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A Scientometric Study of Information Systems Conferences: Exploring ICIS, PACIS and ASAC

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ABSTRACT

This study examines one dimension of the evolution of the information systems (IS) field through a scientometric study of three major global, regional and national conferences: ICIS, PACIS and ASAC. The findings suggest that IS has matured and diversified over the years, since the number of publications and the average number of collaborators per publication have been growing. Using well-established scientometric laws the study further demonstrates that the productivity distribution of researchers in the IS field is in line with what is expected from an established domain with some noticeable characteristics. Implications for IS research are suggested.

Keywords

Scientometrics, conferences, ICIS, PACIS, ASAC, Lotka's Law, Yule-Simon's Law, productivity

INTRODUCTION

The purpose of this study is to analyze the proceedings of three important information systems (IS) conferences, the International Conference on Information Systems (ICIS), Pacific Asia Conference on Information Systems (PACIS) and IS Division of the Administrative Sciences Association of Canada Annual Conference (ASAC), in order to identify trends in research output, co-authorship distribution, most productive authors, and authors' productivity patterns. The results offer valuable insights on the past, present and future of IS as a distinct academic field.

Information systems is a relatively new academic discipline that has its own tradition and history. Since the birth of IS, scholars and practitioners have engaged in ongoing debates on the past, present and future development of the field (Dearden, 1972, Mason and Mitroff, 1973). In many cases, the discipline's identity has become a pivotal point of such discussions (Sidorova, Evangelopoulos, Valacich and Ramakrishnan, 2008). In the 80s, a number of frameworks guiding IS research appeared (e.g., see Ives, Hamilton and Davis, 1980). In the 90s, the field became more formalized; for example, a classification scheme for IS research appeared (Barki, Rivard and Talbot, 1993), and diversity issues within the discipline were debated (Robey, 1996, Benbasat and Weber, 1996). After that, the focus has shifted to several critical issues, such as the quest for an "IT Artifact," search for identity and establishment of relevance of IS research (Agarwal and Lucas, 2005, Benamati, Serva, Galletta, Harris and Niederman, 2007). It has been argued that, despite its history of over 30 years, the IS field has failed to acquire a distinct identity as a well-established reference discipline (Benbasat and Zmud, 2003).

In order to understand the evolution of the IS field, it is critical to explore one side of its intellectual core growth by analyzing the overall contribution to the body of knowledge. For this, scientometric approaches, principles, and techniques may be utilized. Whereas most previous IS scientometric projects concentrated on journals, the proceedings of well-recognized IS conferences received less attention. It may be advantageous, however, to examine conference proceedings as well, since these typically represent a broader range of research themes, some of which will not get into leading IS journals. To this end, the present project adapts several scientometric approaches to analyze works presented at three major IS events, ICIS, PACIS and ASAC (IS Division), with the purpose to better understand authorship evolution as a key dimension of the information systems growth.

LITERATURE REVIEW AND RESEARCH QUESTIONS

The identity of the IS discipline has been traditionally characterized from two perspectives: normative and descriptive (Neufeld, Fang and Huff, 2007). The normative approach establishes heuristics, rules, directions, and boundaries of the discipline. The descriptive method reports on the actual activities of IS researchers and depicts the observed state of the field by viewing the domain as an aggregate of dynamic and continuously changing scholarly outputs. In the present project, the descriptive method is followed because it is better suited to the empirical examination of the discipline's publication outlets.

Specifically, scientometrics offers insights on how to conduct descriptive studies of a scientific domain. From a descriptive perspective, scientometrics is a numerical facet of the science about science. It emerged from classical works of Robert King Merton, Derek J. de Solla Price and Eugene Garfield (Garfield, 1972, Price, 1963, Merton, 1976) as a distinct, respected and well-established field. By following scientometric lines of inquiry, researchers may explore a research field in depth. For example, they may perform meta-analyses of research topics, identify popular research methods, discover research anomalies, conduct opinion surveys, identify leading research individuals, institutions or countries, and observe author collaboration processes. This information in turn allows understanding the state and evolution of a scholarly domain from various perspectives.

