A scientometric analysis of knowledge management and intellectual capital academic literature (1994-2008)

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Abstract

Purpose – *The purpose of this study is to conduct a scientometric analysis of the body of literature contained in 11 major knowledge management and intellectual capital (KM/IC) peer-reviewed journals.*

Design/methodology/approach – *A total of 2,175 articles published in 11 major KM/IC peer-reviewed journals were carefully reviewed and subjected to scientometric data analysis techniques.*

Findings – *A number of research questions pertaining to country, institutional and individual productivity, co-operation patterns, publication frequency, and favourite inquiry methods were proposed and answered. Based on the findings, many implications emerged that improve one's understanding of the identity of KM/IC as a distinct scientific field.*

Research limitations/implications – *The pool of KM/IC journals examined did not represent all available publication outlets, given that at least 20 peer-reviewed journals exist in the KM/IC field. There are also KM/IC papers published in other non-KM/IC specific journals. However, the 11 journals that were selected for the study have been evaluated by Bontis and Serenko as the top publications in the KM/IC area.*

Practical implications – *Practitioners have played a significant role in developing the KM/IC field. However, their contributions have been decreasing. There is still very much a need for qualitative descriptions and case studies. It is critically important that practitioners consider collaborating with academics for richer research projects.*

Originality/value – *This is the most comprehensive scientometric analysis of the KM/IC field ever conducted.*

Keywords *Knowledge management, Intellectual capital, Productivity rate*

Paper type *Research paper*

Introduction

Even though the core concepts in the field of knowledge management and intellectual capital (KM/IC) have been around for just over a decade, the multi-disciplinary perspectives within the discipline make it an attractive and productive area of study. The KM/IC area has its own conceptualizations (Stewart, 1991; Bontis, 1999; Bontis, 2001a), theories (Grant, 2002; Serenko *et al.*, 2007), refereed journals (Bontis and Serenko, 2009; Serenko and Bontis, 2009), academic courses (Bontis *et al.*, 2006, 2008), and productivity rankings and citation impact measures (Gu, 2004a, b; Serenko and Bontis, 2004), which are considered critical attributes of an academic domain. The eventual goal is to establish a unique identity of KM/IC as a scholarly field and to gain recognition among peers, university officials, research granting agencies, and industry professionals. However, as an academic field, KM/IC is still considered to be in its embryonic stages, with much more growing up left to do.

Over the past 15 years, there has been a remarkable increase in articles, books, conferences and job titles all related to the primary issue of harvesting intellectual capital through knowledge management. In fact, it was Thomas Stewart, former editor at *Fortune* magazine (and subsequent editor at *Harvard Business Review*) who provided the initial impetus in a June 2001 cover story by exclaiming that brainpower and intellectual capital were becoming America's most valuable asset. Intellectual capital quickly became part of a new lexicon describing novel forms of economic value. It belonged to a paradigm where sustainable competitive advantage was tied to individual and organizational knowledge. Reliance on traditional productive tangible assets such as raw materials, fixed capital, and land no longer accounted for investments made and wealth created by new and prospering companies. Instead, leveraging knowledge assets became the key reason attributed to corporate success stories during the dawn of the internet age. The overall field of KM/IC research in the early 1990s was supported primarily by practitioners. These so-called Chief Knowledge Officers were entrusted with an important – albeit invisible – corporate asset (Bontis, 2001b). The task of exploring the development of intellectual capital through knowledge management initiatives, and later, understanding how to better exploit them for competitive gain, was not at all easy. At the time, there were no degrees, university programs or training seminars that targeted this field. However, several pioneering CKOs gravitated towards each other and created global networks of expertise. Many consider Leif Edvinsson of Sweden as one of the godfathers of this group. He spearheaded the development of the world's first intellectual capital statements at Skandia, which provided the foundation for a new language, framework and operationalization of the KM/IC field (Bontis, 1998).

There have been numerous other initiatives organized by practitioners, including the following:

- Celemi was the first to develop a simulation game that focuses on managing intangible assets. This was akin to the Monopoly board game for intellectual capital. In fact, empirical research demonstrated that participants of the Tango simulation (see www.Tangonow.net) exhibited a heightened awareness of intellectual capital initiatives (Bontis and Girardi, 2000).
- The Danish Agency for Development of Trade and Industry in collaboration with researchers and 17 Danish firms initiated a project where all the firms published annual intellectual capital reports. The aim was to develop a set of guidelines for the development and publication of intellectual capital statements (see www.tinyurl.com/mvyhp7).
- The New Club of Paris is an association of scientists and intellect entrepreneurs dedicated to research and promotion of the idea of supporting the transformation of our society and economy into a knowledge society and a knowledge economy (see www.the-new-club-of-paris.org).

This initial momentum was supported by a string of popular books. Endorsements by highly respected scholars, such as Dr Baruch Lev (New York University) and Dr Tom Davenport (Babson College), coupled with practitioner icons, such as Hubert Saint-Onge (formerly of CIBC), helped to round out the love affair with this phenomenon. The convergence of a new management discipline with the advent of the Internet age provided the perfect ingredients for a new field with a promising future.

But why is it important to establish the identity of KM/IC? Can we not simply let the field evolve on its own, hoping that it will proceed in the right direction? Based on organizational identity literature, there are several arguments that need to be considered (Sidorova *et al.*, 2008). First, researchers' understanding of the identity, overall direction, underlying principles, foundations, norms and principles of a particular scientific area affects their

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behaviors and decisions. For example, they consider the field's identity when they select investigation topics, inquiry methods, collaboration partners, mentors, or potential doctoral supervisors. Second, identity is directly associated with an overall image of the discipline. There are a variety of external stakeholders (e.g. research granting agencies, university administrators, tenure and promotion committees, prospective students and practitioners) that rely on the discipline's image to make their decisions. If, for example, a particular scholarly field lacks a clear image and research direction, granting agency officials may consciously or subconsciously under-rate its applications. University administrators, peers, and committee members may place less emphasis on research output from that field. Third, in each scholarly domain, there are a number of individuals, referred to as ''gatekeepers'', who actually shape the state and development of the field. Gatekeepers are journal editors, reviewers, conference organizers, influential scholars, and leading industry experts. Collectively, they make decisions affecting the evolution of the discipline. Having a clear understanding of the field's identity, past, present, possible future developments, and image may help them examine and re-examine the core values, assumptions, and perceptions of this scholarly domain to ensure that it progresses towards specific goals.

As such, the discipline's identity is a crucial issue that embraces the field's overall state and intellectual core by aggregating thousands of individual works at a higher level of abstraction. The purpose of this project is to conduct a scientometric analysis of the KM/IC body of knowledge presented in 11 major KM/IC journals. Consistent with previous scientometric investigations, a number of research questions pertaining to country, institutional and individual productivity, co-operation patterns, publication frequency, and favorite inquiry methods were proposed and answered. Based on the findings, many implications emerged that improve our understanding of the identity of KM/IC as a distinct scientific field. The following section describes prior works and outlines this study's research questions.

Literature review and research questions

Scientometrics is the science about science, and as an academic field, it has established lines of inquiry, methodologies and a distinct identity. Scientometrics developed out of work by prominent researchers including Robert King Merton, Derek J. de Solla Price and Eugene Garfield (Price, 1963; Garfield, 1972; Merton, 1973, 1976; Garfield, 1979).

Even though the KM/IC discipline is relatively new, it already boasts a number of scientometric projects with the purpose of better understanding its identity. For example, Serenko and Bontis (2004) investigated, using meta-analysis techniques, publications in three major KM/IC journals (*Journal of Knowledge Management*, *Journal of Intellectual Capital* and *Knowledge and Process Management*). Nonaka and Peltokorpi (2006) extended this work by examining the most influential KM/IC publications, and explored the specific issues of subjectivity and objectivity. Ponzi (2002) looked at the breadth and depth of the field, and searched for interdisciplinary connections among researchers. Dattero (2006) analyzed collaboration preferences of KM/IC scholars, and Harman and Koohang (2005) compared the topics of doctoral dissertations in the KM/IC field with publication frequency and the topics of books. Recently, Bontis and Serenko (2009) developed a ranking of KM/IC-specific journals.

