

Profiling a Decade of *Information Systems Frontiers*' Research

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Abstract. This article analyses the first ten years of research published in the *Information Systems Frontiers (ISF)* from 1999 to 2008. The analysis of the published material includes examining variables such as most productive authors, citation analysis, universities associated with the most publications, geographic diversity, authors' backgrounds and research methods. The keyword analysis suggests that *ISF* research has evolved from establishing concepts and domain of information systems (IS), technology and management to contemporary issues such as outsourcing, web services and security. The analysis presented in this paper has identified intellectually significant studies that have contributed to the development and accumulation of intellectual wealth of *ISF*. The analysis has also identified authors published in other journals whose work largely shaped and guided the researchers published in *ISF*. This research has implications for researchers, journal editors, and research institutions.

Keywords: Information Systems Frontiers (ISF), IS Research, Meta-Analysis, Research Method, Research Profile

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1 Introduction

Information Systems Frontiers (ISF) is a high-ranking research journal, and a premier journal focusing on the frontiers of IS. Within a short period of time *ISF* has emerged as a quality outlet for publishing IS research in all three regions of the Association of Information Systems (AIS). For example, The Australian Council of Professors and Heads of Information Systems (ACPHIS) have listed *ISF* with other high-quality journals in the 'A' Class category² (also see Clarke 2008). Similarly, the UK's Association of Business School's Journal Ranking has included *ISF* within the list of high-quality IS outlets³.

Such recognition within a short period of time was attained through *ISF*'s unique editorial focus, and the composition of its advisory and executive board. As described on the homepage of the journal, *Information Systems Frontiers (ISF)* aims to provide a common forum of dissemination of the frontline industrial developments of substantial academic value and pioneering academic research of significant practical impact (*ISF* homepage⁴). From the onset, *ISF* has had a multidisciplinary approach which draws from both well-established fields such as computer science, telecommunications, operations research, economics, and cognitive sciences and the emerging areas which include enterprise modeling and integration, object/web technologies, information economics, IT integrated manufacturing, medical informatics, digital libraries, mobile computing, and electronic commerce (*ISF* homepage). The aim of the journal and its multidisciplinary approach is reflected in the composition of *ISF* Advisory Board members which include Noble Prize winners (e.g. Kenneth Arrow, *Stanford University*), National Academy of Engineering members (e.g. Arun Netravali, *Past President of Bell Labs and Chief Scientist of Lucent*) and Captains of industry (e.g. Ellen M. Knapp, *PricewaterhouseCoopers*; Satyen N. Mukherjee, *Philips Research Laboratories*; Narayana N.R. Murthy, *Infosys Technologies Ltd.*; and Suek Namgoong, *Samsung Data Systems*). The board also includes some of the renowned academics from various discipline including principal founder and intellectual architect of the academic field of information systems - Gordon Davis, *University of Minnesota*; and economist, computer scientist and winner of the LEO Award for Lifetime Exceptional Achievement in Information Systems - Andrew B. Whinston, *University of Texas at Austin* (*ISF* homepage⁵).

2008 was an important milestone for *ISF* since its publication started off with its inaugural issue in 1999 (Ramesh and Rao 2008). On this occasion the *ISF* editors (see Ramesh and Rao 2008, p1-2) reflected on some of the journal's achievements over the past ten years, including the fact that "ISF has indeed provided a vibrant forum for both academicians and industry specialists to explore the multiple frontiers of the IS/IT field and has brought innovative research on all aspects of IS/IT from analytical, behavioral and technological perspectives" (Ramesh and Rao 2008, p1-2). One of the ways in which *ISF* achieved its aim to be frontiers of IS was by commissioning cutting-edge special issues that were guest edited by leading experts of the area from across the globe on a wide range of topics. Examples of such topics include – Information Dynamics, IT Investment Payoffs, Cyber Law, Knowledge Discovery in High Throughput Biological Domains, Philosophical Reasoning in Information Systems Research, and Secure Knowledge Management (Ramesh and Rao 2008). Some of the recently published (such as ICT in the Residential and Household Context) and the forthcoming guest-edited issues on "Ambient Intelligence and Intelligent Systems and Smart Homes provides evidence of *ISF*'s continuous efforts to foster creativity at the emerging disciplinary interfaces leading to new frontiers in IS/IT research" (Ramesh and Rao 2008, p1-2). Although editors have provided some indication of *ISF*'s evolution and achievements, an in-depth analysis by

² <http://www.acphis.org.au/index.php?option=content&task=category§ionid=6&id=33&Itemid=53>

³ <http://www.the-abs.org.uk/?id=257>

⁴ <http://www.springer.com/business/business+information+systems/journal/10796?detailsPage=aimsAndScopes>

⁵ <http://www.springer.com/business/business+information+systems/journal/10796?detailsPage=editorialBoard>

profiling ten years of its publications would be of great interest to the *ISF* readership as it will uncover the intellectual wealth which has evolved over a ten-year period.

