A scientometric analysis of the Proceedings of the McMaster World Congress on the Management of Intellectual Capital and Innovation for the 1996-2008 period

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Abstract

Purpose – This paper seeks to present a scientometric analysis of the Proceedings of the McMaster World Congress on the Management of Intellectual Capital and Innovation for the 1996-2008 period in order to better understand the evolution and identity of the discipline.

Design/methodology/approach – Qualitative and quantitative data analysis techniques were applied to determine author distribution, country, individual and institutional-level productivity rankings, and employed methodologies.

Findings – It was found that an average manuscript was written by 1.73 authors. The USA, Canada and the UK were the three most productive countries, which is consistent with prior KM/IC productivity research. Most productive institutions were the University of Calgary (Canada), Polytechnic University of Catalonia (Spain) and Universidad de Oviedo (Spain). The most productive individuals were James Falconer, Jose Maria Viedma Marti and Scott Erickson. Lotka's α, which represents the degree of conference delegate retention rate, was established as 2.7. Case studies were the most frequent method of inquiry, followed by framework development and literature reviews. Surveys and usage of secondary data were the leading empirical methodologies. Interviews, laboratory experiments, and field studies were under-represented.

Research limitations/implications – The findings offer valuable insights into the state and development of the KM/IC discipline and shed some light on its identity.

Practical implications – Scientometric analyses are of primary interest for academic researchers and therefore the practical implications of this study are limited.

Originality/value – The research reported is among the first to investigate the issue of the KM/IC discipline identity from a descriptive perspective.

Keywords Conferences, Knowledge management, Intellectual capital, Data analysis

Paper type Literature review

Introduction

The purpose of this study is to explore empirically the state and evolution of knowledge management and intellectual capital (KM/IC) research presented at the McMaster World Congress on the Management of Intellectual Capital and Innovation for the 1996-2008 period. For this, conference proceedings were subjected to various scientometric data analysis techniques to identify authorship distribution, most productive countries, institutions and individuals, publication frequency, and employed methodologies. The results offer valuable insights that help understand the discipline identify and make predictions on its future development.

The McMaster World Congress on the Management of Intellectual Capital and Innovation was initially launched in 1996 just as the field was in its embryonic stages (see Bontis, 1996). The major objective of this conference was to become the pre-eminent academic gathering for the field. The conference organizers utilized a unique strategy whereby the conference participants would include one third academic researchers, one third practitioners, and one third students. This novel approach ensured continuous momentum in the field as well as a coordinated research approach between academia and practice. The event has attracted thousands of delegates in the intervening years from over 50 countries. Eventually, it became the "annual go to" conference for the leading lights of the field. Over the years, there have been many innovative firsts launched at the conference, including several Special Issues in the *Journal of Intellectual Capital*, numerous best paper awards and best student paper awards, a popular knowledge café, several debates and expert panels, as well as hundreds of exhibitors.

In contrast to most other management fields, KM/IC is a relatively new area but it has been growing at an accelerated rate (Bontis, 1999, 2001). Even though its history only goes back to the 1990s, there are already 20 KM/IC-specific academic journals available, and various conferences are organized in all parts of the world. At this point, it is vital to establish KM/IC as a scholarly discipline recognized by the scientific community. Presently, academics who choose KM/IC as their primary field face several challenges. Among them, perhaps the most salient is the uncertainty whether their scholarly works are going to be acknowledged by their institutions, deans, and tenure and promotion committees and have an impact on their future academic careers. For example, it may be difficult to demonstrate the impact of publications, since none of the 20 KM/IC journals was indexed by Thomson Scientific as of 2008. The boundaries of the discipline are not clearly defined, and field identity is in its embryonic stage. Nevertheless, there are many prominent scholars who have made a substantial contribution to KM/IC development.

As such, in order to ensure long-term discipline success, the field's identity should be clearly established. The identity of a scholarly field may be defined from two perspectives – normative and descriptive (Benbasat and Zmud, 2003; Agarwal and Lucas, 2005; Neufeld *et al.*, 2007). The normative approach defines the boundaries of the field. The descriptive method portrays the actual state of the field and reports on activities of the scholars, for example who they are, what topics they pursue, and what methods of inquiry they employ. It views a discipline as a cumulative output of all field participants that form its current state. In the present study, the descriptive perspective is utilized since it is more suitable for a scientometric analysis of conference

proceedings. Specifically, the application of this approach allows an understanding of the evolution, current state, and future of the KM/IC area.