There are two general scientometric approaches:

1. normative; and
2. descriptive (Neufeld *et al.*, 2007).

The purpose of the normative perspective is to establish norms, rules and heuristics to ensure a desirable discipline progress. In contrast, the objective of the descriptive approach is to observe and report on the actual activities of the field's scholars. In this project, the descriptive method is followed since it fits better with a quantitative analysis of scientific publications. It is noted, however, that the line between the normative and descriptive paradigms is blurred. For example, a quantitative analysis of collaboration patterns of

> **“The purpose of this project is to conduct a scientometric analysis of the KM/IC body of knowledge presented in 11 major KM/IC journals.”**

leading researchers may lead to the development of normative recommendations. However, it is believed that any line of research that may potentially advance our understanding of ourselves is worthwhile pursuing.

There are a number of reasons why researchers may want to conduct a descriptive scientometric study of a particular academic area (Straub, 2006). Among them, the most critical issue is an attempt to understand the identity of a scientific discipline. In fact, despite a continuous growth of the body of knowledge, it is useful to pause from time to time and engage in a retrospective analysis of the discipline itself to answer important questions (Holsapple, 2008). We may want to know, for example, what topics we study, what methods we use, who leads our research, how we collaborate, in what outlets we publish, how we perceive the quality of our journals, etc. In other words, descriptive scientometric projects explore the entire intellectual core of a scientific domain instead of concentrating on its individual works (Sidorova *et al.*, 2008).

While there is still ample room to explore these and many more issues in the KM/IC field, the initial results have been encouraging, demonstrating repeatedly that KM/IC is a specific discipline area that has been maturing. This study contributes to our overall understanding of KM/IC as a scholarly domain by analyzing 11 key KM/IC journals by using various scientometric techniques. It proposes and answers six important research questions outlined below.

Country, institutional and individual-level research productivity has been a traditional focus of scientometric projects (Manning and Barrette, 2005). As the competition for funding, faculty and students becomes increasingly more globalized, a scientometric analysis of national productivity becomes critically important. The volume and impact of academic publications are believed to reflect the nation’s scientific wealth and lead to economic development (King, 2004). Understanding which countries develop or exploit competencies within the KM/IC field allows researchers, academics and prospective students to develop their careers strategically. It may also affect the decisions of international granting agencies or private sector companies looking for countries with knowledge-intensive economies. In fact, it seems reasonable to hypothesize a positive correlation between a country’s scholarly KM/IC output and its development of the knowledge-based economy. With this in mind, we propose the following research question:

RQ1. What is the country productivity ranking in the KM/IC field?

Institutional research ranking is of interest to the national granting agencies and administration who must allocate research resources (Erkut, 2002). High levels of productivity can also increase the institutions’ standing, reputation and ability to attract and retain valuable students and faculty. Institutional and faculty rankings are very commonly conducted and published in various forms (e.g. US News & World Report College Rankings, Maclean’s Canadian University Guide, the Financial Times MBA Ranking, and the UK Research Assessment Exercise). However, to our best knowledge, no well-established ranking source provides any information for the KM/IC field in particular. We therefore propose the second research question:

RQ2. What is the institutional productivity ranking in the KM/IC field?

Investigation of individual research productivity is perhaps the most frequent topic of scientometric projects (Wright and Cohn, 1996; Bapna and Marsden, 2002). Currently, it is very difficult for prominent KM/IC researchers to demonstrate their achievements to colleagues, administrators, or university committees. The development of a list of key KM/IC contributors may potentially help these scholars and/or practitioners gain reputation. In addition, doctoral students seeking potential supervisors and junior researchers looking for mentors need to know whom to approach. We continue this line of inquiry with the following research question:

RQ3. What is the individual productivity ranking in the KM/IC field?

A critical issue in determining individual faculty productivity involves assigning credit for multi-authored papers. There are four basic approaches to determining authorial credit:

1. normalized page size;
2. author position;
3. direct count; and
4. equal credit (Chua *et al.*, 2002; Lowry *et al.*, 2007).

Normalized page size divides the number of pages by the number of authors to determine relative contribution; however, the results obtained by this method can be distorted by strict page limits of journals (Scott and Mitias, 1996). In addition, there is no reason to hypothesize that the contribution of a longer paper is more significant than that of a shorter one. This approach, therefore, should be excluded from consideration in the KM/IC field.

The author position method assigns values according to where the author is positioned in the citation (Howard and Day, 1995). Where two authors are listed, the first receives a score of 0.6, while the second receives a score of 0.4. A paper with four authors can generate the scores 0.415, 0.277, 0.185 and 0.123 for the authors in order of their position, in accordance with the formula of Howard *et al.* (1987). Many collaborators, however, prefer to list authors in alphabetical order, which results in an unfair advantage to those with names higher in the alphabet. Individual productivity rankings obtained by this method may also lead to a conflict among co-authors who contributed equally to a manuscript. Therefore, this approach was also excluded to report productivity rankings in this study.

The direct count technique assigns a value of 1.0 for each author, regardless of the number of authors, but this approach is seen as having at least two major drawbacks. First, researchers who tend to work independently can potentially receive lower scores than researchers who tend to work collaboratively, since collaborative work can allow for a greater number of publications in any given measurement period. Second, this method inflates the ranking of those who tend to co-author a large number of papers with multiple authors while keeping their contribution to each paper marginal. Therefore, the direct count technique was not employed in the present investigation.

Equal credit scoring, in which each author receives an equal portion of the score regardless of the authorship order, addresses the problems discussed above. A per-person score is derived by taking the inverse of the number of authors. For instance, an author of a single work receives 1 point; each author of a two-authored work obtains a score of 0.5; three-authored, 0.333, etc. It is believed that this technique inherits less bias compared to its previously mentioned counterparts, and it is selected to report all productivity scores in this paper.

There is evidence to suggest that in some cases, the direct count, author position and equal credit methods may produce comparable results (Serenko *et al.*, 2008). This is especially true when the data are aggregated, for example at the country or even the institutional level. Therefore, it is possible that the KM/IC rankings obtained by these three methods correlate moderately for individuals, strongly for institutions, and perfectly for countries. However, there is no evidence to support or refute this claim. Therefore, we ask:

RQ4. What are the differences in the country, institutional and individual research output calculated by (a) author position, (b) direct count and (c) equal credit methods?

The research questions presented above concentrate on the distribution of productivity scores among a group of leading countries, institutions and individuals. In addition to this, it would be interesting to observe the overall productivity distribution patterns of all KM/IC authors. For this, Lotka's law (Lotka, 1926) has been frequently utilized in prior scientometric studies (Chung and Cox, 1990; Nath and Jackson, 1991; Rowlands, 2005; Kuperman, 2006; Cocosila *et al.*, 2009). This law suggests the following theoretical relationship between the number of publications p and the number of all authors $f(p)$ in a particular scientific domain:

$$f(p) = C/p^n, \tag{1}$$

where C and n are non-negative constants (the Methodology section offers more detail on the values of C and n) and $p = 1, 2, 3, 4$, etc. The purpose of Lotka's law is to predict an approximate number of authors who contribute to the academic body of knowledge with a certain frequency of publications. It proposes that the number of individuals publishing a specific number of papers in a certain discipline is a fixed ratio to the number of scholars producing only a single work (Egghe, 2005). For example, within a particular timeframe, there may be one quarter as many authors with two publications as there are single-paper authors, one ninth as many with three, one sixteenth as many with four, etc.

As such, the goal is to find an optimal value of n that would fit the observed publication distribution (Kretschmer and Rousseau, 2001). To some extent, n reflects the degree of researcher loyalty to a specific scientific field. It may be assumed that the more loyal individuals are, the more frequently they would contribute to a set of the discipline's outlets. The relationship between the value of n and loyalty is negative; the higher n is, the lower publication frequency. By knowing n, it is possible to compare intra-discipline changes longitudinally as well as one scholarly domain with another. Therefore, we ask:

RQ5. Does the frequency of publication by authors in the KM/IC field follow Lotka's law?