The value of scientometrics has been already recognized in IS (Straub, 2006), and numerous projects have been conducted (Lowry, Karuga and Richardson, 2007, Vessey, Ramesh and Glass, 2002). Overall, such scientometric projects analyze IS as a scholarly domain by drawing on the data published in a select set of journals (Palvia, Leary, Mao, Midha, Pinjani and Salam, 2004, Palvia, Pinjani and Sibley, 2007). Recently, some scientometric researchers also started analyzing the body of knowledge presented in conference proceedings (Serenko, Bontis and Grant, 2009, Lister and Box, 2008, Serenko, Cocosila and Turel, 2008, Xu and Chau, 2006, Chan, Kim and Tan, 2006). There are several reasons why the focus has shifted from journals to conferences. First, it usually takes several years for a researcher to move from an idea to a journal article. Some outlets have up to two years of a backlog. As a result, journals often present obsolete findings that are already well-known to both researchers and practitioners (Booker, Bontis and Serenko, 2008). In contrast, conferences allow scholars to share and promote their ideas earlier. Second, there are views that some journals do not accurately represent the IS field in general since they are too specialized; for instance, some outlets favor specific topics or methodologies. As a result, there is a relationship between the 'nationality' of the journal, the 'nationality' of the author, and the place where the project was conducted. Sometimes, specific countries are overrepresented in particular outlets (Whitley and Galliers, 2007). For instance, most MIS Quarterly contributors are based in the USA. In contrast, conferences, especially international ones, are more diverse with respect to their audiences and therefore are more representative of general IS research.

Therefore, the present project is a scientometric investigation of papers published in the proceedings of three IS conferences: ICIS, PACIS and the IS Division of ASAC. It was believed that the analysis of these different events (i.e., international, regional, and national) may offer a realistic picture on the state and evolution of the broader global IS discipline. The rest of this section describes the proposed research questions in detail.

Since the birth of the modern science from the heyday of the Scientific Revolution in the seventeenth century, scholars have been continuously proposing new theories, conducted experiments, and challenged dogma. As a result, the cumulative body of knowledge has been growing exponentially in most disciplines. Despite its history of only over 30 years, IS may also boast a variety of academic journals, books, encyclopedias and conferences. But what is the trend with respect to the number of papers appearing in the proceedings of ICIS, PACIS and ASAC? It is expected that this number would be continuously growing reaching a saturation point determined by the capacity of each event.

Co-authorship is also an important phenomenon that has been widely explored in the scientometric literature (Narin, Stevens and Whitlow, 1991). Generally, it is believed that there is a positive relationship between a scholar's productivity and his/her tendency to cooperate with others (Inzelt, Schubert and Schubert, 2009); works produced through multi-author collaboration processes are of higher quality and cited more often. As a scientific domain matures, the average number of authors of each publication increases (Lipetz, 1999). First, researchers are able to establish their personal collaboration networks over time. Second, if a field develops, the body of knowledge grows, new techniques emerge, and the standard for paper acceptance rises (Serenko and Bontis, 2004). Therefore, it would be interesting to observe the evolution of cooperation patterns of IS scholars:

Research Question 1: What are the trends in an overall research output and co-authorship distribution at ICIS, PACIS, and ASAC?

The investigation of research productivity has been a frequent topic of scientometric investigations (Wright and Cohn, 1996, Bapna and Marsden, 2002). Knowing who the most productive scholars are is important for various stakeholders. With respect to academic conferences, organizers should be aware of the names of leading contributors. Doctoral students may

want to know who to approach to seek career advice. Academic institutions that continuously finance their faculty trips to the events want to see the impact of their investments. Traditionally, scientometric projects present individual research outputs in form of lists of most productive individuals. Therefore, we ask:

Research Question 2: Who are the most productive authors at ICIS, PACIS, and ASAC?

In addition to research trends, outputs and authorship distribution patterns, there are several laws that may also explain author productivity; among these are Lotka's Law and Yule-Simon's Law. Even though such laws have become widely recognized and applied in various scientific domains (Rowlands, 2005, Kuperman, 2006), with a few exceptions (e.g., see Nath and Jackson, 1991) they have been mostly ignored in IS research. Lotka's Law (Lotka, 1926) suggests that there is a relationship between the number of publications p and the number of authors $f(p)$ in a certain field:

$$f(p)= C/p^n \quad (1)$$

where C and n are non-negative constants (see the Methodology section for more details about C and n) and p = 1, 2, 3... According to this law, an approximate number of authors with a certain frequency of publications can be predicted. In fact, the number of scholars producing a certain number of papers is a fixed ratio to the number of individuals publishing only a single article (Egghe, 2005). For instance, during a specific period, there may be 1/4 as many authors with two papers as there are single-paper authors, 1/9 as many with three, 1/16 as many with four, etc.

