Canadian Journal of Administrative Sciences
Revue canadienne des sciences de l'administration
25: 279–294 (2008)
Published online in Wiley Interscience (www.interscience.wiley.com). **DOI**: 10.1002/CJAS.73

The State and Evolution of Information Systems Research in Canada: A Scientometric Analysis

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Abstract
This paper investigates the state and evolution of information systems (IS) research in Canada as reflected in publications of the proceedings of the annual conference of the Administrative Sciences Association of Canada from 1974 to 2007. We present a scientometric analysis of (a) individual and institutional research outputs; (b) differences in three productivity score calculation methods: straight count, equal credit, and author position; (c) study topics; (d) research methods; and (e) use of student samples. Copyright © 2008 ASAC. Published by John Wiley & Sons, Ltd.

Keywords: information systems, scientometrics, research output, research productivity, research methods, discipline evolution

JEL classification: M15

Résumé
Cet article examine l'état et l'évolution de la recherche en systèmes d'information (IS) au Canada en se basant sur les publications contenues dans les actes des congrès annuels de l'Association des sciences administratives du Canada de 1974 à 2007. L'article présente une analyse scientométrique: (a) des résultats des recherches individuelles et institutionnelles; (b) des différences entre trois méthodes de calcul des scores de productivité, à savoir: le décompte direct, le crédit égal et la position de l'auteur; (c) des sujets d'étude; (d) des méthodes de recherche et (e) de l'utilisation des échantillons estudiantins. Copyright © 2008 ASAC. Published by John Wiley & Sons, Ltd.

Mots-clés : systèmes d'information, scientométrie, produit de la recherche, productivité de la recherche, méthodes de recherche, évolution de la discipline

The purpose of this project is to empirically explore the state and evolution of Information Systems (IS) research in Canada as reflected in papers published in the proceedings of the annual conference of the Administrative Sciences Association of Canada (ASAC) from 1974 to 2007. The annual conference of the ASAC has become one of the key academic events for many scholars, and the IS division has gained a strong reputation in the scientific community. For example, in 2006 ASAC attracted a record 650 delegates with IS being the third largest division. Many regular IS division attendees have published in—and served on editorial boards of—leading journals including: MIS Quarterly, Information Systems Research, Journal of Management Information Systems, Information & Management, Journal of the Association

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for Information Systems, and Communications of the Association for Information Systems. Furthermore, many papers published in the ASAC proceedings have been later published in strong peer-reviewed journals (e.g., Barki, Rivard, Sauve, & Talbot, 1986; Salisbury, Gopal, & Chin, 1995; Serenko & Turel, 2007; Straub, 1986).

Investigating the state and development of an academic discipline has a long-standing tradition. IS is a relatively young and growing area. Observing the evolution of an academic field in its early stages of development facilitates discipline progress (Serenko & Bontis, 2004). By understanding the past and present state of a scientific area, it is possible to identify influential academics, observe research gaps, discover understudied topics and explore methodological issues. This in turn helps in forming research agendas, guidelines, and standards. Since the conception of the IS field, many scholars have participated in ongoing debates relating to the nature, development, and future of IS as an academic field (Dearden, 1972). The first ASAC papers related to such debates appeared over 25 years ago (Klein & Welke, 1982), and such discussions persist (Benbasat & Zmud, 2003). A major argument is that the IS field needs to establish itself as a rigorous and recognized scientific domain, and it should at some point become a reference discipline. However, to plan on the future of an academic domain, it is critical to understand its various aspects. For this, IS researchers have engaged in theoretical overviews of the field (Benbasat & Zmud, 2003) and attempted to empirically investigate its various aspects such as individual and institutional productivity, publication impact, popular topics, methodologies, and so forth (Lowry, Karuga, & Richardson, 2007; Palvia et al., 2004). Many scientometric studies have analyzed the existing body of knowledge published in premier refereed journals or proceedings of reputable conferences (Culnan, 1987; Whitley & Galliers, 2007). In fact, it has been argued that scientometric studies are necessary to reflect on the past and present state of a field.

Scientometrics is a science about the state and development of science. It is based on the works of Robert King Merton, Derek J. de Solla Price, and Eugene Garfield (Garfield, 1972, 1979; Robert K. Merton, 1976; Robert King Merton, 1973; Price, 1963). It is a distinct academic field that has its own methods, theories, and history. Scientometric works investigate and describe the scientific field; for example, they report on research topics, utilized methods, leading researchers, institutions and countries, collaboration activities, co-citation analyses, research anomalies, and journal rankings. The importance of such projects has been recognized in all domains including IS (e.g., see Straub, 2006).

As such, numerous scientometric studies in the IS area were done that present a realistic description of the discipline. At the same time, an empirical perspective on the evolution of the IS field in Canada has been lacking. Accordingly, we offer the first scientometric analysis of the ASAC IS Division proceedings for the 1974–2007 period to identify: the most productive schools and individuals, the most frequently studied topics, and the most often used research methods. We look at these data at three different time periods separately (1974–1990, 1991–2000, and 2001–2007), and across all three periods (overall aggregate). Our analysis provides insight into the identity and development of the IS field (Price, 1963; Straub, 2006), focusing on the annual proceedings of the premier Business School Conference in Canada—ASAC.

Literature Review and Research Questions

Research Productivity

Institutional and individual research productivity has been assessed in all scientific fields including IS. Institutional research ranking is important for various stakeholders, including prospective students and sponsoring agencies; it may dramatically affect student enrolment, research grants allocation, alumni contributions, new faculty recruitment, and overall reputation. Various empirical studies have assessed institutional research output in IS with the oldest dating back to over 25 years ago (Hamilton & Ives, 1982).

In Canada, perhaps the most notable institutional ranking reports are the Maclean's *Annual Canadian University Guide* and the *Canadian Business School Research Output Report* by Erkut (2002). However, these publications do not provide rankings for the IS field in particular. Therefore, the following research question is proposed:

> *Research Question 1. In terms of the IS Division proceedings of the annual conference of the ASAC, what is the institutional research output? How has it changed over time?*

The study of individual research productivity also has a long-standing tradition in various scientific disciplines (Bapna & Marsden, 2002; Wright & Cohn, 1996). Individual productivity is important since it directly affects promotion and tenure, builds international reputation, and facilitates external collaboration. The findings of individual productivity projects are usually presented as a list of the most productive authors who have published in specific outlets. Consistent with this line of inquiry, we propose:

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Research Question 2. In terms of the IS Division proceedings of the annual conference of the ASAC, what is the research output of individual scholars? How has it changed over time?