Researchers can use the results of scientometric studies to identify research trends, discover unstudied topics and explore methodological issues. KM/IC is a new field that has not yet established dominant research paradigms or inquiry techniques. Preferred research methods differ among different disciplines. They may also change within a field itself over time. For example, Schoepflin and Glanzel (2001) discovered that case studies have become the preferred methodology published in social science journals. Case studies, which ranked only fourth out of six possible method categories in 1980, had risen to the dominant position by 1997, replacing science policy and discussion papers.

But what are the favorite research methods of KM/IC scholars? In a review of over a decade's worth of papers published in the proceedings of the McMaster World Congress on Intellectual Capital, Serenko *et al.* (2009) report that the most popular methods were:

1. case studies;
2. framework, model, approach, principle, index, metrics or tool development; and
3. literature reviews.

These results, however, apply to only a single KM/IC conference. Therefore, we suggest:

RQ6. What research methods have been used in the KM/IC field?

In order to answer these research questions, 2,175 articles published in 11 major KM/IC peer-reviewed journals were subjected to scientometric data analysis techniques. The following section outlines this project's methodology.

Methodology

Eleven KM/IC journals were selected from the list of outlets developed by Bontis and Serenko (2009) and Serenko and Bontis (2009). All articles from the first up to the last issue available online as of fall 2008 were included (see Table I). Publications written by the editors were retained only if they were published in the form of regular journal articles. Editorials,

Table I List of KM/IC peer-reviewed journals

Journal title	*Issues analyzed*	*Number of articles*
Electronic Journal of Knowledge Management	Vol. 1 No. 1, 2003-Vol. 6 No. 1, 2008	135
International Journal of Knowledge and Learning	Vol. 1 Nos 1/2, 2005-Vol. 4 No. 5, 2008	109
International Journal of Knowledge Management	Vol. 1 No. 1, 2005-Vol. 4 No. 2, 2008	73
International Journal of Knowledge Management Studies	Vol. 1 Nos 1/2, 2006-Vol. 2 No. 3, 2008	52
International Journal of Learning and Intellectual Capital	Vol. 1 No. 1, 2004-Vol. 5 No. 2, 2008	121
Journal of Intellectual Capital	Vol. 1 No. 1, 2000-Vol. 9 No. 2, 2008	270
Journal of Knowledge Management	Vol. 1 No. 1, 1997-Vol. 12 No. 3, 2008	482
Journal of Knowledge Management Practice	Vol. 1 No. 1, 1998-Vol. 9 No. 2, 2008	151
Knowledge and Process Management	Vol. 4 No. 1, 1997-Vol. 15 No. 2, 2008	293
Knowledge Management Research and Practice	Vol. 1 No. 1, 2003-Vol 6 No. 2, 2008	127
The Learning Organization	Vol. 1 No. 1, 1994-Vol. 15 No. 3, 2008	362
Total	1994-2008	2,175

conversations, and book reviews were excluded. For each article, the following variables were collected: journal's name, year, volume, issue, title, list of authors, their affiliations, their countries of residence, and total number of authors. When two affiliations were mentioned the first one was used, since it was assumed that authors tend to list their more relevant affiliation first. Article title, volume and issue were not used in the analysis and retained only to avoid duplicate entries. After the dataset was developed, it was proofread by two independent researchers, and minor mistakes were fixed.

The selected publications represent over 70 percent of the body of knowledge existing in KM/IC-specific outlets, and an analysis of this set of articles may produce results generalizable to KM/IC research in general.

Recall that there are at least four distinct approaches that may be utilized to calculate productivity scores:

1. normalized page size;
2. author position;
3. direct count; and
4. equal credit.

To answer *RQ1*, *RQ2* and *RQ3*, lists of the 30 most productive countries, institutions and individuals were constructed. For this, the equal credit technique was selected to report all productivity scores.

To answer *RQ4*, the direct count and author position techniques were used to measure productivity. The scores obtained by these methods, however, are not presented in this study; they were only used to calculate correlation coefficients among the three methods (i.e. author position, direct count, and equal credit).

To test Lotka's law (*RQ5*), numbers of individuals who published, one, two, three, four, etc. papers were calculated and compared to theoretical frequencies predicted by Lotka's law. The goal is to find the most optimal value of n that would fit the observed publication patterns. Lotka initially suggested that $n = 2$; different values, however, were often obtained, from 1.5 to 3 (Bonnevie, 2003), from 1.95 to 3.26 (Chung and Cox, 1990), and from 2.21 to 2.46 (Cocosila *et al.*, 2009). Specifically, $n = 2.7$ was suggested for a specific KM/IC conference (McMaster World Congress) (Serenko *et al.*, 2009). Therefore, similar to previous projects (Newby *et al.*, 2003; Rowlands, 2005), a number of different values of n were used to optimize the distribution and to minimize aggregated errors that were calculated as sums of squared differences between predicted and observed numbers. The C coefficient corresponded to the number of individuals who published only one paper.

To investigate research methods employed by KM/IC scholars (*RQ6*), a classification scheme presented by Serenko *et al.* (2009) was utilized. This approach is based on a number of prior works (Palvia *et al.*, 2003, 2004, 2007; Serenko *et al.*, 2008) and adapted for the KM/IC field specifically. Coding was done by two independent researchers who had expertise in both research methods and the KM/IC field; all inconsistencies were identified, discussed and fixed. To ensure the reliability of the coding process, one researcher repeatedly coded 100 random articles several months after the coding was complete, and achieved perfect accuracy.

Results interpretation – a note of caution

There are several critical issues related to the interpretation of this study's findings that the reader should be aware of up front. First, this project concentrates on research productivity in terms of the number of publications only. However, there are other ways to contribute to scholarship. For example, participating in university committees, serving on editorial boards, reviewing manuscripts, teaching graduate students, and developing curricula both directly and indirectly advance the state of research. Second, in this project, only peer-reviewed KM/IC journals were considered. Books, conference proceedings, and works published in professional journals were excluded from consideration. Many KM/IC publications also appear in non-KM/IC journals, especially in management information systems, accounting, strategy, human resources and organizational behavior outlets. Third, research productivity does not automatically correspond to research quality or impact. Fourth, institutional productivity rankings favor larger faculties that produce more publications in general. More populated countries also tend to have more educational and research institutions resulting in a higher volume of publications in all disciplines including KM/IC. Fifth, to develop institutional and individual productivity rankings, it is very difficult to correctly identify all publications because of record inconsistencies. For example, Jane C. Smith may also list her name as Jane Smith, J.C. Smith or J. Smith. There were also spelling inconsistencies in cases of non-English names and affiliations. For instance, Autonomous University of Madrid was mentioned both in English and Spanish languages (i.e. Universidad Autónoma de Madrid). Despite multiple rounds of revisions and cross-checks, it is possible that in some cases, names or affiliations were identified incorrectly, and some productivity scores were underestimated.

We strongly suggest that the reader bear these points in mind. We do not suggest that the contribution of a particular country, institution or individual to the KM/IC scholarly domain is higher or lower. Instead, we simply present the results based on a particular well-established scientometric technique and leave it up to the reader how to interpret and utilize the findings.

Findings

Overall trends

During the period under investigation, 2,175 articles were published by 4,236 authors. These 4,236 individuals represent the total number of authors, including double-counting; out of them, 3,109 unique authors were identified (i.e. excluding double-counting). To assess the distribution of authorship, the dataset was split into two time periods that had approximately an equal number of papers, i.e. 1994-2004 and 2005-2008. It was found that for the overall 1994-2008 period, each article was written by 1.94 authors. However, for the 1994-2004 and 2005-2008 periods, there were 1.80 and 2.07 authors per article, respectively. Therefore, there has been a decline in single-authored works over time (see Figures 1-3). For example, in the second time period, the percentage of single-authored publications decreased from 45 percent to 34 percent, whereas the proportion of three-author papers increased from 14 percent to 20 percent. Therefore, a trend towards the publication of multi-authored works has been identified.