Scientometrics is referred to as a science about science; it is a distinct, recognized and well-established scholarly field with its own identity, history, theories, and methodologies. There are several prominent academics – for example, Robert King Merton, Derek J. de Solla Price and Eugene Garfield – who formed the foundation of scientometrics (Price, 1963; Garfield, 1972, 1979; Merton, 1973, 1976). Scientometric projects often present meta-analyses of topics and methodologies, identify the most productive individuals, institutions and countries, describe collaboration processes, report on citation and co-citation analyses, discover research anomalies, and conduct opinion surveys. The value of scientometrics has received recognition in most areas (see, for example, Straub, 2006).

Scientometric techniques have already been applied to the KM/IC field. For example, Serenko and Bontis (2004) conducted a meta-analysis of 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 Serenko and Bontis's work by examining the top 20 KM/IC articles and reported on objectivity and subjectivity in the field. Ponzi (2002) explored the intellectual structure and interdisciplinary breadth of the discipline. Harman and Koohang (2005) compared the publication frequency and topics of KM books with those in doctoral dissertations. Gu (2004b) analyzed similarities and differences between information management and knowledge management publications, and Gu (2004a) did a bibliometric analysis of global KM research. Serenko and Bontis (2009) developed a global ranking of 20 KM/IC academic journals by surveying 233 active field researchers. Despite these projects, the scarcity of scientometric studies in the KM/IC field is regrettable. To fill this gap, this study reports on a scientometric analysis of the proceedings of a leading KM/IC conference – the McMaster World Congress on the Management of Intellectual Capital and Innovation – with the purpose to understand better the evolution and identity of the discipline.

Literature review and research questions
The purpose of this section is to offer an overview of the extant literature and present five research questions.

Research productivity
The investigation of research productivity has been conducted in all recognized scientific disciplines (see, for example, Wright and Cohn, 1996; Athey and Plotnicki, 2000; Bapna and Marsden, 2002; Chua *et al.*, 2002). Knowing who are the most productive individuals, institutions and countries is important for various stakeholders (Manning and Barrette, 2005). First, perspective students, especially those interested in a future academic career, should be able to identify research centers concentrating on specific areas. For instance, a doctoral program applicant may want to know about an institution where he/she is likely to find a potential thesis advisor. Second, universities that demonstrate high-volume and high-impact scholarly output may improve their overall reputation, boost rankings, increase student enrolment, and be able to attract perspective faculty members. Academics with impressive research records find it easier to obtain external funding and co-operate with other prominent scholars. Third,

countries may use research productivity data for benchmarking and academic policy development. The extant literature offers a variety of research productivity studies that present their findings in terms of three distinct categories:

(1) countries;

(2) institutions; and

(3) individuals.

These scientometric investigations explore the phenomenon by drawing research output data from numerous outlets, such as select journals or conferences. For example, Erkut (2002) investigated research productivity and impact of Canadian academics, and Lowry *et al.* (2007) presents a list of 16 research performance assessment projects conducted in a relatively new field of management information systems. At the same time, except for a few notable, there are few documented attempts to investigate research productivity in the KM/IC domain (see, for example, Gu, 2004a; Serenko and Bontis, 2004).

On the one hand, a comprehensive research productivity report should cover all works in the KM/IC field, such as books, book chapters, journal articles and conference proceedings. On the other hand, evidence suggests that it is almost impossible to include all potential publication outlets in a single project. In fact, many prior studies analyzed publications with respect to a limited dataset, concentrating on a single journal (see, for example, Palvia *et al.*, 2007) or conference (see, for example, Culnan, 1987; Whitley and Galliers, 2007). With respect to the present project, the proceedings of the McMaster World Congress on the Management of Intellectual Capital and Innovation were selected. This is the first global conference in the field that has been run for over ten years and has continuously attracted large numbers of academics and practitioners. Therefore, it would be interesting to assess the development of the discipline from the perspective of this key event. The following research questions (RQs) are proposed:

RQ1. In terms of the proceedings of the McMaster World Congress on the Management of Intellectual Capital and Innovation, what is the country research output?

RQ2. In terms of the proceedings of the McMaster World Congress on the Management of Intellectual Capital and Innovation, what is the institutional research output?