At least three approaches have been used in IS to study research output: institutional research productivity surveys, article counting, and citation impact analysis (Chua, Cao, Cousins, & Straub, 2002; Lowry et al., 2007). Each method has its advantages yet suffers from specific problems. For instance, nonresponse bias may dramatically affect survey results. In article counting, different authorship allocation methods distort findings, and citation impact is affected by outlet choices (Egghe, Rousseau, & Van Hooydonk, 2000). With respect to the ASAC conference proceedings analysis, the article counting approach is the most appropriate because the purpose is to study productivity in terms of this specific outlet.

The calculation of per-author publication credit is a challenging task in cases of multiauthored manuscripts. At least four approaches may be used to assign scores to multiauthored publications: normalized page size, straight count, author position, and equal credit (Serenko & Bontis, 2004). In terms of the normalized page size method, productivity scores depend on the total number of pages of each paper (Scott & Mitias, 1996), which cannot be applied in the present study because almost all ASAC papers must adhere to a maximum page allowance, which is strictly enforced. Moreover, the quality and contribution of a longer manuscript is not necessarily higher than that of a shorter one. Based on the straight count approach, each author receives one (1) point regardless of the total number of authors. This, however, favours individuals coauthoring many papers. According to the author position method, scores are determined based on the formula suggested by Howard, Cole, and Maxwell (1987), which favours the ratings of first authors and diminishes the scores of the other ones. For instance, authors of a two-authored article would be given the scores of 0.6 and 0.4 respectively. Those of a four-authored manuscript would receive the scores of 0.415, 0.277, 0.185, and 0.123 respectively (Howard & Day, 1995). From the equal credit standpoint, a per-author credit is calculated by taking the inverse of the number of authors; an author of a solo-authored paper would receive one (1) point; each author of a two-authored publication would obtain a score of 0.5, and so forth. It is interesting to know the potential differences in rankings produced by these three productivity score allocation methods in IS:

Research Question 3. In terms of the IS Division proceedings of the annual conference of the ASAC, what are the differences in the institutional and individual research output calculated by (a) straight count, (b) author position, and (c) equal credit methods?

Research Topics and Methods

Many academics argue that the IS discipline may be defined from the descriptive perspective by portraying a "real discipline state" and reporting on actual scholarly activities, such as research topics and inquiry methods (Agarwal & Lucas, 2005; Neufeld, Fang, & Huff, 2007). The descriptive approach is also suitable for a scientometric analysis of journal publications or conference proceedings. IS academics have already conducted similar investigations by looking at specific journals or conferences (Palvia, Mao, Salam, & Soliman, 2003) or only at a single outlet (Palvia, Pinjani, & Sibley, 2007). The purpose of our scientometric analysis is to identify the profile and trends in IS research topics and methods of studies published in the ASAC proceedings from 1974 to 2007:

Research Question 4. In terms of the IS Division proceedings of the annual conference of the ASAC, what research topics have been investigated? How have they changed over time?

Research Question 5. In terms of the IS Division proceedings of the annual conference of the ASAC, what research methods have been used? How have they changed over time?

Empirical inquiry involving primary data from human subjects (e.g., surveys, interviews, and experiments) is frequently used by IS researchers. At the same time, some IS scholars, including ASAC participants, have expressed concern regarding the use of student samples (Compeau, Marcolin, & Kelley, 2001; Walstrom, 1996). On the one hand, the field of experimental economics advocates that theories may be successfully tested in laboratory and simulated settings if subjects are highly motivated, for example, through monetary incentives (Smith, 1987). On the other hand, results obtained from students may not necessarily generalize to target populations. For example, Peterson (2001) stated that "caution must be exercised when attempting to extend any relationship found using college student subjects to a nonstudent (adult) population" (p. 450). Similar concerns have been raised by others (Burnett & Dune, 1986; James & Sonner, 2001; Serenko, 2007). In the current study, we make no claim about the potential generalizability of results when using students as research subjects. Rather, we simply examined the extent to which researchers used student samples:

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Research Question 6. In terms of the IS Division proceedings of the annual conference of the ASAC, how often have researchers relied on student samples?

As such, the research questions above pertain to the institutional and individual research output, potential differences in three productivity calculation methods (i.e., straight count, author position, and equal credit), popular research topics, employed methods, and usage of student samples. With respect to research productivity measurement, research topics and methods, similar investigations have been conducted in the IS field. However, none of them were done in Canada. For example, it is known what research topics and methods the international IS community generally favours (Neufeld et al., 2007; Palvia et al., 2004; Palvia et al., 2003; Palvia et al., 2007). But how does the Canadian IS research compare to the rest of the world? The answer is yet unknown. In terms of the potential differences in productivity measurement approaches and the employment of student samples in IS, to our best knowledge, no empirical work has been conducted. Previous IS productivity projects utilized various measurement techniques, yet we do not know to which extent the results depend on the selected method. If a majority of the Canadian IS scholars rely on student samples, the generalizability of our scientific findings may be questioned. We believe that by answering these research questions, important recommendations and conclusions can be made to advance the Canadian IS field.

Method

As noted earlier, we analyzed the ASAC IS Division proceedings for the period from 1974 to 2007, except for 1978, 1979, and 1980, as we were unable to obtain the proceedings for these three years. Only articles published in full form in the proceedings were considered (i.e., no abstracts or panels).

The following variables were used in our analysis: author's name, affiliation, country of residence, number of authors, publication year, and article title. Article titles were collected to avoid duplicate entries. If an author had two affiliations, the first was chosen; we assumed that people list their more important affiliation first. Since the ASAC conference is a bilingual event (English and French), two English-speaking and two bilingual researchers proofread the list to identify double entries, misspelled names, and inconsistent affiliations.