Practitioners, who were defined as authors not affiliated with an educational and/or research institution, such as a college or university, represented almost 17 percent of all KM/IC authors. A longitudinal analysis (see Figure 4) demonstrates a gradual decrease in practitioner contribution after 1998. When the first KM/IC articles appeared from 1994 to

Figure 1 Authorship distribution (1994-2008)

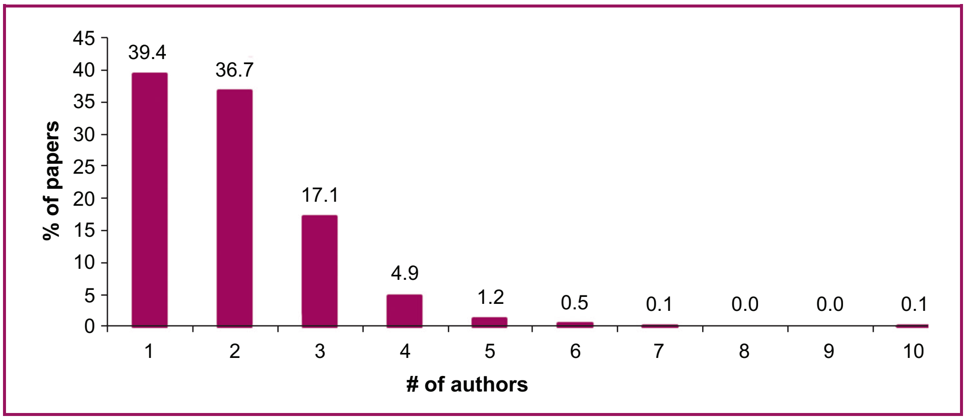


Figure 2 Authorship distribution (1994-2004)

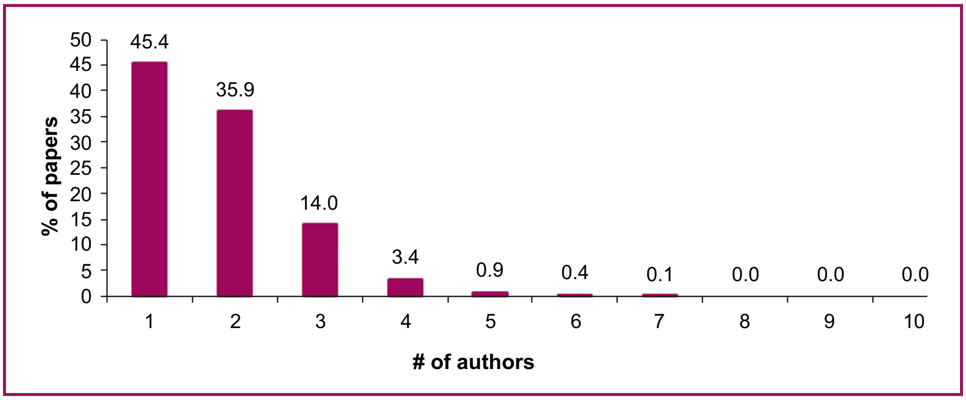
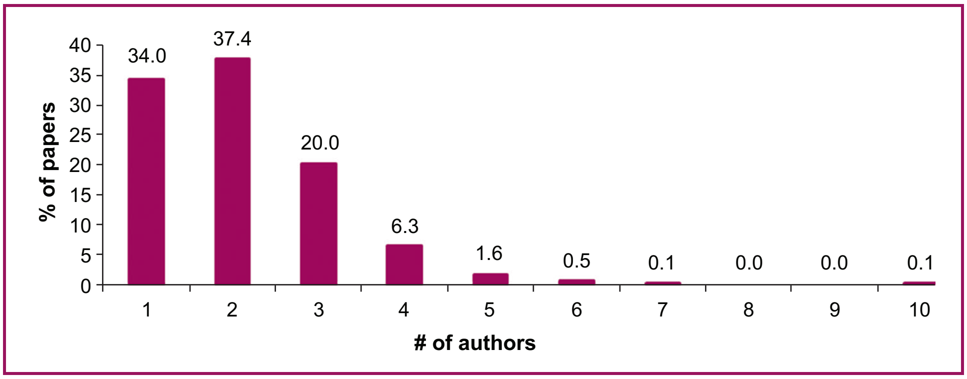


Figure 3 Authorship distribution (2005-2008)



1998, non-academics represented approximately one-third of all contributors. However, by 2008, their numbers had declined dramatically to just over 10 percent.

Productivity rankings

To investigate country productivity ranking, 73 individual countries were identified. Table II outlines the list of top 30 contributors. The top five countries were the USA, the UK, Australia, Spain, and Canada. The contribution of relatively smaller countries, such as Finland,

Figure 4 Percentage of practitioners

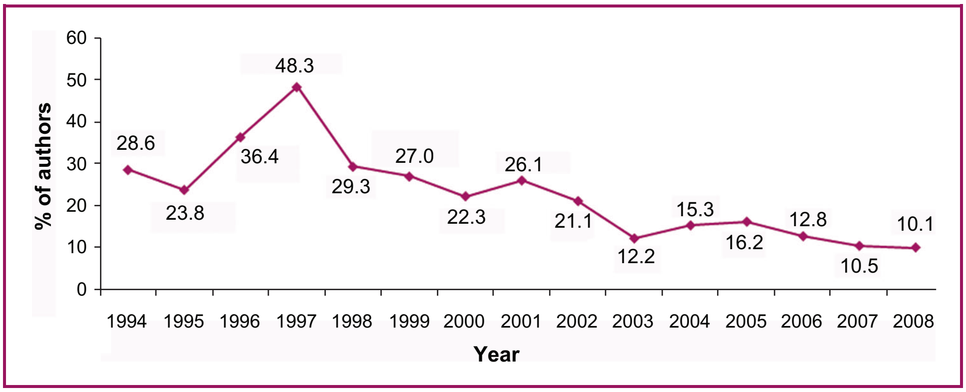


Table II Country productivity ranking (equal credit method)

Rank	*Country*	*Score*
1	USA	465.66
2	UK	390.44
3	Australia	178.60
4	Spain	106.72
5	Canada	94.25
6	Germany	74.88
7	Finland	63.42
8	Sweden	63.00
9	The Netherlands	60.17
10	Italy	46.50
11	Greece	46.33
12	Denmark	40.25
13	Taiwan	33.10
14	India	32.58
15	France	30.07
16	New Zealand	28.75
17	Malaysia	26.58
17	Singapore	26.58
19	Norway	24.58
20	Japan	23.42
21	Ireland	22.33
22	Austria	20.33
23	Hong Kong	19.47
24	Switzerland	18.92
25	Israel	17.60
26	Brazil	14.17
27	South Korea	13.75
28	Belgium	12.02
29	Portugal	10.42
30	South Africa	10.33

Sweden, The Netherlands and Greece, is also acknowledged. It is noted that the research outputs of Taiwan (33.10) or Hong Kong (19.47) exceeded that of China (9.00).

Out of all 73 countries identified, 45 that had total productivity scores of at least 3 points were selected. For them, the Spearman's correlation between the productivity scores and their 2008 GDP per capita was calculated ($\rho = 0.597$, $p < 0.000$).

In total, 1,450 unique institutions were identified. Out of them, there were 955 and 455 academic and non-academic organizations, respectively. Table III presents the list of leading KM/IC institutions. The top five were:

Table III Institutional productivity ranking (equal credit method)

Rank	*Institution*	*Score*
1	Cranfield University, UK	32.84
2	Copenhagen Business School, Denmark	21.07
3	Macquarie University, Australia	17.68
4	University of Oviedo, Spain	17.50
5	McMaster University, Canada	16.23
6	Open University, UK	13.58
7	Tampere University of Technology, Finland	13.17
8	Loughborough University, UK	12.92
9	Chalmers University of Technology, Sweden	12.85
10	George Washington University, USA	12.83
11	Griffith University, Australia	12.42
12	Technische Universität Kaiserslautern, Germany	12.00
13	University of Sheffield, UK	11.35
14	Monash University, Australia	11.33
15	Helsinki University of Technology, Finland	11.00
16	University of Warwick, UK	10.58
17	Kingston University, UK	10.25
18	National Technical University of Athens, Greece	9.75
19	University of Limerick, Ireland	9.60
20	The Leadership Alliance Inc., Canada (non-academic)	9.50
20	University of Technology, Sydney, Australia	9.50
22	University of Westminster, UK	9.33
23	Autonomous University of Madrid, Spain	9.25
24	Brunel University, UK	9.08
25	INHOLLAND University, The Netherlands	9.00
25	University of New South Wales, Australia	9.00
27	Athens University of Economics and Business, Greece	8.92
27	University of Southampton, UK	8.92
29	Multimedia University, Malaysia	8.83
30	University of Western Sydney, Australia	8.50

1. Cranfield University, UK;
2. Copenhagen Business School, Denmark;
3. Macquarie University, Australia;
4. University of Oviedo, Spain; and
5. McMaster University, Canada.

