Firm Combinative Capabilities And The Replication Of Technology	1992	26	Article
15	Handbook On Knowledge Management	2003	25	Book
16	Wellsprings Of Knowledge Building And Sustaining The Source Of Innovation	1995	25	Book
17	Knowledge Management Systems Issues Challenges And Benefits	1999	24	Article
18	Situated Learning Legitimate Peripheral Participation	1991	24	Book
19	The Knowledge Creating Company	1991	23	Article
20	The Concept Of Ba Building A Foundation For Knowledge Creation	1998	22	Article
21	The Eleven Deadliest Sins Of Knowledge Management	1998	22	Article
22	Toward A Theory Of Knowledge Reuse Types Of Knowledge Reuse Situations And Factors In Reuse Success	2001	22	Article
23	Exploring Internal Stickiness Impediments To The Transfer Of Best Practice Within The Firm	1996	22	Article
24	Organizational Learning And Diversification	1994	21	Article
25	Organizing Knowledge	1998	21	Article

Table 3. 25 Most-cited works in KM articles, sorted by times cited.

To further investigate the trend we found in the citation analysis, a brief literature review was conducted on KM literature from 2008 to 2009 (inclusive). This literature review followed a similar methodology (and search parameters) from Phase 1 but was expanded from only the top journals to any peer-reviewed journal. Table 4 shows the preliminary findings from the 2008-2009 literature review. The preliminary findings indicate that just less than 5% of the articles published during this time attempt to develop, expand, or explore KM theory, possibly explaining the trend of declining citations.

Most of the recent articles we have examined so far (nearly 60%) are practical applications of KM. In other words, it seems researchers are exploring applicability of frameworks and constructs to current situations and organizations, thus the large percentage of case studies and validation of concepts. Almost 30% of these articles are developing models and frameworks, most likely based on theory created at KM's peak and applied to an organizational situation.

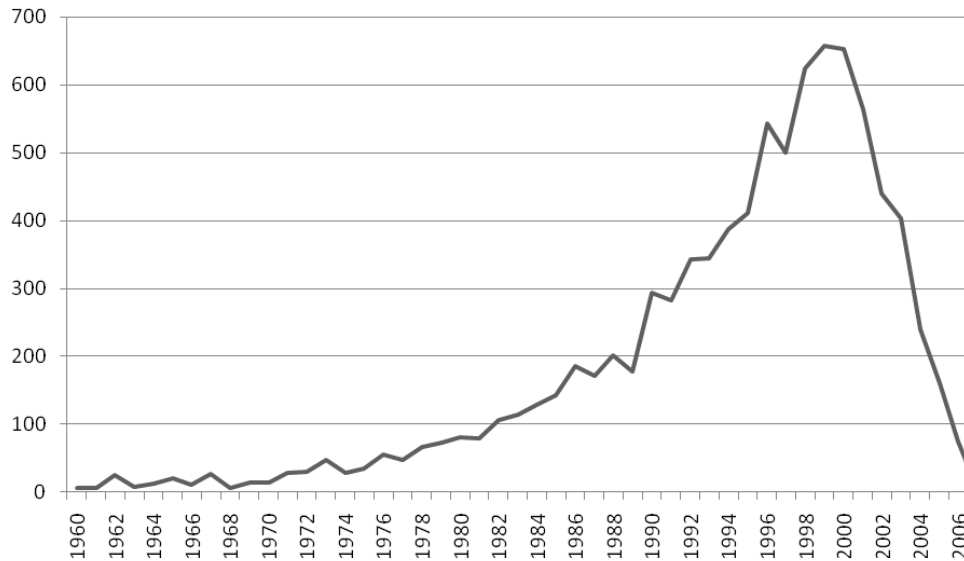


Figure 3. Number of KM Citations by year, all works

One can see that some application of KM is occurring, but it is not being popularized or spread thoroughly by citations. Our research indicates that KM is now being applied to real-world scenarios and case studies or researchers are trying to develop their own models rather than extend (and thus cite) other work. We hope that KM has entered a development and/or rebuilding stage in which researchers try to expand and establish a firm literature base. It is also possible that studies are being published in the practitioner literature, more specialized, or more KM-specific outlets, rather than popular or top MIS/Management journals. It appears that the terms being used to locate KM-related articles (or additional works) are not finding all recent related articles. This could be an indication that KM terminology is changing or its application is steering it into a different field. Holsapple and Joshi (2002) noted that many organizations have not approached KM formally as of 2002. It is possible that research on KM is not sufficiently reaching organizational leaders, that organizations do not formalize their KM efforts, or the resources needed to undertake KM projects are just not available.

Type of study	Percentage of Total
Framework/Model Development	29.8%
Testing a framework/model	6.4%
Case Study	29.8%
Empirical study of a KM concept	29.8%
Theoretical exploration	4.3%

Table 4. Categories of KM articles, 2008-2009 (inclusive)

Another possibility is that opportunities to study KM in organizations may be very limited at this time due to changing economic conditions, or perhaps longitudinal studies are just now being finished and analyzed and we will see the results of these studies soon. One study notes that small and medium-sized enterprises (SMEs) are growing and utilizing KM but often do not officially recognize it or use KM terminology (Salojarvi, Furu, & Sveiby, 2005). Establishing relationships with larger firms in order to carry out a KM study is probably much more difficult than establishing a relationship with a SME. This may be an explanation for the decline in KM citations as well.

CONCLUSION

There continues to be interest in Knowledge Management in conference venues, and there are many journals that publish KM-centered articles and studies, but where is the development for the field? Our results indicate that articles published in

top MIS journals are not citing newer work. We have confirmed that there have been limited theoretical contributions since the peak of KM and that modern works seem to cite the same pool of literature. We suggest that this could be due to a lack of relevant research in the field or a lack of opportunity to study KM and develop new theories but hope this is due to a rebuilding stage in KM's development as a discipline.

This study is limited by errors in data entry and in errors that exist in published references. Our system and methodology was able to correct many of these, but we still had an error rate of almost 2.6%, indicating unidentifiable citations. If they were accurate citations, we were unable to give credit to the source. Researchers should make an effort to diligently record references to minimize these types of errors.

It is hoped that this study will generate new interest in KM and theory exploration. Also, perhaps some authors will be able to identify gaps in the top-cited published research wherein they will be able to publish their own findings. Still others may wish to do further comparative analyses of a manual citation analysis with the ones offered online, such as Google Scholar or Web of Science. Of particular interest might be comparisons of their respective presentations of indices and times cited.

In the future, we are interested in visually (or cognitively) mapping the KM field and attempting to trace its influences and have already begun work to do so. We believe that the data we have collected in this study might lend itself to that end. We have shown that KM is being pulled throughout both IS and Organizational Science literature and are also interested in tracing these influences and their strengths. A study attempting to explain or trace the decline of KM citations we have just discussed is also of further interest to these researchers.

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