Three methods were used to calculate individual and institutional productivity scores: (1) straight count (a score of one for each article regardless of the number of authors), (2) author position (as suggested by Howard et al., 1987), and (3) equal credit methods (a per-author credit is calculated by taking the inverse of the number of authors with each author getting an equal credit). To identify research topics, we employed the classification scheme developed by Barki, Rivard, and Talbot (1993). According to this classification approach, each topic is labelled under one of nine broad categories: A—Reference Disciplines, B—External Environment, C—Information Technology, D—Organizational Environment, E—IS Management, F—IS Development and Operations, G—IS Usage, H—Information Systems, and I—IS Education and Research. The structure of this scheme is multilevel (up to five levels) so that each topic may be uniquely classified. However, coding each topic up to the fifth level is not necessary given that the results are always presented up to three levels only to avoid a large number of categories with only a few cases each. Therefore, we coded each topic up to the third level only. We did not assess level A (Reference Disciplines) since it is rarely done in similar projects. To analyze research methods, a scheme proposed by Palvia et al. (2007, p. 2) was followed. Up to three topics and two methods were recorded for each article. Coding was done on full text. Each empirical article was reviewed to determine reliance on student samples, and there were two independent, trained coders for each paper. The overall inter-rater agreement was 83% and 94% respectively for research topics and for research methods. Discrepancies were discussed by the coders until agreement was reached. In several ambiguous cases, P. Palvia and his colleagues, whose methods classification approach was used in this project, were approached for assistance. To test intra-rater reliability, three months after the initial coding procedure was complete, each coder randomly selected 35 articles and coded them repeatedly. Each coder achieved 100% accuracy (i.e., the results of the second round of coding were absolutely identical to those of the first round), and it was concluded that intra-rater reliability was assured.

Data Analysis and Results

From 1974 to 2007 (excluding 1978–1980) a total of 358 papers (55 in French and 303 in English) were published by 682 authors. These 682 authors represent the total number of authors, including double counting; 366 unique authors were identified. To assess the evolution of IS research longitudinally, three periods were selected: 1974–1990; 1991–2000; and 2001–2007. Firstly, each period represents a distinct computing era: DOS-based applications, Graphical User Interface (GUI) / Windows OS, and electronic commerce, respectively. Secondly, the number of papers published in each period

was approximately equal. Figures 1 through 4 present authorship distributions. Each paper was written by an average of 1.9 authors. Longitudinally, this number was 1.8, 1.9, and 2.1, for each period. Only 1 of 18 papers in 2007 was single-authored. This reveals a trend towards multiauthored works that is also observed in other disciplines (Lipetz, 1999). As a scientific field matures, it becomes more difficult for a single researcher to produce high quality publications (Serenko & Bontis, 2004). Moreover, the trend may reflect the establishment of research networks among ASAC participants over time.

Institutional Research Output

To answer the first research question, institutional productivity was measured by three different methods. Overall, seventy-three unique academic institutions were identified: 35 of which were Canadian, 29 US, and 9 international (Australia, New Zealand, France, UK, China, and India; see Tables 1 through 4). We tried to keep the numbers at approximately 20 entries per table. This was difficult to achieve because of ranking ties in different periods and by using different methods. "Non-academic" refers to authors not affiliated with academic institutions (e.g., practitioners). With respect to the overall research output, Western, HEC, Queen's, Laval and Calgary have been consistently ranked in the top five. Some minor differences were observed longitudinally; for example, the output of UBC was higher in the first and second period.

Individual Research Output

The second research question pertained to the individual research output. For this, a similar analysis was performed to obtain individual productivity scores for 366 unique (i.e., excluding double counting) authors who were identified in the proceedings (see Tables 5 through 8). Only two papers were written by practitioners without the participation of academics. Of the 682 contributors (i.e., 682 includes double counting), 18, 58, and 68 were students in period one, two, and three, respectively,

Figure 1.
Authorship for 1974–2007

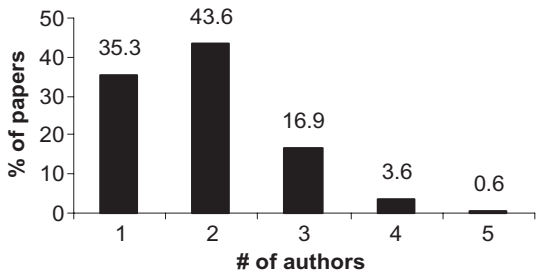

Figure 2.
Authorship for 1974–1990

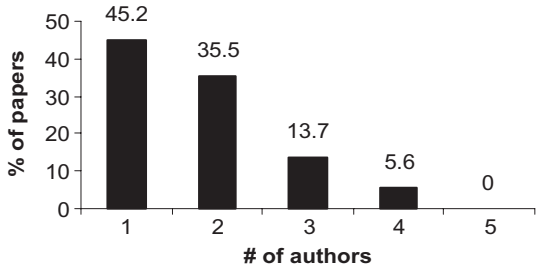

Figure 3.
Authorship for 1991–2000

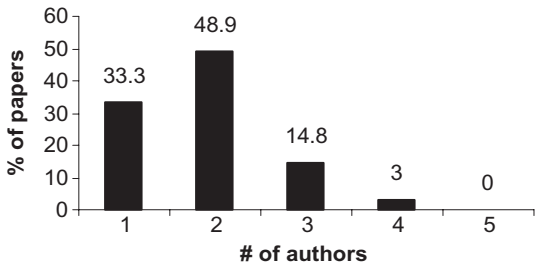

Figure 4.
Authorship for 2001–2007

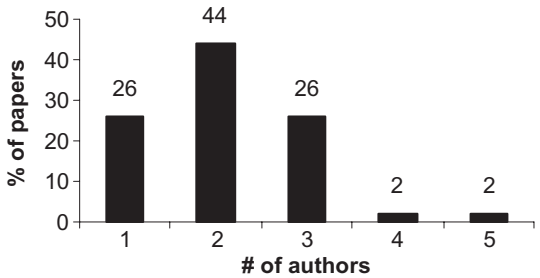

Table 1
Overall Institutional Research Output—Top Schools (1974–2007)