Two interesting findings emerged. First, out of 30 institutions, nine were from the UK and only one (George Washington University) from the USA. Second, only one non-academic institution was included in the list. Overall, the leading non-academic organizations were:

1. the Leadership Alliance, Inc., Canada (score of 9.50);
2. Intellectual Capital Services Limited, UK (6.90);
3. Progressive Practices, USA (6.00);
4. Knowledge Research Institute, Inc., USA (5.00); and
5. IBM, USA (4.50).

In total, 77 percent of all non-academic organizations were represented by only a single individual. The most productive practitioners were:

1. Peter A.C. Smith, Canada (score of 10.00);
2. Jay Chatzkel, USA (6.00); and
3. Karl M. Wiig, USA (5.00).

A total of 89 percent of all practitioners authored or co-authored only one article.

Table IV presents a list of the most productive authors (both academics and practitioners). The top KM/IC contributors were Patricia Ordonez de Pablos, Heiner Müller-Merbach, Peter A.C. Smith, Nick Bontis, and Anthony Wensley.

It was observed that the top five most productive countries, institutions and individuals generated 56.8 percent, 4.8 percent, and 2.5 percent of the entire research output, respectively. This demonstrates that there are several countries dominating the KM/IC research area, whereas institutional and individual research output is spread more equally.

Table V presents Spearman's correlations for three different productivity score calculation methods. It was found that the results obtained by these techniques may coincide or deviate depending on the level of analysis (country, institution or individual). It was also observed that the equal credit and author position techniques offer almost identical results.

Research methods

In terms of methods, 76.3 percent of investigations used only one method, and 23.7 percent employed two. Table VI outlines all methods for the entire time period and longitudinally.

Table IV Individual productivity ranking (equal credit method)

Rank	*Author*	*Score*
1	Patricia Ordonez de Pablos	14.00
2	Heiner Müller-Merbach	12.00
3	Peter A.C. Smith	10.00
4	Nick Bontis	9.64
5	Anthony Wensley	8.00
6	Jay Liebowitz	6.81
7	Daniel Andriessen	6.50
8	Ganesh Bhatt	6.33
9	Jay Chatzkel	6.00
9	Jose Maria Viedma Marti	6.00
11	Alexander Styhre	5.28
12	Luiz Antonio Joia	5.25
13	Andrew Goh	5.00
13	Rodney McAdam	5.00
13	Walter Skok	5.00
13	Karl M. Wiig	5.00
17	Ortrun Zuber-Skerritt	4.75
18	Miltiadis D. Lytras	4.67
19	Kaj U.Koskinen	4.50
20	Jan Mouritsen	4.28
21	Goran Roos	4.20
22	Ashley Braganza	4.14
23	Petter Gottschalk	4.08
24	Deborah Blackman	4.00
24	Clyde W. Holsapple	4.00
24	William R. King	4.00
24	Anders Örtenblad	4.00
28	Elayne Coakes	3.83
29	James Guthrie	3.78
30	Leif Edvinsson	3.58
30	Syed Z. Shariq	3.58

Table V Spearman's correlations for different productivity calculation methods

	Direct count-equal credit		*Direct count-author position*		*Equal credit-author position*	
Countries	*0.985*	*(p < 0.000)*	*0.988*	*(p < 0.000)*	*0.999*	*(p < 0.000)*
Institutions	0.673	($p < 0.000$)	0.656	($p < 0.000$)	0.989	($p < 0.000$)
Individuals	0.442	($p < 0.05$)	0.379	($p < 0.05$)	0.968	($p < 0.000$)

Table VI The usage of research methods by percentage

Rank	Method	1994-2008	1994-2004	2005-2008
1	Framework, model, approach, principle, index, metrics, or tool development	32.14	34.29	30.28
2	Case study	23.83	25.83	22.11
3	Literature review (work is based on existing literature)	10.76	12.16	9.55
4	Survey (administration of a questionnaire with open and/or close-ended questions)	9.88	8.23	11.31
5	Secondary data (use of existing organizational or business data, e.g. reports, statistics, etc.)	8.34	7.70	8.89
6	Interviews (asking respondents directly)	6.83	4.68	8.70
7	Other qualitative research such as ethnography, action research, focus groups, interpretive study, examination of texts, or documents	5.36	4.00	6.54
8	Speculation/commentary (based on personal opinions without empirical or literature support)	0.98	1.74	0.33
9	Mathematical model (an analytical or descriptive model for the phenomena under investigation)	0.70	0.30	1.05
10	Laboratory experiment (research in simulated laboratory environments by manipulating/controlling variables)	0.63	0.53	0.72
11	Meta-analysis of literature (e.g. the usage of techniques to summarize relationships, establish causal links, compare and combine previous findings, etc.)	0.21	0.23	0.20
12	Field experiment (research in organizational settings by manipulating/controlling variables)	0.18	0.08	0.26
13	Field study	0.14	0.23	0.07
	Total	100	100	100

Note: Figures shown are percentages

Framework, model, approach, principle, index, metrics or tool developments have been the most favored approach, followed by case studies and literature reviews. Second, there has been a decline in case studies and non-empirical methods, such as literature reviews, and speculations/commentaries. At the same time, empirical inquiry techniques – for example surveys, the use of secondary data, interviews, and other qualitative methods – have become more popular. Third, field experiments and field studies have been virtually non-existent. Fourth, contrary to expectations, no increase in the volume of meta-analysis publications has been discovered.

Lotka's law

Table VII outlines author count distribution frequencies with an optimal value of $n = 2.82$. This value was dramatically higher than that hypothesized by Lotka, since 80 percent of all authors contributed only once to the selected set of journals.

Table VII Lotka's law – author count distribution frequencies

Number of papers	Observed number of authors	Predicted number of authors ($\alpha = 2$)	Squared difference observed – predicted ($n = 2$)	Predicted number of authors ($n = 2.82$)	Squared difference observed – predicted ($n = 2.82$)
1	2,491	2,002.99	118.897	2,513.71	0.205
2	403	500.75	19.081	355.97	6.214
3	110	222.55	56.923	113.46	0.105
4	50	125.19	45.157	50.41	0.003
5	18	80.12	48.164	26.87	2.926
6	7	55.64	42.519	16.07	5.117
7	13	40.88	19.012	10.40	0.649
8	5	31.30	22.096	7.14	0.641
9	3	24.73	19.092	5.12	0.878
10	3	20.03	14.479	3.80	0.170
Over 10	6	4.82	0.286	6.05	0.000
Total	3,109	3109	405.707	3109	16.909

Discussion and conclusions

The purpose of this project was to conduct a scientometric analysis of KM/IC academic research in order to understand the discipline's identity. For this, 2,175 articles published in 11 major KM/IC peer-reviewed journals were analyzed. A number of implications emerged that warrant further discussion as pertains to the identity of the field:

Implication I: the KM/IC discipline is very diverse

During the project, 3,109 unique authors from 1,450 unique institutions (955 academic and 455 non-academic) were identified. Despite its relatively short history, KM/IC already boasts a continuously growing body of knowledge. The discipline has attracted the attention of a tremendous number of individual contributors from a variety of both academic and non-academic institutions. On the one hand, a number of very productive institutions and individuals were identified. On the other hand, the top five universities and academics generated only 4.8 percent, and 2.5 percent of the total research output, respectively. Therefore, there is no single university or person generating the most research. Instead, it is the cumulative contribution of a large variety of individuals from hundreds of academic and non-academic organizations that shape the KM/IC scholarly domain.