The Yule-Simon's Law comes from a class of distributions first proposed by Yule (1924) and later explicated by Simon (1955). According to this rule, the frequency distribution is:

$$p(x) = (\alpha+1)\Gamma(x)\Gamma(\alpha+1)/\Gamma(\alpha+x+1) \quad (2)$$

where $\Gamma(x)$ is the Gamma function and $\alpha>0$ for x = 1, 2, 3… Similar to Lotka's Law, Yule-Simon's Law attempts to predict the values of a distribution where the number of observations is rapidly decreasing and, therefore, may be suitable to predict, among others, the distribution of authors by number of papers published (Chung and Cox, 1994). The following research question is proposed:

Research Question 3: Does the frequency of publications of authors at ICIS, PACIS, and ASAC follow Lotka's and Yule-Simon's Laws?

METHODOLOGY

The proceedings of the IS Division of ASAC (1974 – 2008), PACIS (1993 – 2008), and ICIS (1980 – 2008) were examined. In total, 32 proceedings were identified for ASAC (volumes for the 1978 – 1980 period were missing in the Canadian National Library), 11 for PACIS (the periodicity of PACIS has been between 1 and 3 years), and 29 for the annual ICIS. All papers published in the proceedings for each of these conferences were included in the analysis.

The following data were collected by two independent researchers to avoid potential mistakes: author's name, affiliation, article title, number of authors per article, and publication year. The tables were organized for each conference separately. The *observed frequencies* of the author names were compared to the *theoretical frequencies* produced by Lotka and Yule-Simon bibliometric laws. To measure author productivity, a straight count method was employed: each author received a score of one for each paper regardless of the total number of authors. Data were assessed longitudinally based on the following three periods: 1974-1990 (DOS-based applications); 1991-2000 (graphical user interface and Windows operating system); and 2001-2008 (electronic commerce, enterprise resource planning, and knowledge management).

To test Lotka's Law, numbers of authors having one, two, three, etc. publications were calculated and compared to the numbers produced by Lotka's Law (equation (1)) according to the methodological approaches in similar works (Newby, Greenberg and Jones, 2003, Rowlands, 2005). Given controversies regarding the per se applicability of the initial formula suggested by Lotka (having the value of the constant n=2), several index values attempting to produce a better fit of the theoretical law to the observed distribution were also tested (Bonnevie, 2003). In calculations, the C coefficient corresponded to the number of authors with only one paper.

To test the Yule-Simon distribution law, the value of the frequency distribution function was calculated according to equation (2) for each x corresponding to the number of publications. The value was then corrected with the total number of authors taken into account. Similarly to Lotka's Law estimation, different values for the coefficient α were tested in an attempt to produce the best fit.

RESULTS

Overall Research Output and Co-authorship Trends

Figure 1 outlines the trends in the numbers of papers in the conference proceedings. It shows a general increase in the number of papers presented at all three conferences with the largest values attained in 2008 for ASAC and ICIS (23 and 207 manuscripts, respectively) and in 2004 for PACIS (222 manuscripts).