Straight count method		Author position method		Equal credit method	
Score	Affiliation	Score	Affiliation	Score	Affiliation
91	U of Western Ontario	44.836	U of Western Ontario	46.16	U of Western Ontario
89	HEC	44.509	HEC	44.04	HEC
63	Queen's U	36.462	Queen's U	35.41	Queen's U
47	U of Laval	20.639	U of Laval	20.41	U of Laval
34	U of Calgary	16.155	U of Calgary	16.74	U of Calgary
33	Carleton U	15.339	U of Quebec	15.33	Concordia U
32	U of Quebec	15.211	Concordia U	15.19	U of Quebec
25	Concordia U	13.801	UBC	14.00	UBC
25	Simon Fraser U	11.273	Carleton U	11.74	McGill U
24	UBC	11.215	McGill U	11.33	Carleton U
22	McGill U	10.600	McMaster U	10.41	Simon Fraser U
18	McMaster U	7.000	U of New Brunswick	10.00	McMaster U
17	Nonacademic	6.160	Nonacademic	7.00	U of New Brunswick
11	Lethbridge U	6.000	U of Toronto	6.82	Nonacademic
9	Florida International U	5.688	Lethbridge U	6.00	U of Toronto
8	Case Western Reserve	4.400	Case Western Reserve	5.58	Lethbridge U
8	U of Waterloo	4.000	Mount Saint Vincent U	4.50	Case Western Reserve
7	U of Ottawa	4.000	U of Waterloo	4.00	Mount Saint Vincent U
7	U of New Brunswick	3.400	Ryerson U	4.00	U of Waterloo
7	U of Toronto	3.790	York U	3.50	Ryerson U

Table 2
Longitudinal Institutional Research Output—Top Schools—Straight Count Method

Period one (1974–1990)		Period two (1991–2000)		Period three (2001–2007)	
Score	Affiliation	Score	Affiliation	Score	Affiliation
34	U of Western Ontario	33	U of Western Ontario	40	HEC
29	U of Laval	26	HEC	24	U of Western Ontario
23	HEC	25	Queen's U	22	Queen's U
16	Queen's U	22	U of Calgary	20	Carleton U
13	UBC	13	U of Quebec	17	Simon Fraser U
13	U of Quebec	12	U of Laval	15	Concordia U
12	Nonacademic	10	UBC	12	McGill U
7	U of Calgary	9	Carleton U	7	McMaster U
6	McGill U	9	Florida International U	6	U of Laval
6	Simon Fraser U	7	Case Western Reserve U	6	U of Quebec
5	McMaster U	7	U of New Brunswick	5	Lethbridge U
5	U of Toronto	6	Concordia U	5	U of Calgary
4	Carleton U	6	Lethbridge U	4	Victoria U of Wellington, NZ
4	Concordia U	6	McMaster U	3	Lakehead U
4	Mount Saint Vincent U	5	Nonacademic	3	U of Dayton
4	U of Ottawa	5	U of Waterloo	3	U of Georgia
4	U of Sherbrooke	4	McGill U	3	Wake Forest U
3	U of Waterloo			3	York U

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Table 3
Longitudinal Institutional Research Output—Top Schools—Author Position Method

Period one (1974–1990)		Period two (1991–2000)		Period three (2001–2007)	
Score	Affiliation	Score	Affiliation	Score	Affiliation
17.985	U of Western Ontario	15.461	U of Western Ontario	19.398	HEC
12.526	U of Laval	15.126	HEC	15.600	Queen's U
9.985	HEC	12.832	Queen's U	11.390	U of Western Ontario
8.030	Queen's U	10.544	U of Calgary	8.400	Concordia U
7.063	U of Quebec	7.000	UBC	6.185	Carleton U
6.590	UBC	7.000	U of New Brunswick	5.605	Simon Fraser U
5.000	U of Toronto	5.990	U of Quebec	4.926	McGill U
4.000	Mount Saint Vincent U	5.197	U of Laval	3.800	McMaster U
3.834	Nonacademic	4.000	Case Western Reserve U	2.916	U of Laval
3.800	Simon Fraser U	3.600	Concordia U	2.811	Lethbridge U
3.611	U of Calgary	3.400	McMaster U	2.286	U of Quebec
3.489	McGill U	3.396	Carleton U	2.200	Lakehead U
3.400	McMaster U	3.084	Florida International U	2.000	U of Calgary
3.211	Concordia U	2.877	Lethbridge U	1.800	U of Dayton
2.000	Indiana U	2.326	Nonacademic	1.790	York U
2.000	Lehigh U	2.800	McGill U	1.400	Victoria U of Wellington, NZ
2.000	National U of Singapore	2.400	Ryerson U	1.200	Brock U
2.000	U of Sherbrooke	2.000	U of Waterloo	1.011	U of Georgia
2.000	U of Waterloo	2.000	York U		

Table 4
Longitudinal Institutional Research Output—Top Schools—Equal Credit Method

Period one (1974–1990)		Period two (1991–2000)		Period three (2001–2007)	
Score	Affiliation	Score	Affiliation	Score	Affiliation
19.50	U of Western Ontario	15.00	U of Western Ontario	19.13	HEC
12.50	U of Laval	14.66	HEC	15.50	Queen's U
10.25	HEC	12.66	Queen's U	11.66	U of Western Ontario
7.25	Queen's U	10.91	U of Calgary	8.50	Concordia U
6.66	UBC	7.00	UBC	6.25	Carleton U
6.50	U of Quebec	7.00	U of New Brunswick	5.66	McGill U
5.00	U of Toronto	6.16	U of Quebec	5.41	Simon Fraser U
4.16	Nonacademic	5.08	U of Laval	3.50	McMaster U
4.00	Mount Saint Vincent U	4.00	Case Western Reserve U	2.83	Lethbridge U
4.00	Simon Fraser U	3.58	Carleton U	2.83	U of Laval
3.83	U of Calgary	3.50	Concordia U	2.53	U of Quebec
3.33	Concordia U	3.50	McMaster U	2.00	Lakehead U
3.08	McGill U	3.16	Florida International U	2.00	U of Calgary
3.00	McMaster U	3.00	McGill U	1.66	York U
2.00	Indiana U	2.75	Lethbridge U	1.50	U of Dayton
2.00	Lehigh U	2.66	Nonacademic	1.50	Victoria U of Wellington, NZ
2.00	National U of Singapore	2.50	Ryerson U	1.33	U of Georgia
2.00	U of Waterloo	2.00	U of Waterloo	1.00	Ryerson U
1.50	Carleton U	2.00	York U	1.00	Wake Forest U
1.50	Royal Military College				

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Table 5
Overall Individual Research Output—Top Authors (1974–2007)