Implication II: the KM/IC field has been showing signs of academic maturity

As a scientific discipline, KM/IC is maturing. There are three indicators of this process: changes in co-authorship patterns, in inquiry methods and in the roles of practitioners. With respect to co-authorship patterns, a clear trend towards the publication of multi-authored manuscripts was observed. Recall that during the 1994-2004 and 2005-2008 periods, there were 1.80 and 2.07 authors per article, respectively. Specifically, there was a significant drop in single-authored papers from 45 percent to 34 percent. Prior scientometric research argues that co-authorship preferences are an important phenomenon reflecting the maturity of a scholarly domain (Narin *et al.*, 1991; Inzelt *et al.*, 2009) – specifically, a positive relationship exists between the average number of authors per each manuscript and the field's maturity (Lipetz, 1999). First, as the domain matures, the competition for journal space increases and acceptance rates decline. Therefore, inputs from multiple researchers are required to improve the quality of each work to ensure its acceptance. Second, researchers may gradually establish their personal research networks leading to higher co-operation.

With regard to inquiry methods, speculation/commentary, based on personal opinions without empirical or literature support, were extremely rare (0.33 percent). There has been a decline in pure theoretical approaches, such as the development of frameworks, models, principles, indices, metrics, or tools, which form the foundation for future research. At the same time, an increase in empirical methods, such as surveys, the use of secondary data and interviews, reveals another trend towards scientific maturity. When a new scholarly domain emerges, its theoretical foundations need to be established. Gradually, these theoretical principles are being tested empirically, and this trend is evident in the KM/IC domain.

In terms of the role of practitioners, their contribution to the body of knowledge has been declining. This trend also reveals a sign of academic maturity of the KM/IC discipline since most of its works are currently written by academic researchers. At the same time, this trend is somewhat worrisome as discussed in the next implication.

Implication III: ambiguous role of practitioners

When the first KM/IC papers appeared from 1994 to 1998, non-academics constituted one-third of all authors. In fact, it was key practitioners who provided the initial impetus for the field (e.g. Leif Edvinsson at Skandia, Hubert Saint-Onge at CIBC, Goran Roos at ICS, Patrick Sullivan at ICM Group, etc.). Many of the initial academic papers were case studies and re-conceptualizations of what had already occurred in practice. Of course it is common for practice to lead academia initially. While KM/IC had been initially discussed by the mid-1990s in practitioner books, magazines and trade journals (e.g. *KM World*), academic journals followed only a few years later. Gradually, KM/IC captured the attention of academics from various disciplines, who also started contributing to the literature. The role of non-academic researchers, who represented 17 percent of all KM/IC authors identified in this study, has been dramatic in terms of their relative contribution to the scholarly domain. In fact, it is practitioners who identified a need for KM/IC, developed its foundations, and suggested avenues for future scholarly research.

However, by 2008, practitioners' contributions dropped to only ten percent of all KM/IC authors. Pragmatic field studies and experiments, which require an active cooperation of businesses and the involvement of practitioners, constitute only 0.33 percent of all inquiry methods. There has also been a decline in case studies from 26 percent (1994-2004) to 22 percent (2005-2008) in favor of empirical research in form of surveys and interviews that are sometimes referred to as more scientifically rigorous. The same phenomenon was observed in the management information systems domain when the scholarly contribution of practitioners became virtually non-existent (Serenko *et al.*, 2008). As a result, the practical relevance and applicability of the information systems scholarly research was questioned (Baskerville and Wood-Harper, 1996; Benbasat and Zmud, 1999; Kock *et al.*, 2002; Desouza *et al.*, 2006; Benamati *et al.*, 2007). For example, a survey of IS professionals demonstrated that most of them are unaware of academic publications, believe that scholarly articles are outdated, difficult to read and offer no value (Pearson *et al.*, 2005). Recently, Booker *et al.* (2008) interviewed a number of KM/IC practitioners and also concluded that they experience difficulty accessing and utilizing academic knowledge for managerial decision-making. At the same time, these professionals believed that there is a great value in KM/IC scholarly knowledge.

Overall, there is a great danger that KM/IC may lose its practical side and become a pure scholarly discipline. Even though scholarly relevance and rigor are a must, the needs of the KM/IC industry should also be considered. One of the best approaches is to recommend that academic researchers increasingly collaborate with industry practitioners on various research projects. Researchers should increase their usage of the currently under-represented inquiry methods, for example, interviews, field experiments, and various qualitative methods including ethnography, action research, focus groups, interpretive study, and examination of texts. Journal editors and reviewers should welcome submissions that involve academic-practitioner collaborations, for example, studies reporting on a field experiment in an actual organization.

Implication IV: a minority of countries generates the most research output – the existence of the Matthew effect for countries was confirmed in the KM/IC domain

In this project, 73 contributing countries were identified. The five leading countries (the USA, the UK, Australia, Spain and Canada) generated 57 percent of the entire research output. Twenty-one percent of all research was generated by the USA alone. This suggests that the production of scholarly KM/IC research is not distributed equally among the nations. Instead, a handful of countries accounts for the majority of publications.

A related phenomenon, referred to as the Matthew effect for countries (Bonitz *et al.*, 1997), has been observed in virtually all scientific fields. The Matthew effect, introduced in the seminal works by Merton (1968, 1988) refers to the situation when an initial advantage gained by an individual scholar, institution or country leads to further advantage, whereas their less fortunate counterparts receive little or no gain. It is likely that wealthy countries were able to initially invest heavily in research institutions, attract top faculty, and provide research grants. This in turn facilitates the production of more research in those select countries, and

“In terms of the role of practitioners, their contribution to the body of knowledge has been declining.”

the research arena becomes dominated by only a few scientific elite nations. Unfortunately, the Matthew effect for countries also appears in KM/IC.

Implication V: the comparison of most productive countries, institutions and individuals with those reported by Serenko and Bontis (2004)

In this study, the top 30 most productive countries, institutions and individuals were identified. These findings were compared with those reported by Serenko and Bontis (2004). Recall that Serenko and Bontis analyzed only three KM/IC outlets:

1. *Journal of Knowledge Management*;
2. *Journal of Intellectual Capital*; and
3. *Knowledge and Process Management*.

First, the same countries were included in both top five lists. Spain, however, increased its output and moved from the fifth to the fourth place, leaving Canada behind. Out of the top 30 countries ranked in the present project, only three (Italy, Taiwan and Austria) did not appear in Serenko and Bontis's top 30 list. Second, even though Cranfield University topped both lists, differences in institutional top 30 rankings were observed. As such, 16 new institutions appeared. Third, in the list of the leading 30 scholars, 20 new names appeared. Overall, this demonstrates that the selection of target journals and time frame has little impact on national rankings; however, it dramatically affects institutional and individual top lists.

Implication VI: productivity scores obtained by author position, direct count, and equal credit methods depend on the level of analysis (i.e. country, institution or individual)

Based on the comparison of three different productivity score calculation methods, the following observations were made. First, for countries, all three methods produced almost identical results. Second, equal credit and author position techniques generated similar productivity scores regardless of the level of analysis (i.e. country, institution or individual). Third, there was a positive relationship between the degree of data aggregation and consistency of the productivity scores obtained by these methods. In other words, when the productivity scores were combined at the institutional or national levels, these three approaches offered more consistent results. Note that the author position technique is very laborious and error-prone. Therefore, it may be fully eliminated in favor of direct count or equal credit methods. It is also concluded that the direct count technique, which is very simple to perform, may be successfully utilized in cases of national productivity rankings.

Implication VII: there are many KM/IC authors, especially practitioners, who contributed only once to the body of knowledge

With respect to Lotka's law, the value of n was found to be 2.82. This is higher than what is proposed by Lotka ($n = 2$) because a large proportion of all authors (80 percent) published only a single work in the outlets examined in the present investigation. This phenomenon took place because of the high number of practitioners who contributed only once (89 percent). In fact, since it is not the sole or key duty of non-academics to produce research, they are likely to contribute less frequently than academics. However, given that the overall contribution of practitioners has been gradually declining, it is likely that future authors within the field of KM/IC will eventually be represented by academics with higher publication frequencies. Therefore, the overall proportion of all authors with only a single work will decline, thereby bringing the value of n closer to 2 as theorized by Lotka.