With reference to journal publications, profiling is considered to be an art of introspection that aims to benefit a specific audience, and takes a journal towards the right and balanced direction (Dwivedi et al. 2008; Dwivedi and Kuljis 2008; Palvia et al. 2007). For the benefit of *ISF*'s audience, this paper provides an overview of research published in the journal which is intended to help them to appreciate and identify topics worthy of research and publication (Palvia et al. 2007). Also, such efforts will provide a valuable addition towards the efforts exerted by Avison et al. (2008), Claver et al. (2000), Dwivedi et al. (2008), Dwivedi and Kuljis (2008) and Palvia et al. (2007) towards understanding and developing the area of IS research. Furthermore, our study is likely to stimulate researchers to profile other IS Journals in order to conduct comparative/cross-journal studies which will ultimately help to understand the overall evolution of the IS discipline.

Before stating the aim and objectives of the paper it is important to evaluate the *ISF* literature focusing upon research agenda, evolution of IS field, and theoretical and methodological issues. Our literature search suggests that *ISF* has published many such articles, most notably a paper on "Team Theory and Distributed Processing" (Arrow 1999) and a foreword on "Information Dynamics in the Networked World" (Arrow 2003) both by Noble Laureate Prof. Kenneth Arrow and a paper by one of the founders of IS - Prof. Gordon Davis - entitled "A Research Perspective for Information Systems and Example of Emerging Area of Research" (Davis 1999). Further to this, Freeman's (2001) work established IS Foundations, Definitions and Applications. Another notable contribution in this area is by Gray and Hovav (1999) on identifying frontiers of IS based on scenario. On the methodological and theoretical side, Adam and Richardson (2001) examined feminist philosophy and Dobson (2001) discussed philosophy of critical realism. A number of studies successfully attempted to explore and limit the boundary of emerging sub domains including electronic commerce (Shaw 1999), knowledge management (Sage and Rouse 1999), philosophy of information technology and systems as tools (Bunker 2001), workflow automation: overview and research issues (Stohr and Zhao 2001), philosophical underpinnings of software engineering research (Gregg et al. 2001) and semantic web services (Bell et al. 2007). A recently published guest editorial attempted to profile adoption and diffusion research from a household/consumer perspective (Dwivedi et al. 2008a). The publication of these studies clearly indicates that *ISF* regularly publishes articles focusing on various facets of IS research evolution. This paper will be a further contribution towards understanding the evolution of the IS discipline from the *ISF*'s perspective.

In light of the above, the aim of this paper is to provide a systematic review of *ISF* publications in order to ascertain their current "state of play" along a number of dimensions. This overall aim is realised by means of the following objectives: 1. To identify the most prolific authors published in *ISF*; 2. To determine the gender of contributing authors; 3. To determine the occupation/position of contributing authors; 4. To identify authors' backgrounds (i.e. home departments and academic, or practitioner); 5. To perform co-author analysis; 6. To identify the universities associated with the most research publications; 7. To determine the geographic location of contributing authors; 8. To classify *ISF* publications according to the research methods employed; 9. To determine the most frequently used keywords in *ISF* publications; 10. To determine the research impact of the published research by undertaking citations analysis; and 11. To examine the knowledge transfer from other academic outlets to the *ISF*.

In order to achieve these objectives, a systematic review of 307 articles published during the period 1999-2008 was conducted. The remainder of this paper is structured as follows. Section 2 provides a discussion of the method employed in the analysis of the published *ISF* research. The findings are presented and discussed in Section 3. Finally, Section 4 presents conclusions from this work and the limitations of the approach.

2 Research methodology

In order to create a profile of the research methods, universities, and authors, the study thoroughly examined all *ISF* papers published between the years 1999 and 2008. The authors carefully reviewed a total of 307 research articles to capture data on these variables. Such an approach for the systematic classification of research published in a particular journal is termed as a 'meta-study' or 'longitudinal literature review' (Palvia et al. 2007; Dwivedi et al. 2008). Since this approach has been successfully employed previously to profile a number of IS and related journals, including the *European Journal of Information Systems (EJIS)* (Dwivedi and Kuljis 2008), *Information & Management (I&M)* (Claver et al. 2000; Palvia et al. 2007), the *Information Systems Journal (ISJ)* (Avison et al. 2008) and *Journal of Electronic Commerce Research (JECR)* (Dwivedi et al. 2008), we also utilised it to profile *ISF* publications.