Straight count method		Author position method		Equal credit method	
Score	Author	Score	Author	Score	Author
22	Huff, Sid	8.470	Rivard, Suzanne	9.39	Huff, Sid
20	Rivard, Suzanne	8.307	Huff, Sid	9.32	Rivard, Suzanne
15	Gallupe, Brent	7.390	Gallupe, Brent	7.65	Gallupe, Brent
12	Compeau, Deborah	7.000	Wang, Shouhong	7.00	Wang, Shouhong
10	Barki, Henri	5.000	Fertuck, Len	5.16	Raymond, Louis
9	Bergeron, François	4.931	Barki, Henri	5.08	Pinsonneault, Alain
9	Pinsonneault, Alain	4.884	Raymond, Louis	5.00	Fertuck, Len
8	Raymond, Louis	4.688	Pinsonneault, Alain	4.73	Compeau, Deborah
7	Chan, Yolande	4.532	Compeau, Deborah	4.58	Barki, Henri
7	Dexter, Albert	3.916	Glass, Richard	3.83	Glass, Richard
7	Gemino, Andrew	3.541	McKeen, James	3.66	Dexter, Albert
7	Marcolin, Barbara	3.442	Bergeron, François	3.50	Archer, Norm
7	McKeen, James	3.400	Archer, Norm	3.48	Bergeron, François
7	Munro, Malcolm	3.284	Dexter, Albert	3.41	McKeen, James
7	Paré, Guy	3.274	Bernier, Carmen	3.16	Chan, Yolande
7	Wang, Shouhong	3.200	Serenko, Alexander	3.08	Chin, Wynne
6	Archer, Norm	3.193	Gemino, Andrew	3.07	Gemino, Andrew
6	Bernier, Carmen	3.169	Paré, Guy	3.00	Fisher, Randall
6	Chin, Wynne	3.147	Aubert, Benoit A.	3.00	Gable, Guy G.
6	Croteau, Anne-Marie	3.088	Chin, Wynne	3.00	Kwon, Dowan
6	Talbot, Jean	3.074	Thompson, Ron	3.00	Serenko, Alexander
		3.026	Marcolin, Barbara	3.00	Vandenbosch, Betty
				3.00	Welke, Richard

which amounts to 21% overall. In these periods, there were 9%, 11%, and 16% of student-only papers (i.e., no faculty member or practitioner was listed as an author), or 12% of overall output. Even though we could not analyze best paper and honourable mention award recipients because of incomplete data, we observed that many students received awards.

The number of authors per paper written by the top three contributors (Sid Huff, Suzanne Rivard, and Brent Gallupe) was 2.59, 2.35, and 2.20, respectively. This exceeds a similar ratio of 1.9 for the entire dataset, suggesting that these three scholars collaborated on their proceedings papers to a greater extent than did the other authors who published in the ASAC proceedings. We also observed more longitudinal differences in individual than in institutional rankings. For example, Shouhong Wang was included in the top five list in period two only.

Differences in Research Output Depending on a Credit Calculation Method

The third research question referred to the potential differences in three productivity calculation methods: (1) straight count, (2) author position, and (3) equal credit. To answer this question, nonparametric Spearman correlations were calculated for the data presented in Table 1 and Table 5 for institutional and individual research output. All three methods correlated very strongly, ranging from 0.74 to 0.99. Especially equal credit and author position methods correlated almost perfectly with Spearman coefficients of 0.99 and 0.92 for institutions and individuals, respectively (see Table 9). Therefore, it is suggested that these methods produce very similar results and may be used as substitutes.

Research Topics, Research Methods, and Use of Student Samples

In order to answer the fourth research question, all research topics were classified (see Table 10). Total is presented for the first (aggregate) coding level. Subsequent levels are presented to visualize the distribution of topics. For External Environment (level B), mostly legal and social aspects were studied. The Information Technology (IT) Level (C) was represented by Computer Systems (CA) and Software (CB). In Computer Systems,

Table 6
Longitudinal Individual Research Output—Top Authors—Straight Count Method

Period one (1974–1990)		Period two (1991–2000)		Period three (2001–2007)	
Score	Affiliation	Score	Affiliation	Score	Affiliation
12	Huff, Sid	8	Huff, Sid	6	Compeau, Deborah
9	Rivard, Suzanne	7	Gallupe, Brent	5	Croteau, Anne-Marie
6	Gallupe, Brent	7	Wang, Shouhong	5	Gemino, Andrew
6	McKeen, James	6	Chin, Wynne	5	Rivard, Suzanne
6	Talbot, Jean	6	Compeau, Deborah	4	Barki, Henri
5	Barki, Henri	6	Rivard, Suzanne	4	Meister, Darren
5	Dexter, Albert	5	Archer, Norm	4	Mignerat, Muriel
5	Fertuck, Len	5	Higgins, Chris	4	Paré, Guy
5	Gingras, Lin	5	Vandenbosch, Betty	4	Pinsonneault, Alain
4	Bergeron, François	4	Aubert, Benoit A.	4	Serenko, Alexander
4	Glass, Richard	4	Chan, Yolande	3	Gopal, Abhijit
4	Parker, Drew	4	Marcolin, Barbara	3	Grant, Gerald
4	Raymond, Louis	4	Munro, Malcolm	3	Kwon, Dowan
3	Benbasat, Izak	3	Bergeron, François	3	Léger, Pierre-Majorique
3	Bernier, Carmen	3	Elam, Joyce	3	Reich, Blaize Horner
3	Bouchard, Lyne	3	Kao, Diana	3	Street, Christopher T.
3	Fisher, Randall	3	Kelley, Helen		
3	Munro, Malcolm	3	Kelsey, Barbara		
3	Pavri, Francis	3	Moore, Gary		
3	Welke, Richard	3	Murray, Elspeth		
		3	Newsted, Peter		
		3	Paré, Guy		
		3	Parent, Michael (student)		
		3	Pinsonneault, Alain		
		3	Robey, Daniel		

communications technologies such as networks, email, teleconferencing, telecommuting, instant messaging, and other telecommunication systems were studied. The IT Software level (CB) was mostly represented by topics on programming and databases. In periods one and two, the Organizational Environment Level (D) comprised culture, size, and structure aspects, whereas in periods two and three, the focus shifted towards organizational dynamics, such as business process reengineering and innovation. In period three, knowledge management became a leading topic. In terms of IS Management (Level E), IS evaluation was a predominant topic. There was a steady increase in strategy-related issues. Little interest was paid to security and global IT factors. With respect to IS Development and Operations (Level F), researchers concentrated on development of strategies, methods, and tools mostly in period one, whereas they covered IS implementation issues to a lesser extent but very consistently. With regard to IS Usage (Level G), more attention was paid to users and their characteristics in periods two and three. An interesting pattern was observed in the Information Systems Level (H). Firstly, electronic commerce/business, supply chain management, customer relationship management, and enterprise resource planning peaked in period three. Secondly, there was a dramatic, steady decrease in Decision Support Systems. Thirdly, no single IS was identified as a leading technology in any period. In other words, all IS types were covered to approximately the same extent over time. In terms of IS Education and Research (Level I), IS education papers were presented in period one only. Surprisingly, there was a decline in IS research issues in period two.