Implication VIII: scholarly KM/IC output may potentially contribute to the wealth of nations

During this study, a number of smaller, very productive countries were discovered. The strong attention of smaller nations to KM/IC topics suggests that KM/IC may potentially offer a competitive advantage and help develop knowledge-intensive economies. It is noted that most of these countries are non-English speaking. At the same time, their academics have dramatically contributed to the KM/IC body of research published in English-language journals. Therefore, it is likely that these authors also published KM/IC works in non-English

> “Overall, there is a great danger that KM/IC may lose its practical side and become a pure scholarly discipline.”

outlets that were not included in this project. Therefore, the overall KM/IC scholarly output of these nations may potentially be higher than that reported in this project.

Some past studies have focused on national levels of intellectual capital development and have shown a positive link between human capital investment and financial wealth (Bontis, 2004). In fact, the correlation between countries' GDP per capita and their KM/IC research output was strong (Spearman's $\rho = 0.597$, $p < 0.000$). Similar correlations between the GDP and the volume of scientific research were observed in other countries and scholarly domains (Hart and Sommerfeld, 1998). Even though it is difficult to explain precisely the causal relationship between these two variables (Rousseau and Rousseau, 1998), it is possible that KM/IC scholarly research is, to some extent, transformed into practical managerial approaches and organizational practices that contribute to national intellectual capital development.

In conclusion, a large obstacle confronting the KM/IC field concerns the communication gap between researchers and practitioners. Although we have come a long way since the early 1990s, bridging the gap between theory and practice continues to present a challenge. The majority of scientific work in KM/IC published in top tier peer-reviewed journals is targeted to other academics. Our journal articles are written in a specific scientific language and are structured in a way that readers without advanced post-graduate education cannot quickly comprehend. Since the number of research-oriented practitioners has been declining, so has the number of non-academic readers.

Clearly, the influential models developed by various authors provide much of the intellectual foundation for the KM/IC field. However, what is evident thus far is that the future of this field will surely benefit from a wide and diverse publication base that covers both academic institutions and corporate organizations. Furthermore, the global coverage of countries represented as well as the sheer number of authors that have influenced the field's rise, bodes well for its future health as a body of literature that is both influential and meaningful to managers in the knowledge era and the academics who study them.

References

Bapna, R. and Marsden, J.R. (2002), ''The paper chase: comparing the research productivity of quantitative/technical departments in schools of business'', *OR/MS Today*, Vol. 29 No. 6.

Baskerville, R.L. and Wood-Harper, A.T. (1996), ''A critical perspective on action research as a method for information systems research'', *Journal of Information Technology*, Vol. 11 No. 3, pp. 235-46.

Benamati, J., Serva, M.A., Galletta, D.F., Harris, A. and Niederman, F. (2007), ''The slippery slope of MIS academia: a discussion of the quest for relevance in our discipline'', *Communications of the Association for Information Systems*, Vol. 18, pp. 657-75.

Benbasat, I. and Zmud, R.W. (1999), ''Empirical research in information systems: the practice of relevance'', *MIS Quarterly*, Vol. 23 No. 1, pp. 3-16.

Bonitz, M., Bruckner, E. and Scharnhorst, A. (1997), ''Characteristics and impact of the Matthew effect for countries'', *Scientometrics*, Vol. 40 No. 3, pp. 407-22.

Bonnevie, E. (2003), ''A multifaceted portrait of a library and information science journal: the case of the *Journal of Information Science*'', *Journal of Information Science*, Vol. 29 No. 1, pp. 11-23.

Bontis, N. (1998), ''Intellectual capital: an exploratory study that develops measures and models'', *Management Decision*, Vol. 36 No. 2, pp. 63-76.

Bontis, N. (1999), ''Managing organizational knowledge by diagnosing intellectual capital: framing and advancing the state of the field'', *International Journal of Technology Management*, Vol. 18 Nos 5-8, pp. 433-62.

Bontis, N. (2001a), ''Assessing knowledge assets: a review of the models used to measure intellectual capital'', *International Journal of Management Reviews*, Vol. 3 No. 1, pp. 41-60.

Bontis, N. (2001b), ''CKO wanted – evangelical skills necessary: a review of the Chief Knowledge Officer position'', *Knowledge and Process Management*, Vol. 8 No. 1, pp. 29-38.

Bontis, N. (2004), ''National Intellectual Capital Index: a United Nations initiative for the Arab region'', *Journal of Intellectual Capital*, Vol. 5 No. 1, pp. 13-39.

Bontis, N. and Girardi, J. (2000), ''Teaching knowledge management and intellectual capital lessons: an empirical examination of the TANGO simulation'', *International Journal of Technology Management*, Vol. 20 Nos 5-8, pp. 545-55.

Bontis, N. and Serenko, A. (2009), ''A follow-up ranking of academic journals'', *Journal of Knowledge Management*, Vol. 13 No. 1, pp. 16-26.

Bontis, N., Hardie, T. and Serenko, A. (2008), ''Self-efficacy and KM course weighting selection: can students optimize their grades?'', *International Journal of Teaching and Case Studies*, Vol. 1 No. 3, pp. 189-99.

Bontis, N., Serenko, A. and Biktimirov, E.N. (2006), ''MBA knowledge management course: is there an impact after graduation?'', *International Journal of Knowledge and Learning*, Vol. 2 Nos 3/4, pp. 216-37.

Booker, L., Bontis, N. and Serenko, A. (2008), ''The relevance of knowledge management and intellectual capital research'', *Knowledge and Process Management*, Vol. 15 No. 4, pp. 235-46.

Chua, C., Cao, L., Cousins, K. and Straub, D.W. (2002), ''Measuring researcher-production in information systems'', *Journal of the Association for Information Systems*, Vol. 3, pp. 145-215.

Chung, K.H. and Cox, R.A.K. (1990), ''Patterns of productivity in the finance literature: a study of the bibliometric distributions'', *Journal of Finance*, Vol. 45 No. 1, pp. 301-9.

Cocosila, M., Serenko, A. and Turel, O. (2009), ''A scientometric study of information systems conferences: exploring ICIS, PACIS and ASAC'', *Proceedings of the 15th Americas Conference on Information Systems (AMCIS), San Francisco, CA*.

Dattero, R. (2006), ''Collaboration between the top knowledge management/intellectual capital researchers'', *Knowledge and Process Management*, Vol. 13 No. 4, pp. 264-9.

Desouza, K.C., Sawy, O.A.E., Galliers, R.D., Loebbecke, C. and Watson, R.T. (2006), ''Beyond rigor and relevance towards responsibility and reverberation: information systems research that really matters'', *Communications of the Association for Information Systems*, Vol. 17, pp. 341-53.

Egghe, L. (2005), ''The power of power laws and an interpretation of Lotkaian informetric systems as self-similar fractals'', *Journal of the American Society for Information Science and Technology*, Vol. 56 No. 7, pp. 669-75.

Erkut, E. (2002), ''Measuring Canadian business school research output and impact'', *Canadian Journal of Administrative Sciences*, Vol. 19 No. 2, pp. 97-123.

Garfield, E. (1972), ''Citation analysis as a tool in journal evaluation'', *Science*, Vol. 178 No. 4060, pp. 471-9.

Garfield, E. (1979), *Citation Indexing: Its Theory and Application in Science, Technology, and Humanities*, Wiley, New York, NY.

Grant, R.M. (2002), ''The knowledge-based view of the firm'', in Choo, C.W. and Bontis, N. (Eds), *The Strategic Management of Intellectual Capital and Organizational Knowledge*, Oxford University Press, Oxford, pp. 133-48.

Gu, Y. (2004a), ''Global knowledge management research: a bibliometric analysis'', *Scientometrics*, Vol. 61 No. 2, pp. 171-90.

Gu, Y. (2004b), ''Information management or knowledge management? An informetric view of the dynamics of academia'', *Scientometrics*, Vol. 61 No. 3, pp. 285-99.

Harman, K. and Koohang, A. (2005), ''Frequency of publication and topical emphasis of knowledge management books versus doctoral dissertations: 1983-2005'', *Journal of Computer Information Systems*, Vol. 46 No. 2, pp. 64-8.