RQ3. In terms of the proceedings of the McMaster World Congress on the Management of Intellectual Capital and Innovation, what is the individual research output?

Lotka's law
A fruitful approach for investigating author productivity is Lotka's law (Lotka, 1926). This method is well known in scientometrics research (Egghe, 2005; Rowlands, 2005) including the management domain (see, for example, Chung and Cox, 1990). Lotka's law suggests that there is a relationship between the number of published works p and the number of all authors $f(p)$ in a specific field: $f(p) = C/p^{\alpha}$, where C is the number of authors who published only one paper, and $\alpha = 2$ (α is a non-negative constant). The

purpose of the law is to predict the number of authors who published a certain number of papers in a particular scientific area. The law states that the number of authors publishing a certain number of papers is a fixed ratio to the number of scholars who produced only a single manuscript. For example, within a specific timeframe, there are expected to be one quarter as many authors with two papers as there are single-paper authors, one ninth as many with three, one sixteenth as many with four, etc. To the best knowledge of the authors, Lotka's law has not been applied in the KM/IC domain; therefore, the following research question is proposed:

RQ4. In terms of the proceedings of the McMaster World Congress on the Management of Intellectual Capital and Innovation, does the frequency of publication by authors follow Lotka's law?

Research methodologies

The investigation of research methodologies has a long-standing tradition in scientometric research (see, for example, Palvia *et al.*, 2003, 2004). Since KM/IC is one of the youngest business domains, researchers might not have time to develop their own inquiry methods. Instead, they are likely to utilize methodologies from reference disciplines, for instance, organizational behavior, strategy, psychology, etc. Each methodology has it own strengths, limitations and degrees of applicability. Anecdotal evidence suggests that KM/IC researchers tend to conduct case studies and surveys. Many works are theoretical and conceptual in nature. It is assumed that KM/IC researchers select methods based on their personal preferences, educational background, prior experience, intended audience, target outlet, topic under investigation and particular research question. Therefore, strong empirical evidence on research methodologies in KM/IC is needed:

RQ5. In terms of the proceedings of the McMaster World Congress on the Management of Intellectual Capital and Innovation, what research methodologies have been utilized?

Results interpretation

The authors of this project would like to advise the reader in advance that the findings of this scientometric study should be interpreted with caution. First, the proceedings of only one KM/IC conference were utilized for data analysis. On the one hand, the McMaster World Congress has become one of the leading events in the field. On the other, there are other KM/IC conferences that attract excellent, groundbreaking works. Many conferences in other management domains, for example, the Americas Conference on Information Systems, have also introduced KM tracks. Some researchers may also send their manuscripts directly to journals. These publications were omitted in this project. Second, research productivity measured in terms of paper count does not necessarily reflect research quality or impact. Third, the size of a faculty is often related to its volume of research; therefore, small departments may be disadvantaged. As such, the reader should bear in mind the arguments presented above when interpreting the findings. In fact, the authors of this project do not indicate the contribution that an individual, institution or country has made to KM/IC. No generalizability claims can be made with respect to more or less popular inquiry

methods. In this study, the authors only offered a realistic description of the discipline state at the McMaster World Congress.

Methodology and results
Authorship distribution
For the 1996-2008 period inclusive, 436 papers were published in the proceedings. In order to avoid a subjectivity bias, 37 manuscripts where at least one of the authors was affiliated with McMaster University were excluded from the analysis. Therefore, 399 papers were retained. Figure 1 outlines authorship distribution. It was discovered that 50 percent of all works were single-authored, and there were 1.73 authors per manuscript on average. The results of this authorship distribution are similar to those reported by Serenko and Bontis (2004), who indicated that 46 percent of KM/IC articles published in *JKM*, *JIC* and *KPM* were single-authored. In contrast, Serenko *et al.* (2008) state that only 35 percent of all papers published in the proceedings of the information systems division at the Administrative Sciences Association of Canada Conference are single-authored. Bapna and Marsden (2002) also claim that only 25 percent of journal articles written by Canadian business scholars are single-authored.