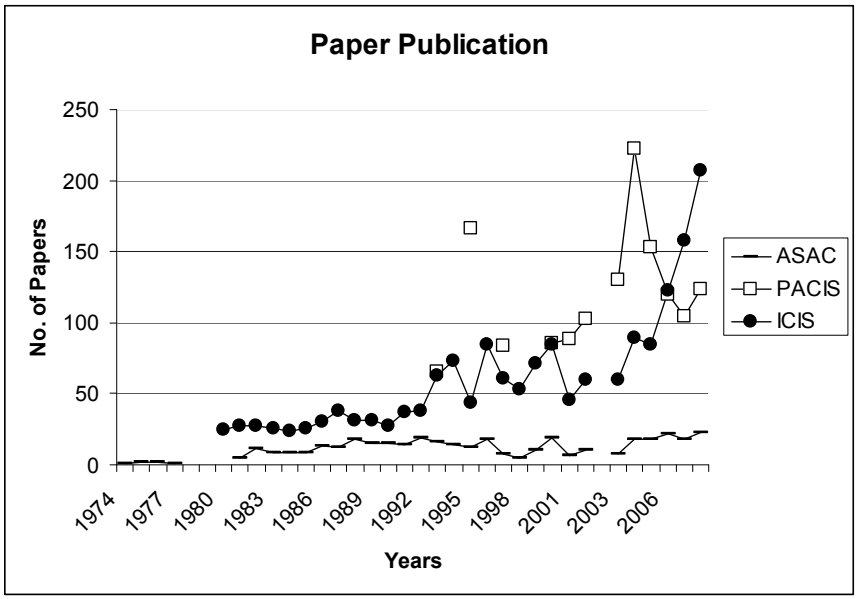

Figure 1. Number of Papers Published over Time

In order to investigate co-authorship distribution, the cooperativity index was calculated as the ratio between the total number of authors and the total number of papers at each conference for each year. Figure 2 represents the trend of this index over time. It was observed that there has been a steady increase in cooperation at each conference. This means that IS researchers have been gradually increasing their cooperation and producing more multi-authored works. By 2001-2008 period, at ICIS and PACIS each paper was written by 2.5 researchers on average, and at ASAC by 2.07 (Table 1).

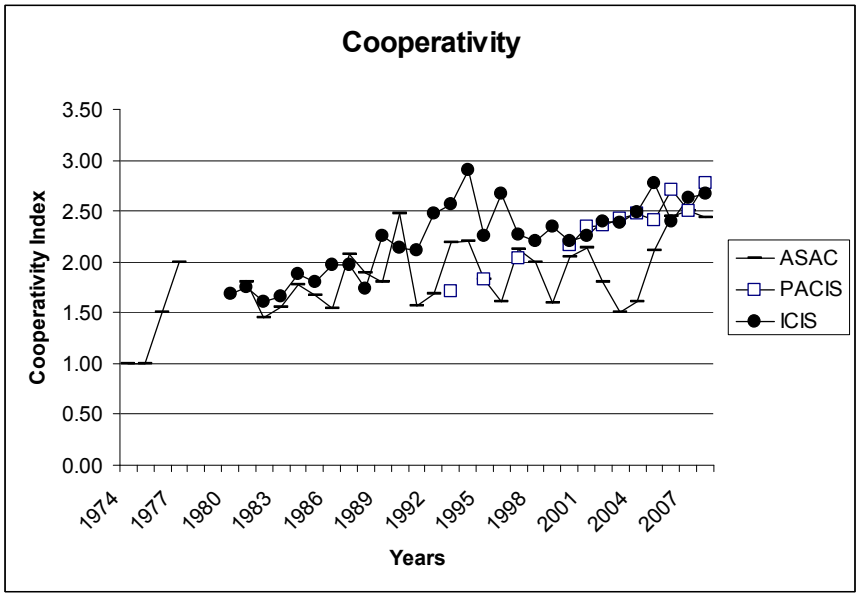

Figure 2. Co-authorship Distribution over Time

Period	Average No of Papers / Conference			Average Author Cooperativity Index		
	ASAC	PACIS	ICIS	ASAC	PACIS	ICIS
1974-1990	8.71	n/a	28.64	1.68	n/a	1.86
1991-2000	13.50	100.50	61.00	1.89	1.94	2.40
2001-2008	15.50	130.63	103.50	2.07	2.50	2.50

Table 1. Average Number of Papers and Average Cooperativity Distribution for Three Historic Periods

Most Productive Authors

A total of 392, 2,291 and 2,368 authors published at ASAC, PACIS and ICIS, respectively. For each conference, by far the largest percent of authors had just one contribution: 72.19% at ASAC, 73.59% at PACIS and 69.38% at ICIS. The remaining categories of authors had generally between 2 and 10 contributions. Very few authors had above 10 contributions. Table 2 presents the most productive ten authors ranked based on their total contributions numbers.

ASAC		PACIS		ICIS	
No of Papers	Author	No of Papers	Author	No of Papers	Author
23	Sid Huff	18	Brian Corbitt	21	Andrew Whinston
20	Suzanne Rivard	16	Guy Gable	19	Erik Brynjolfsson
15	Brent Gallupe	15	Kwok Kee Wei	19	Hock-Hai Teo
12	Deborah Compeau	13	Paul Jen-Hwa Hu	19	Kwok-Kee Wei
10	Henri Barki	13	Chih-Ping Wei	16	Benn Konsynski
10	Andrew Gemino	12	Doug Vogel	16	Kalle Lyytinen
9	Francois Bergeron	11	Lihua Huang	16	Bernard Tan
9	Alain Pinsonneault	11	Mohammed Quaddus	15	Jay Nunamaker Jr.
8	Anne-Marie Croteau	10	Fu-Ren Lin	14	Gerardine DeSanctis
8	Guy Paré	10	Darshana Sedera	14	Ramayya Krishnan
8	Louis Raymond			14	Ron Weber

Table 2. Most Productive Authors

Lotka's and Yule-Simon's Law Analysis

Lotka's Law was applied to the distributions for the datasets pertaining to each conference individually. Consistent with previous projects, the value of 15 was used as a cut-off value for the highest number of contributions. The procedure described by Newby and colleagues (2003) was used, followed by the standardization suggested by Burell (2004). An index n=2 was applied initially, and aggregated errors were calculated as weighted sums of squares of differences between the observed frequencies and those predicted by the theoretical law.