Various items were recorded for each article including the citations of selected articles, geographic regions, authors' backgrounds and the research methods used by the authors. The impact of the research was assessed using both Web of Science (WoS) and Google Scholar citation counts. Institutional contributions/productivity were examined by utilising an adjusted count approach in which only one count was allocated to authors from the same institution (Palvia et al. 2007; Dwivedi et al. 2008; Dwivedi and Kuljis 2008). Both the authors' backgrounds and geographic location variables were adapted from previous studies (Avison et al. 2008; Dwivedi et al. 2008). However, following the arguments put forward by Dwivedi et al. (2008), we further divided the three regions suggested by the Association of Information Systems (AIS) into seven regions to reflect the true picture of the publication activity from different geographic regions. AIS divided the world into the following three regions: (1) AIS Region 1 – Americas; (2) AIS Region 2 – Europe, Africa and Middle East; and (3) AIS Region 3 – Asia Pacific. For the purpose of this study we modified this scheme and divided the regions into the following seven categories: (1) AIS-R1- USA & Canada; (2) AIS-R1- Other (Latin American & South American Countries); (3) AIS-R2- Europe & UK; (4) AIS-R2- Middle East & Africa; (5) AIS-R3- South Korea, Singapore, Hong Kong, Taiwan, China, Japan, India; (6) AIS-R3- Australia & New Zealand; and (7) AIS-R3- Other.

The categories for recording the research methods' related aspects were adapted from previous studies (Avison et al. 2008; Dwivedi et al. 2008; Palvia et al. 2007). A number of research method categories (e.g. Descriptive/Theoretical/Conceptual, Survey, Experiment, Case Study, Data Analysis, Interview, and Ethnographic Studies) were employed to classify *ISF* publications. Although, due to space limitations, it is not appropriate to provide detailed information on these categories, readers can refer to the original sources (Avison et al. 2008; Palvia et al. 2007; Dwivedi et al. 2008) for more detail.

It is important to emphasise at this point that like previous profiling studies (Claver et al. 2000; Palvia et al. 2007) the findings of this study, in terms of universities with the most contributors, should be regarded as 'indicative and not an authoritative declaration' (Palvia et al. 2007). This is because it is possible that some universities may have niches of research expertise that are not yet visible.

2.1 Knowledge transfer from other journals to ISF

In this section, the methodology associated with performing co-citation analysis of citation data pertaining to *ISF* journal is described. The citation data is obtained from the *ISI Web of Knowledge* database and it contains a total of 241 articles and reviews. The issues that make up this data set start from 3(3):377-392 and end at 10(4):483-497, encompassing a period from September 2001 to September 2008 respectively. The co-citation analysis is performed using the Knowledge Domain Visualization (KDViz) software called CiteSpace (Chen, 2004). The research method for this purpose is described below.

Step 1: Citation data pertaining to *ISF* journal is downloaded from the *ISI Web of Knowledge* database in ISI format.

Step 2: The citation data is fed into CiteSpace. This is achieved through creating a new project and mapping the directory containing the citation data from within the CiteSpace program.

Step 3: Various CiteSpace options are selected. These include (a) the time interval of analysis (2001-2008); (b) the unit of analysis (1 year); (c) the citation threshold (between 2 and 3); (d) the co-citation threshold (between 2 and 3); (e) the pruning and merging option (pathfinder network scaling); and (f) the visualisation option (merged network cluster view). The reader is referred to Chen (2006) for an extensive discussion of these variables.

Step 4: Nodes and links are the building blocks of a co-citation network. CiteSpace supports a total of eight different Node Types (NT). Each NT is associated with a particular type of analysis. For this paper we have performed a total of four different analyses using the following four different NTs:

- (a) Articles that can be considered as intellectually significant (*NT references*)
- (b) Articles with high citations (*NT references*)
- (c) Journals that are highly cited by *ISF* authors (*NT cited authors*)
- (d) Mapping the evolution of IS (*NT noun phrases*)

Step 5: The result of the analysis has been described below in the findings section. A combination of tables and figures has been used to report the findings.

3 Findings and discussion

The findings of this study are presented in the following subsections. The first subsection presents the most productive authors and then the variables related with the authors such as gender, occupation, departments, and academic or industry association. This follows the co-author analysis to show the collaborative nature of the research published in *ISF*. Following this, geographical diversity and the authors' university and country information is presented.

Next, we profile the publication by the research method utilised. The next two subsections discuss the most frequently utilised keywords and noun phrases published in *ISF*. This is followed by citation analysis to illustrate the research impact of the most inferential studies. The last three subsections present analysis on the influence of other publishing outlets on IS researchers in terms of intellectually significant articles, articles highly cited by *ISF* authors, and journals highly cited within *ISF* publications.