Hart, P.W. and Sommerfeld, J.T. (1998), ''Relationship between growth in gross domestic product (GDP) and growth in the chemical engineering literature in five different countries'', *Scientometrics*, Vol. 42 No. 3, pp. 299-311.

Holsapple, C.W. (2008), ''The pulse of multiparticipant systems'', *Journal of Organizational Computing and Electronic Commerce*, Vol. 18 No. 4, pp. 333-43.

Howard, G.S. and Day, J.D. (1995), ''Individual productivity and impact in developmental psychology'', *Developmental Review*, Vol. 15 No. 2, pp. 136-49.

Howard, G.S., Cole, D.A. and Maxwell, S.E. (1987), ''Research productivity in psychology based on publication in the journals of the American Psychology Association'', *American Psychologist*, Vol. 42 No. 11, pp. 975-86.

Inzelt, A., Schubert, A. and Schubert, M. (2009), ''Incremental citation impact due to international co-authorship in Hungarian higher education institutions'', *Scientometrics*, Vol. 78 No. 1, pp. 37-43.

King, D.A. (2004), ''The scientific impact of nations: what different countries get for their research spending'', *Nature*, Vol. 430 No. 6997, pp. 311-16.

Kock, N., Gray, P., Hoving, R., Klein, H., Myers, M. and Rockart, J. (2002), ''IS research relevance revisited: subtle accomplishment, unfulfilled promise, or serial hypocrisy?'', *Communications of the Association for Information Systems*, Vol. 8, pp. 330-46.

Kretschmer, H. and Rousseau, R. (2001), ''Author inflation leads to a breakdown of Lotka's law'', *Journal of the American Society for Information Science and Technology*, Vol. 52 No. 8, pp. 610-14.

Kuperman, V. (2006), ''Productivity in the internet mailing lists: a bibliometric analysis'', *Journal of the American Society for Information Science and Technology*, Vol. 57 No. 1, pp. 51-9.

Lipetz, B.-A. (1999), ''Aspects of JASIS authorship through five decades'', *Journal of the American Society for Information Science*, Vol. 50 No. 11, pp. 994-1003.

Lotka, A.J. (1926), ''The frequency distribution of scientific productivity'', *Journal of the Washington Academy of Sciences*, Vol. 16 No. 2, pp. 317-24.

Lowry, P.B., Karuga, G.G. and Richardson, V.J. (2007), ''Assessing leading institutions, faculty, and articles in premier information systems research journals'', *Communications of the Association for Information Systems*, Vol. 20, pp. 142-203.

Manning, L.M. and Barrette, J. (2005), ''Research performance in academe'', *Canadian Journal of Administrative Sciences*, Vol. 22 No. 4, pp. 273-82.

Merton, R.K. (1968), ''The Matthew effect in science'', *Science*, Vol. 159 No. 3810, pp. 56-63.

Merton, R.K. (Ed.) (1973), *The Sociology of Science: Theoretical and Empirical Investigations*, University of Chicago Press, Chicago, IL.

Merton, R.K. (1976), *Sociological Ambivalence and Other Essays*, Collier Macmillan Canada, Toronto.

Merton, R.K. (1988), ''The Matthew effect in science, II: cumulative advantage and the symbolism of intellectual property'', *Isis*, Vol. 79 No. 4, pp. 606-23.

Narin, F., Stevens, K. and Whitlow, E.S. (1991), ''Scientific co-operation in Europe and the citation of multinationally authored papers'', *Scientometrics*, Vol. 21 No. 3, pp. 313-23.

Nath, R. and Jackson, W.M. (1991), ''Productivity of management information systems researchers: does Lotka's law apply?'', *Information Processing & Management*, Vol. 27 Nos 2/3, pp. 203-9.

Neufeld, D., Fang, Y. and Huff, S. (2007), ''The IS identity crisis'', *Communications of the Association for Information Systems*, Vol. 19, pp. 447-64.

Newby, G.B., Greenberg, J. and Jones, P. (2003), ''Open source software development and Lotka's law: bibliometric patterns in programming'', *Journal of the American Society for Information Science and Technology*, Vol. 54 No. 2, pp. 169-78.

Nonaka, I. and Peltokorpi, V. (2006), ''Objectivity and subjectivity in knowledge management: a review of 20 top articles'', *Knowledge and Process Management*, Vol. 13 No. 2, pp. 73-82.

Palvia, P., Pinjani, P. and Sibley, E.H. (2007), ''A profile of information systems research published in *Information & Management*'', *Information & Management*, Vol. 44 No. 1, pp. 1-11.

Palvia, P., Mao, E., Salam, A.F. and Soliman, K.S. (2003), ''Management information systems research: what's there in a methodology?'', *Communications of the Association for Information Systems*, Vol. 11, pp. 289-309.

Palvia, P., Leary, D., Mao, E., Midha, V., Pinjani, P. and Salam, A.F. (2004), ''Research methodologies in MIS: an update'', *Communications of the Association for Information Systems*, Vol. 14, pp. 526-42.

Pearson, J.M., Pearson, A. and Shim, J.P. (2005), ''The relevancy of information systems research: the practitioner's view'', *Information Resources Management Journal*, Vol. 18 No. 3, pp. 50-67.

Ponzi, L.J. (2002), ''The intellectual structure and interdisciplinary breadth of knowledge management: a bibliometric study of its early stage of development'', *Scientometrics*, Vol. 55 No. 2, pp. 259-72.

Price, D. (1963), *Little Science, Big Science*, Columbia University Press, New York, NY.

Rousseau, S. and Rousseau, R. (1998), ''The scientific wealth of European nations: taking effectiveness into account'', *Scientometrics*, Vol. 42 No. 1, pp. 75-87.

Rowlands, I. (2005), ''Emerald authorship data, Lotka's law and research productivity'', *Aslib Proceedings: New Information Perspectives*, Vol. 57 No. 1, pp. 5-10.

Schoepflin, U. and Glanzel, W. (2001), ''Two decades of 'Scientometrics': an interdisciplinary field represented by its leading journal'', *Scientometrics*, Vol. 50 No. 2, pp. 301-12.

Scott, L.C. and Mitias, P.M. (1996), ''Trends in rankings of economics departments in the US: an update'', *Economic Inquiry*, Vol. 34 No. 2, pp. 378-400.

Serenko, A. and Bontis, N. (2004), ''Meta-review of knowledge management and intellectual capital literature: citation impact and research productivity rankings'', *Knowledge and Process Management*, Vol. 11 No. 3, pp. 185-98.

Serenko, A. and Bontis, N. (2009), ''Global ranking of knowledge management and intellectual capital academic journals'', *Journal of Knowledge Management*, Vol. 13 No. 1, pp. 4-15.

Serenko, A., Bontis, N. and Grant, J. (2009), ''A scientometric analysis of the *Proceedings of the McMaster World Congress on the Management of Intellectual Capital and Innovation for the 1996-2008 Period* '', *Journal of Intellectual Capital*, Vol. 10 No. 1, pp. 8-21.

Serenko, A., Bontis, N. and Hardie, T. (2007), ''Organizational size and knowledge flow: a proposed theoretical link'', *Journal of Intellectual Capital*, Vol. 8 No. 4, pp. 610-27.

Serenko, A., Cocosila, M. and Turel, O. (2008), ''The state and evolution of information systems research in Canada: a scientometric analysis'', *Canadian Journal of Administrative Sciences*, Vol. 25 No. 4, pp. 279-94.

Sidorova, A., Evangelopoulos, N., Valacich, J.S. and Ramakrishnan, T. (2008), ''Uncovering the intellectual core of the information systems discipline'', *MIS Quarterly*, Vol. 32 No. 3, pp. 467-82.

Stewart, T.A. (1991), ''Brainpower: how intellectual capital is becoming America's most valuable asset'', *Fortune*, June 3, pp. 44-60.

Straub, D. (2006), ''The value of scientometric studies: an introduction to a debate on IS as a reference discipline'', *Journal of the Association for Information Systems*, Vol. 7 No. 5, pp. 241-5.

Wright, R.A. and Cohn, E.G. (1996), ''The most-cited scholars in criminal justice textbooks, 1989-1993'', *Journal of Criminal Justice*, Vol. 24 No. 5, pp. 459-67.

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