Research productivity
There are four approaches that may be employed to measure research output of multi-authored publications:

(1) normalized page size;

(2) straight count;

(3) author position; and

(4) equal credit (Howard *et al.*, 1987; Howard and Day, 1995; Scott and Mitias, 1996; Erkut, 2002).
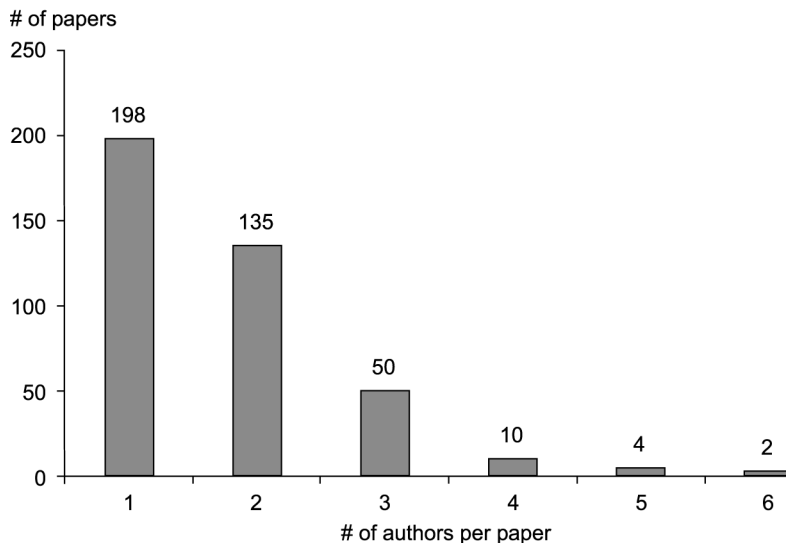

Figure 1.
Authorship distribution

Of these, the equal credit method was selected. This approach is more objective than the normalized page count and straight count methods. It is also less laborious than the author position method, but produces comparable results (Serenko *et al.*, 2008). Therefore, per-author, per-institution and per-country publication scores for multi-authored contributions were calculated by taking the inverse of the number of authors. For instance, for a two-author work, each received a score of 0.5, for a three-author manuscript, each was given a score of 0.33, etc. Tables I-III outline country, institution and individual research productivity scores. A substantial contribution by practitioners (individuals not affiliated with an academic institution) is noted. As such, practitioners' contribution was equivalent to that of all top ten academic institutions.

Lotka's law
Table IV outlines observed distribution frequencies for author count as well as the distribution predicted by Lotka with the suggested value of $\alpha = 2$. Given that the constant α ranges from 1.5 to 3 (Bonnevie, 2003) or even from 1.95 to 3.26 (Chung and Cox, 1990), it is important to establish an optimal value that reflects the nature of the discipline under investigation (Kretschmer and Rousseau, 2001). By following the line or reasoning offered by Newby *et al.* (2003), aggregated errors were calculated as sums of squared differences between predicted and observed numbers. As a result, $\alpha = 2.7$ is believed to produce the minimum total error and is recommended as an optimal value in this project. Lotka initially suggested the value of $\alpha = 2$ when approximately 60 percent of all authors would publish only a single paper. Serenko *et al.* (2008) obtained $\alpha = 2.4$ and found that 73 percent of all conference participants published one work. The value of $\alpha = 2.7$ is higher since 79 percent of all World Congress

	Country	Score
1	USA	81.67
2	Canada	70.13
3	UK	45.47
4	Spain	32.00
5	Australia	27.70
6	Finland	23.33
7	The Netherlands	12.67
8	France	11.50
9	Taiwan	9.50
10	Austria	7.50
11	India	6.00
12	China	5.00
12	Denmark	5.00
14	Italy	4.17
14	Switzerland	4.17
16	Brazil	4.00
16	Portugal	4.00
16	Turkey	4.00
19	Sweden	3.50
20	South Africa	3.33

Table I.
Country research
productivity

	School name	Score
1	University of Calgary	9.30
2	Polytechnic University of Catalonia	9.00
3	Universidad de Oviedo	8.83
4	Hanken University	7.50
4	Helsinki University of Technology	7.50
4	National Chengchi University	7.50
7	Ithaca College	7.33
8	Henley Management College	6.83
9	University of Toronto	6.67
10	La Trobe University	5.50
11	INHOLLAND University	5.00
12	Marist College	4.67
12	Vienna University	4.67
14	Université Marne La Vallée	4.50
15	Liverpool John Moores University	4.00
15	McGill University	4.00
17	City University of Hong Kong	3.50
17	Swinburne University of Technology	3.50
17	University of Aarhus	3.50
20	Lappeenranta University of Technology	3.00
	Practitioners	72.32