Since Lotka's distribution index found in various studies generally ranged between 1.5 and 3 (Bonnevie, 2003), successive trials for the index n varying between these extreme values were conducted. The index corresponding to the smallest aggregated error for each data set was recorded as 'optimal' (i.e., that provides the best fit). The following optimal indices were found: 2.21 for the ASAC dataset, 2.46 for PACIS and 2.26 for ICIS. Table 3 outlines the observed distribution of frequencies for author count and the distribution predicted by Lotka's Law with the optimal value of the index n for each dataset.

Author Productivity	ASAC (n=2.21)		PACIS (n=2.46)		ICIS (n=2.26)	
	Observed No of Authors	Expected No of Authors	Observed No of Authors	Expected No of Authors	Observed No of Authors	Expected No of Authors
1	283	271.54	1686	1714.13	1643	1670.33
2	43	58.69	347	311.54	364	348.72
3	21	23.95	128	114.90	148	139.48
4	15	12.68	50	56.62	72	72.80
5	6	7.75	26	32.70	43	43.97
6	6	5.18	22	20.88	23	29.12
7	7	3.68	11	14.29	16	20.55
8	3	2.74	7	10.29	14	15.20
9	2	2.11	4	7.70	11	11.65
10	2	1.67	2	5.94	7	9.18
11	0	1.36	2	4.70	9	7.40
12	1	1.12	1	3.80	2	6.08
13	0	0.94	2	3.12	5	5.07
14	0	0.80	0	2.60	3	4.29
15	1	0.68	1	2.19	1	3.67
Total	390	390	2289	2289	2361	2361

Table 3. Lotka's Law Tests

The Yule-Simon Law was tested by using the procedure described by Kuperman (2006). To have at least 5 records in each cell, a cut-off point of 10 author contributions was used, and authors having between 8 and 10 papers were grouped together. Several values between 0 and 1 were tested for the parameter α; for each of them, the aggregated errors were calculated through the procedure described by Burell (2004). Through several trials, the 'optimal' values for *alpha* were found as 0.36 for the ASAC dataset, 0.41 for PACIS, and 0.60 for ICIS. Table 4 depicts the distribution of frequencies observed and those predicted by Yule-Simon's Law with the optimal value of the index α for each dataset.

Author Productivity	ASAC (a =0.36)		PACIS (a =0.41)		ICIS (a =0.60)	
	Observed No of Authors	Expected No of Authors	Observed No of Authors	Expected No of Authors	Observed No of Authors	Expected No of Authors
1	283	293.92	1686	1712.05	1643	1680.26
2	43	67.11	347	404.26	364	453.70
3	21	18.72	128	114.99	148	139.52
4	15	5.67	50	35.30	72	45.27
5	6	1.79	26	11.30	43	15.12
6	6	0.58	22	3.71	23	5.14
7	7	0.19	11	1.24	16	1.77
8-10	7	0.02	13	0.14	32	0.22
Total	388	388	2283	2283	2341	2341

Table 4. Yule-Simon's Law Tests

DISCUSSION AND CONCLUSIONS

This study advances the understanding of the past, current and future states of IS research by taking a descriptive perspective, and exploring three scientometric research questions. The first question has focused on the trends in the overall research output and co-authorship distribution at ICIS, PACIS, and ASAC. The results demonstrate that, as expected, there is a global natural growth both in the number of IS conference publications and in the collaborative efforts exerted by researchers in the IS field. This indicates that the IS field has been making progress and, very likely, has not yet reached saturation and full maturity. In the future, we may expect more inter-researcher collaboration and more global conference publications.

The second research question has focused on the most productive authors at ICIS, PACIS, and ASAC. The results reveal some familiar names, but most importantly show that there is variation across researchers and conferences. It is very likely that some scholars pick a conference or two with which they become comfortable. They further develop certain loyalty to this conference and continue publishing in this outlet of their choice (in some cases more than 20 papers).