We also analyzed and coded all research methods as per the fifth research question (see Table 11). The development of a theoretical framework or a conceptual model was the most frequent inquiry method, followed by surveys, literature reviews, case studies, and interviews. Field studies, the usage of mathematical models, and field experiments were extremely rare. Some changes

Table 7
Longitudinal Individual Research Output—Top Authors—Author Position Method

Period one (1974–1990)		Period two (1991–2000)		Period three (2001–2007)	
Score	Affiliation	Score	Affiliation	Score	Affiliation
5.000	Fertuck, Len	7.000	Wang, Shouhong	3.200	Serenko, Alexander
4.978	Huff, Sid	3.088	Chin, Wynne	3.000	Kwon, Dowan
4.428	Rivard, Suzanne	3.000	Archer, Norm	2.800	Mignerat, Muriel
3.684	Gallupe, Brent	3.000	Vandenbosch, Betty	2.600	Street, Christopher T.
3.474	Raymond, Louis	2.905	Gallupe, Brent	2.400	Léger, Pierre-Majorique
3.331	McKeen, James	2.614	Huff, Sid	2.221	Compeau, Deborah
3.000	Fisher, Randall	2.547	Aubert, Benoit A.	2.011	Croteau, Anne-Marie
2.916	Glass, Richard	2.400	Kelsey, Barbara	2.000	Ortiz de Guinea, A. (student)
2.815	Barki, Henri	2.311	Compeau, Deborah	1.916	Rivard, Suzanne
2.400	Parker, Drew	2.126	Rivard, Suzanne	1.784	Paré, Guy
2.400	Welke, Richard	2.000	Pinsonneault, Alain	1.600	Zahir, Sajjad
2.257	Talbot, Jean	2.000	Wybo, Michael	1.593	Gemino, Andrew
2.211	Pavri, Francis	1.832	Higgins, Chris	1.516	Barki, Henri
2.074	Dexter, Albert	1.800	Chan, Yolande	1.474	Jenkin, Tracy A. (student)
2.063	Gingras, Lin	1.762	Marcolin, Barbara	1.421	Meister, Darren
2.000	Gable, Guy G.	1.600	Bergeron, François	1.411	Pinsonneault, Alain
2.000	Pliniussen, John	1.600	Gemino, Andrew	1.200	Addas, Shamel
2.000	Straub, Detmar	1.600	Kao, Diana	1.200	Caya, Olivier
2.000	Thompson, Ron	1.516	Moore, Gary	1.200	Gopal, Abhijit
2.000	Wiginton, John	1.516	Murray, Elspeth	1.200	Marcon, Teresa

were observed longitudinally. In period three, speculations/commentaries, field studies, and laboratory experiments declined. At the same time, as the field matured, more meta-analysis works were published.

Research question six pertained to the usage of student samples in empirical investigations. We observed that students were used in 14%, 19%, and 18% of studies in periods one, two, and three, respectively (17% on average).

We also compared research topics and methods reported in the proceedings of the ASAC conference with those identified in previous non Canada focused studies. Please refer to Table 11 for the comparison of research methods and topics respectively. Note that Palvia and his colleagues (2004; 2003; 2007) also utilized the Barki, Rivard, and Talbot (1993) classification approach but did not report research topics under the same labels as we did in Table 10. Therefore, we converted Palvia et al's. data to Barki et al's. label-based categories. Since Palvia et al. combined topics from levels B (External Environment) and D (Organizational Environment), so did we to be consistent with their reporting. Only by following the steps above was it possible to compare our results with those reported in prior non Canadian studies.

Discussion

Summary

The purpose of this study was to investigate the state and evolution of IS research in Canada. During the investigation, ASAC proceedings for the years from 1974 to 2007 were divided into three evolutionary periods and subjected to various scientometric data analysis techniques. Based on the findings, a number of implications with the purpose to better understand and advance the field are offered.

Contributions to Scholarship

By examining research disseminated through the IS Division of ASAC over three decades, our study fills a significant gap with respect to the state and evolution of IS work published in Canada form 1974 to 2007. Papers by 366 individuals from 73 schools were analyzed, a majority of them being from Canada, which is consistent with the ASAC mandate.

Consequently, Western, HEC, Queen's, Laval, and Calgary are universities that have consistently been the

Table 8
Longitudinal Individual Research Output—Top Authors—Equal Credit Method

Period one (1974–1990)		Period two (1991–2000)		Period three (2001–2007)	
Score	Affiliation	Score	Affiliation	Score	Affiliation
5.32	Huff, Sid	7.00	Wang, Shouhong	3.00	Kwon, Dowan
5.00	Fertuck, Len	3.24	Huff, Sid	3.00	Serenko, Alexander
4.33	Rivard, Suzanne	3.08	Chin, Wynne	2.50	Léger, Pierre-Majorique
3.66	Gallupe, Brent	3.00	Archer, Norm	2.50	Mignerat, Muriel
3.33	Raymond, Louis	3.00	Vandenbosch, Betty	2.50	Street, Christopher T.
3.08	McKeen, James	2.99	Gallupe, Brent	2.33	Croteau, Anne-Marie
3.00	Fisher, Randall	2.66	Rivard, Suzanne	2.33	Rivard, Suzanne
2.83	Glass, Richard	2.50	Kelsey, Barbara	2.32	Compeau, Deborah
2.83	Talbot, Jean	2.41	Compeau, Deborah	2.00	Ortiz de Guinea, A. (student)
2.50	Parker, Drew	2.16	Aubert, Benoit A.	1.83	Barki, Henri
2.50	Welke, Richard	2.16	Higgins, Chris	1.83	Pinsonneault, Alain
2.33	Dexter, Albert	2.00	Chan, Yolande	1.70	Paré, Guy
2.33	Pavri, Francis	2.00	Pinsonneault, Alain	1.66	Meister, Darren
2.25	Barki, Henri	2.00	Wybo, Michael	1.57	Gemino, Andrew
2.00	Gable, Guy G.	1.50	Bergeron, François	1.50	Gopal, Abhijit
2.00	Pliniussen, John	1.50	Gemino, Andrew	1.50	Zahir, Sajjad
2.00	Straub, Detmar	1.50	Kao, Diana	1.33	Jenkin, Tracy A. (student)
2.00	Thompson, Ron	1.41	Marcolin, Barbara	1.00	Addas, Shamel
2.00	Wiginton, John	1.33	Dexter, Albert	1.00	Caya, Olivier
1.99	Gingras, Lin	1.33	Moore, Gary	1.00	Gallupe, Brent
		1.33	Murray, Elspeth	1.00	Haggerty, Nicole
		1.33	Neufeld, Derrick (student)	1.00	Marcon, Teresa
		1.33	Newsted, Peter	1.00	Salisbury, David
		1.33	Parent, Michael (student)	1.00	Turel, Ofir