Table II.
Institution research
productivity

	Name	Score
1	Falconer, James	8.00
2	Viedma Marti, Jose Maria	7.50
3	Erickson, G. Scott	6.50
4	Ordonez, Patricia	5.33
5	Andriessen, Daniel	5.00
6	Bounfour, Ahmed	4.50
7	Tovstiga, George	4.33
7	Williams, S. Mitchell	4.33
9	Bhatti, Khalid	4.00
9	Dalkir, Kimiz	4.00
11	Rothberg, Helen	3.67
12	Bose, Sanjoy	3.33
13	Haldin-Herrgård, Tua	3.00
13	Kristandl, Gerhard	3.00
13	Smedlund, Anssi	3.00
16	Roos, Goran	2.90
17	Birchall, David	2.50
17	Bond, Peter	2.50
17	Chatzkel, Jay	2.50
17	Kong, Eric	2.50
17	Stam, Christiaan	2.50

Table III.
Individual research
productivity

Number of papers	Observed number of authors	Predicted number of authors ($\alpha = 2$)	Squared difference observed – predicted ($\alpha = 2$)	Predicted number of authors ($\alpha = 2.7$)	Squared difference observed – predicted ($\alpha = 2.7$)
1	393	393	0	393	0
2	71	98	743	60	111
3	17	44	711	20	10
4	5	25	383	9	19
5	2	16	188	5	10
6	3	11	63	3	0
7	2	8	36	2	0
8	4	6	5	1	7
9	0	5	24	1	1
10	0	4	15	1	1
Over 10	1	−111	12,557	1	0
Total	498	498	14,724	498	158

Table IV.
Lotka's law – author count distribution frequencies

attendees published a single manuscript. When applied to conference proceedings, α reflects the degree of attendee retention rate. In other words, there is a negative relationship between the value of Lotka's α and the extent to which a conference retains its past attendees.

Research methodologies

In order to identify research methodologies, a classification approach suggested in works of Palvia *et al.* (2003, 2004, 2007) with adjustments by Serenko *et al.* (2008) was followed. Up to two methodologies employed in each article were classified and are presented in Table V. Note that a category pertaining to a framework or conceptual model was extended to reflect the nature of the KM/IC field.

Discussion, conclusions, and future research directions

The purpose of this project was to conduct a scientometric study of the proceedings of the McMaster World Congress on the Management of Intellectual Capital and Innovation for the 1996-2008 period. During this project, several issues were identified that warrant attention.

First, KM/IC researchers tend to publish more single-authored works than their colleagues in other scientific domains. This is a normal attribute of a new discipline. When the field is new, it is relatively easy for a single author to produce a publication. As a scientific field matures, new theories, methodologies and concepts emerge. The literature base becomes more comprehensive. More scholars enter the field and increase competition for space in conference proceedings and academic journals that reduces acceptance rates. Reviewers' expectations rise, and the overall rigor of scientific works is expected to improve. Therefore, more collaboration is needed to ensure paper acceptance. In addition, researchers tend to gradually establish their personal research networks over time leading to increased collaboration in future.

No.	Methodology	1996-2002	2003-2008	1996-2008
1	Case study	21.88	25.12	23.57
2	Framework, model, approach, principle, index, metrics, or tool development	22.92	19.43	21.09
3	Literature review (work is based on existing literature)	21.35	18.48	19.85
4	Survey (administration of a questionnaire with open and/or close-ended questions)	15.10	11.85	13.40
5	Secondary data (use of existing organizational or business data, e.g., reports, statistics, etc.)	9.38	15.17	12.41
6	Interviews (asking respondents directly)	3.65	4.27	3.97
7	Speculation/commentary (based on personal opinions without empirical or literature support)	3.13	3.79	3.47
8	Meta-analysis of literature (e.g. the usage of techniques to summarize relationships, establish causal links, compare and combine previous findings, etc.)	0.00	0.95	0.50
9	Laboratory experiment (research in simulated laboratory environments by manipulating/controlling variables)	0.52	0.00	0.25
9	Field study	0.52	0.00	0.25
9	Mathematical model (an analytical or descriptive model for the phenomena under investigation)	0.52	0.00	0.25
12	Other qualitative research such as ethnography, action research, focus groups, interpretive study, examination of texts, or documents	1.04	0.95	0.99
13	Field experiment (research in organizational settings by manipulating/controlling variables)	0.00	0.00	0.00
	Total	100	100	100

Table V.
The usage of research methodologies (percentages)

Second, the USA, Canada, the UK, Spain and Australia were the most productive countries, which is consistent with prior KM/IC productivity research. The contribution of Finland and The Netherlands is also acknowledged.