The third research question concentrated on two scientometric laws dealing with authorship distributions. The results provide some insights on the IS discipline, and its similarity, in terms of patterns, to other fields. Prior work found that the author count distribution frequencies for various domains do not strictly follow Lotka's Law. The coefficient n that Lotka found to be 2, what made the relationship to be called an "inverse square law of scientific productivity" (Lotka, 1926, p. 320), is probably dependent on the field and its age (Kretschmer and Rousseau, 2001). Since no calculation of a coefficient for the IS field was found in the literature, and even the verification of Lotka's law for IS research is an issue still under debate (Nath and Jackson, 1991), we attempted to fit Lotka's Law to three datasets from three distinct conferences: ICIS, PACIS and ASAC. In each of these cases we found values above the theoretical value of 2.00 to produce the best fit between observed and predicted distributions: 2.26, 2.46 and 2.21, respectively (Table 3). These results are confirmed by the percents of the authors with only one contribution: 69.38% for ICIS, 73.59% for PACIS, and 72.19% for ASAC. All these are above the 60% level predicted by Lotka's theoretical distribution (with n=2). A possible explanation is that all three conferences examined have a strong international dimension and high admission standards and, therefore, the vast majority of the scholars were able to participate just once. Therefore, attempts should be made to retain this category of participants for future conference editions.

The same remarks can be made about Yule-Simon's Law. We did not find previous research applying this distribution law in IS. We demonstrated that the law is roughly applicable and even found 'optimal' values of the parameter α. However, a visual inspection of Tables 3 and 4 shows Yule-Simon's Law to provide a worse fit than Lotka's Law. As previous research showed, Yule-Simon's Law provided a good fit for situations where the first data category (i.e., x=1) represents approximately 50% of all data set (Chung and Cox, 1994). But as for our datasets the percent was between 69.38% and 73.59%, the fit was poorer than that provided by Lotka's Law. The theoretical condition of Lotka's Law (to have 60% authors with one contribution) is not met either by our datasets but, however, the differences between observations and predictions are smaller in this case. Obviously, more research is necessary to confirm our findings for other publication venues. When applied to a conference, both Lotka's and Yule-Simon's Law reflect the degree of retention of conference delegates. The lower the fraction of researchers who publish only a single work in the conference proceedings, the higher is the conference delegate retention rate.

This project has several limitations. First, there were inconsistencies in author names in different proceedings volumes; therefore, some omissions were possible. Second, caution should be exerted in generalizing the 'optimal' indices found in this research. The procedures we used are still debated in the scientometric literature, and it can be hardly argued that these coefficients are applicable to IS in general. More research on other datasets and more tests on these laws' suitability for IS in general are expected.

An important discussion issue regards the selection of the conferences for our study and the generalizability of the findings to representative IS conferences. Thus, the three conferences we selected are not exactly comparable:

- While PACIS and ICIS are conferences dedicated exclusively to information systems, ASAC is a multi-division conference;
- The number of articles from ASAC proceedings is much lower compared to those of the other two conferences, although the period of time examined is much larger;
- Although ASAC and PACIS have a geographical framework (Canada and Pacific and Asia, respectively), they have a strong international component whereas ICIS is international by definition.

However, the possibility to compare the authorships patterns identified in three different settings (national, regional, and international) was considered to be an asset as offering important conclusions on the comparability of the results. Nonetheless, future research should examine more IS representative conferences (as, for instance, the Americas Conference on Information Systems or the European Conference on Information Systems) to identify whether theoretical bibliometric distributions could be fitted to observed distributions. However, by bringing new conferences into the picture, there is a likelihood of a larger proportion of more regional submissions and, thus, cultural influences on collaboration and co-authorship on writing articles might intervene.

An interesting comparison would be between proceedings of IS-only conferences and general conferences also comprising IS tracks (or divisions). An equally interesting comparison would be between IS conferences proceedings and some IS leading journals. A possible direction of future research should look at possible cultural aspects regarding the co-authorship on papers; e.g., do papers coming from some continents (i.e., academic environments) tend to have more authors compared to papers coming from other continents?

This study explored the state and evolution of the IS field through the lens of ICIS, PACIS and ASAC conferences. The findings suggest that the IS field has been in a constant process of maturation and diversification, and that the collaboration among researchers has been growing. This is a positive signal about the future of the field, which seems to be on an encouraging trajectory towards full maturity. We, therefore, would like to encourage other researchers to periodically examine the field and its progress in order to generate a more nuanced understanding of where the discipline is currently at, and where it is headed to.

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