Table 9
Spearman Correlations for Different Productivity Calculation Methods (significant at 0.01 level)

	Direct count-equal credit	Direct count-author position	Equal credit-author position
Institutions	0.94	0.92	0.99
Individuals	0.79	0.74	0.92

top five contributors to IS publications in the ASAC proceedings. Knowing about key research schools is important for various stakeholders such as prospective students, job applicants, and granting agencies. Interestingly, the IS productivity of the University of Toronto, which is considered one of the leading research institutions in Canada, is somewhat low. In fact, the Rotman School of Management does not have an IS discipline, and many members of the Faculty of Information Studies investigate topics that are somewhat different from those traditionally presented at ASAC.

Our analysis shows that the evolution of Canadian IS research demonstrates signs of maturity with a trend of an increasing number of co-authored papers over time. From 1974 to 1990 (period one), many papers were written by nonacademics, with fewer such papers published from 1991 to 2000 (period two), and no such papers published between 2001 and 2007 (period three). It appears that Canadian IS research has gradually become purely academic in nature. Our findings are consistent with the findings of similar studies that have examined the outlets of other well known IS conferences (e.g.,

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Table 10
The Frequency of Research Topics in Percentage

Research topics	Period one (1974–1990)	Period two (1991–2000)	Period three (2001–2007)	% of Total
B—External environment (legal, political and social)				
Subtotal: B—External environment	**1.17**	**3.14**	**5.98**	**3.43**
C—Information technology				
CA—Computer systems (computer-based communications systems and the Internet)	2.92	4.93	2.72	
CB—Software (operating systems, algorithms, programming languages, databases)	1.75	4.93	1.09	
Subtotal: C—Information technology	**4.67**	**9.86**	**3.81**	**6.11**
D—Organizational environment				
DA—Organizational characteristics (culture, size, structure)	4.09	5.83	2.72	
DB—Organizational functions (departments)	0.58	3.14	1.09	
DC—Task characteristics	0.58	0.00	1.09	
DD01-DD04—Organizational dynamics (change, business process reengineering, innovation, information flows)	0.58	4.04	4.35	
DD06/7—Organizational learning, knowledge management, information flows	0.00	0.45	4.89	
Subtotal: D—Organizational environment	**5.83**	**13.46**	**14.14**	**11.14**
E—IS management				
EE—Project management	1.17	0.45	2.72	
EF—IS planning (methods, issues, objectives, strategic planning, and operational planning)	0.58	2.69	4.34	
EG—Organizing IS (issues, structure of IS function, centralization / decentralization)	2.92	5.83	2.17	
EH—IS staffing	0.58	0.45	1.63	
EI/EJ—IS evaluation and control	9.77	16.70	11.87	
EK—IS security	1.17	0.45	0.54	
EL—IS management issues (globalization)	0.58	0.90	0.00	
Subtotal: E—IS management	**16.77**	**27.47**	**23.27**	**22.50**
F—IS development and operations				
FA/FC—IS development strategies, methods and tools	15.20	6.28	5.43	
FD—IS implementation	5.26	4.04	5.43	
Subtotal: F—IS development and operations	**20.46**	**10.32**	**10.86**	**13.88**
G—IS usage				
GA—Organizational use of IS	9.36	7.17	12.50	
GB—Users (characteristics, attitudes, behaviors, types, and personalities)	2.34	6.28	4.89	
Subtotal: G—IS usage	**11.70**	**13.45**	**17.39**	**14.18**
H—Information systems				
HA– Executive IS	0.58	1.35	0.00	
HA—Decision support systems	9.94	2.24	1.09	
HA– Group decision support systems, negotiation and collaboration	2.92	5.83	0.00	
HA– Accounting IS	1.17	0.90	1.09	
HA– Interorganizational IS	0.00	0.45	1.09	
HA– Supply chain management, customer relationship management, and enterprise resource planning	0.58	0.90	5.43	
HA—AI-based systems and intelligent/interface agents (excluding decision support systems)	4.09	2.69	2.17	
HD—Electronic commerce/business and eGovernment	0.00	1.79	5.43	
HD—IS characteristics and features (graphical user interface)	1.75	1.8	1.09	
Subtotal: H—Information systems	**21.03**	**17.95**	**17.39**	**18.79**
I—IS Education and research				
IA—IS education	7.02	0.00	0.00	
IB—IS research	8.77	4.04	7.61	
Subtotal: I—IS education and research	**15.79**	**4.04**	**7.61**	**9.15**

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Table 11
The Usage of Research Methodologies in Percentage

Methodology	Period one (1974–1990)	Period two (1991–2000)	Period three (2001–2007)	Total %	Palvia et al. (2003)	Palvia et al. (2004)	Palvia et al. (2007)
Framework or conceptual model	33.79	22.07	24.55	26.80	15.00	11.60	6.89
Survey (administration of a questionnaire with open and / or close-ended questions)	18.62	24.14	23.64	22.13	24.00	22.00	41.54
Literature review (based on existing literature)	11.03	11.72	12.73	11.83	2.90	2.00	0.84
Case study	5.52	13.79	13.64	10.98	10.40	9.40	9.18
Interviews (asking respondents directly)	9.66	6.90	6.36	7.64	3.70	4.60	4.59
Laboratory experiment (research in simulated laboratory environments by manipulating / controlling variables)	6.21	8.97	2.73	5.97	12.50	11.20	8.56
Secondary data (use of existing organizational or business data, e. g., reports, statistics, etc.)	2.76	4.14	5.45	4.12	2.70	4.50	3.13
Meta-analysis	0.00	2.07	10.00	4.02	6.30	4.60	4.59
Speculation/commentary (based on personal opinions without empirical or literature support)	6.21	0.69	0.00	2.30	6.60	9.10	3.76
Field study	2.76	2.76	0.91	2.14	5.60	6.50	8.56
Mathematical model (an analytical or descriptive model for the phenomena under investigation)	2.76	1.38	0.00	1.38	7.30	10.30	3.76
Field experiment (research in organizational settings by manipulating / controlling variables)	0.69	0.69	0.00	0.46	2.20	2.60	2.09
Other qualitative research such as ethnography, action research, focus groups, interpretive study, examination of texts, or documents	0.00	0.69	0.00	0.23	0.80	2.10	1.88
Total	100	100	100	100	100	100	100