Third, the three most productive institutions were the University of Calgary (Canada), the Polytechnic University of Catalonia (Spain) and Universidad de Oviedo (Spain). Fourth place was shared among Hanken University (Finland), Helsinki University of Technology (Finland), and National Chengchi University (Taiwan). In contrast to many other scholarly conferences, World Congress attracts a great number of practitioners who produce a considerable amount of an overall research output.

Fourth, the top five most productive contributors were James Falconer, Jose Maria Viedma Marti, Scott Erickson, Patricia Ordonez, and Daniel Andriessen.

Fifth, when applied to a conference, Lotka's α is believed to measure the degree of retention of conference delegates. As such, there is an inverse relationship between the value of α and delegate retention rate. A higher α value means that there are more authors who contributed to the proceedings only once. When applied to the entire scientific domain, α is believed to have a value of 2.0, with only 60 percent of one-work contributors. At the World Congress, α was found to be 2.7 with 79 percent of all attendees publishing a single manuscript.

Sixth, analysis of research methodologies revealed that case studies were most frequently employed by KM/IC scholars (24 percent), particularly, in the 2003-2008 period (25 percent). In fact, KM/IC is a practice-driven discipline with many active researchers working in the industry. This results in the production of multiple case studies that document their experience. The development of a framework, model, approach, principle, index, metrics, or tool was the second most widely utilized approach (21 percent), with a slight reduction in the second time period. In fact, such works are expected to dominate in an emerging discipline that requires strong theoretical base to ensure its future academic recognition and success. In addition, conceptual work-in-progress papers are common in conference proceedings; the purpose of many conference attendees is to share their preliminary ideas with peers to advance their research further towards empirical studies. It is for the same reason literature reviews were also presented very often (20 percent). The employment of surveys (13 percent) and secondary data (12 percent) were identified as leading empirical inquiry methods. At the same time, very few interview-based empirical works were found (4 percent). Speculations and commentaries that are based on personal opinions without empirical or literature support were very rare (3 percent). On the one hand, such papers are more suitable for practitioner outlets. On the other hand, when entirely new concepts are developed, no literature may exist to support the author's reasoning. Meta-analyses of literature (e.g. the usage of techniques to summarize relationships, establish causal links, compare and combine previous findings, etc.) are still under-represented in KM/IC research, which will hopefully change as the field matures. Other empirical methods, for example laboratory experiments and field studies, were extremely rare.

In terms of future research, numerous opportunities are open. First, it is desirable to replicate this project by analyzing proceedings of other KM/IC conferences, for example the International Conference on Intellectual Capital, Knowledge Management & Organizational Learning. Second, it is important to know what topics KM/IC scholars tend to investigate. This issue was omitted in the present project since no comprehensive KM/IC topic classification mechanism exists. Initially, a comprehensive keyword classification scheme of KM/IC topics should be developed, as has been successfully accomplished in other scientific domains (see, for example, Barki *et al.*, 1993). Third, a similar scientometric study should encompass the 20 KM/IC academic journals identified and ranked by Serenko and Bontis (2009). In this case, a comprehensive picture of the discipline identify will be obtained.

The field of KM/IC has had significant growth in the last decade and a half. Much of this growth can be attributable to McMaster University and the role it has played in hosting a world class conference. Ultimately, whether it is at McMaster or any of the other top producing institutions, the key element to driving a field's growth is the continued support of key individual researchers. At almost every single leading KM/IC institution is an individual who acts as a hub of activity. Collaborators are invited to join him, organizations are invited to share their experiences, and future PhD students are also groomed by that same individual. As the global number of KM/IC researchers increases, it is important that a supporting infrastructure be there as well. University administrators must recognize the burgeoning growth of the field and provide financial support where necessary in the form of research grants or conference funding. Furthermore, as many of the mature KM/IC researchers enter leadership positions

(with tenure) in their institutions, it will be important for them to mentor a new life-blood of researchers so that the momentum of inquiry does not abate.

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