International Conference on Information Systems) and show that IS scholars constitute a community that collaborates more and more to produce quality works (Xu & Chau, 2006). Consistent with analogous investigations, the most productive authors (Sid Huff, Suzanne Rivard, and Brent Gallupe for our study) collaborated more on average than did others who published in the ASAC proceedings. This suggests that volume of publications and visibility in the academic community is likely to be enhanced through involvement in collaborative research. Knowing the most well published scholars (see Table 5) can be helpful as they serve as role models and as possible advisors or mentors for junior scholars. Another sign of the maturity of Canadian IS research is its capacity to attract new members, especially doctoral students; in addition to the established scholars with consistent publications over extended periods of time, the overall contribution of doctoral students was also evident. We believe that the IS division of ASAC has played a pivotal role in creating new generations of scholars; as such, students alone generated 12% of the entire research output published in the ASAC proceedings and received several awards. Our findings also show that student contribution has gradually increased; for example, two students were ranked in the top 20 category in period three. This is a very encouraging observation since it is essential for the future development of the field.

Although it was developed over 15 years ago (i.e., it was published in 1993), Barki and colleagues' classification scheme remains appropriate for coding IS research topics. However, we noticed that due to the evolution of the field overtime, the addition of two new categories may be necessary: knowledge management technologies and electronic commerce/business.

The above conclusions underscore the vitality of the ASAC conference as a key outlet for Canadian IS research. They also represent encouraging signals for newer IS researchers seeking to participate in the specialized division of ASAC.

Applied Implications

IS Management issues were the most frequently investigated topic (22.5%), followed by studies of various Information Systems (19%). Types of information systems examined varied longitudinally, and no leading system was identified. We believe that Canadian scholars mostly addressed the same issues typical of IS scholars internationally (see Table 12).

The three different score calculation methods that were used in the analysis (straight count, equal credit, and author position) generated similar results. Therefore, these methods may be potentially used as substitutes for one another to measure individual and institutional research output. At the same time, we warn future researchers that the employment of the straight count method may theoretically inflate the output of a scholar who tends to co-author a high number of publications. More research is required to understand the validity of this measurement technique.

To maximize chances of paper acceptance at ASAC, scholars should consider our findings on the types of IS studies published in the IS proceedings. Our analysis shows that the largest proportion of papers (26%) attempted to develop a theoretical model or framework. This is not surprising, since many conference submissions contain more conceptual work-in-progress compared to journal articles. The purpose of ASAC, as that of most other academic conferences, is to allow researchers to present their ideas at early stages in order to receive valuable feedback on their research questions, methodologies and findings, and to prepare a manuscript for

Table 12
The Frequency of Research Topics in Percentage—Comparison

Research topic	ASAC	Neufeld et al. (2007)	Palvia et al. (2003)	Palvia et al. (2004)	Palvia et al. (2007)
B&D—External & internal organizational environment	14.57	17.10	5.45	2.88	2.17
C—Information technology	6.11	19.23	12.53	15.06	8.96
E—IS management	22.50	18.38	28.44	31.15	32.30
F—IS development and operations	13.88	14.53	11.6	7.57	8.14
G—IS usage	14.18	5.98	7.85	12.13	16.86
H—Information systems	18.79	23.93	19.45	27.92	27.54
I—IS education and research	9.15	0.85	14.63	4.00	4.07
Total	100	100	100	100	100

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journal publication. Therefore, scholars who have a research idea in mind may want to initially submit a conceptual paper offering a preliminary framework or model. The feedback they receive from the conference could help in refining the model and in informing the design of an empirical study to test the model. Surveys were a very popular method of inquiry (22%), followed by case studies (11%), interviews (7.6%), and lab experiments (6%). Use of student samples was quite low (17%) and few scholars used secondary data (4%). Almost 12% of papers were based solely on literature reviews, whereas only 4% reported on literature meta-analyses. A dramatic increase of literature meta-analyses in period three is encouraging since it is a sign of academic maturity of the IS discipline. Speculations and commentaries, which are based on personal opinions of the authors without empirical or literature support, were extremely rare. Based on the comparison of our findings with those reported in four other studies that focused on international researchers (Neufeld et al., 2007; Palvia et al., 2003; Palvia et al., 2004; Palvia et al., 2007), it appears that Canadian IS scholars mostly employ the same research methods as their international counterparts. Their over reliance on student samples does not appear problematic.

Limitations

Similar to all scientometric studies, extra care should be taken when interpreting the results. Firstly, the proceedings of the annual convention of ASAC were analyzed. Even though ASAC has become a major event for many Canadian IS academics, there are other IS conferences that attract Canadian works. It is possible that some productive researchers select these events instead of ASAC, or simply prefer sending their manuscripts directly to journals. For example, Izak Benbasat, who is one of the most productive Canadian scholars, is listed in the top 20 authors in period one (1974–1990) only. This, however, does not reflect his actual contribution. Secondly, research production in terms of paper count may not reflect research quality or impact. Thirdly, the measurement approach, which counts the quantity of papers produced by each school, favours larger faculties. However, as it is impractical to track the yearly size of each IS department since 1974, it is therefore impossible to report on the number of papers adjusted to the department size. Overall, we do not claim that a specific IS academic or department is more or less productive; we simply attempt to present a realistic picture of the state and development of the discipline based on a specific methodology.

This investigation presents a descriptive approach according to which an actual state and development of the discipline was reported. We believe that any inquiry that helps scholars understand their past, realize their present, and plan their future is worth pursuing.

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Can J Adm Sci
25(4), 279–294 (2008)