3.1 Most productive authors

An analysis is conducted to identify those authors who published the most in the 10-year period (1999-2008) in *ISF*. Similar to the study by Palvia et al. (2007), for assessing research productivity the normal count approach is employed. Palvia et al. (2007) suggested that all publications naming the researcher should be counted equally (i.e. an article with three co-authors would provide one count for each). However, this approach results in the combined count of all authors being greater than the total number of articles (Palvia et al. 2007).

For presenting the findings of this study, only those authors who have published three or more articles during the period studied are included in the list. A total of 694 authors contributed to the 307 articles of *ISF*. Table 1 lists the 9 most productive authors, ordered according to the number of articles published in *ISF* during the study period, and also each author's most recent affiliation. The findings suggest that only two authors (Amjad Umar and Michael J. Shaw) have contributed to four publications each. The remaining seven authors in Table 1 each contributed to three articles. Although not listed in the Table, 42 authors contributed to two articles each and finally, the largest number of authors (C= 642) contributed to one article each.

Table 1 The most productive authors who published three or more papers in *ISF* between 1999 and 2008 (approach adapted from Dwivedi and Kuljis 2008; Palvia et al. 2007).

SL	Author Name (n=694)	Count (N=307)	Gender	Most Recent Affiliation
1	Amjad Umar	4	M	Fordham University
2	Michael J. Shaw	4	M	University of Illinois at Urbana-Champaign
3	Ramesh Sharda	3	M	Oklahoma State University
4	Kweku-Muata Osei-Bryson	3	M	Virginia Commonwealth University
5	Andrew B. Whinston	3	M	University of Texas at Austin
6	Ozgur Turetken	3	M	Ryerson University
7	Lida Xu	3	M	Old Dominion University
8	Rudy Hirschheim	3	M	Louisiana State University
9	Susan A. Sherer	3	F	Lehigh University

In terms of the most productive authors, although the lists provided in the *I&M* study (Palvia et al. 2007) and in this study both include renowned authors, none of the authors appeared in both the studies. This simply indicates that each journal has their specific author population for generating intellectual wealth by contributing the scholarly articles. Author population for each journal is large but the population of loyal authors who prefer to contribute to specific journals a number of times are very few. We believe that such authors understand the editorial policy, quality criteria and review process of their preferred journal well enough that they manage to publish more than two or three articles in the same journals. The findings of Palvia et al. (2007) and this research clearly suggest that future researchers reporting findings on the most productive authors based on only one publishing outlet should be cautious when making authoritative claims.

3.2 Gender of authors

Gender information of a total of 726 (95.8%) authors was extracted from authors' biographies; however, it was not possible to determine the gender of 32 (4.2%) authors due to a lack of such information in their biographies or due to complete lack of biography in certain articles. The analysis presented in Table 2 suggests that the proportion of male authors is much higher than females. A total of 589 (77.7%) male authors contributed articles in *ISF*. A much lower proportion of female authors (C=137, 18.1%) made intellectual contributions to the journal.

Table 2 Gender of *ISF* authors (approach adapted from Avison et al. 2008)

	Frequency	Percent
Male	589	77.7
Female	137	18.1
Total	726	95.8
Unknown	32	4.2
Total	758	100.0

3.3 Occupation of authors

The data presented in Table 3 suggests that the highest proportion of *ISF* authors hold professorship positions. This is then followed by associate professor and assistant professor positions. An almost equal number of authors were either doctoral candidates (C=75, 9.89%) or researchers (C=74, 9.76%), followed by authors from industry (i.e. practitioners) whose role it was not possible to specify, and then lecturers and senior lecturers and a variety of other occupations, not all of which are listed below. Other less frequently reported roles/positions not listed in Table 3 include Assistant Registrar, Lab Manager, Systems Analyst, Senior Technologist, Project Director, Software Engineer, General Manager, IT Architect, Senior Clinical Investigator, Business architect, Biostatistician, Chief Knowledge Officer, Research Coordinator, Systems Architect, Program Manager, Web Developer, Strategy Analyst, Assistant Manager, Senior Software Developer, Software Factory Manager, Assistant Professor, Group Leader, Quality Manager and Attorney.

Table 3 Occupation of authors

Occupation	Frequency	Percent
Professor	201	26.52
Associate Professor	95	12.53
Assistant Professor	88	11.61
Researcher	75	9.89
Ph.D. candidate	74	9.76
Practitioner	35	4.62
Lecturer	29	3.83
Senior Lecturer	22	2.90
Research Scientist	7	0.92
Senior Research Scientist	5	0.66
Consultant	5	0.66
Scientist	5	0.66
Engineer	4	0.53
Principal Research Scientist	3	0.40
Chief Executive Officer	2	0.26
Research Leader	2	0.26
Software Architect	2	0.26
Project Manager	2	0.26
Reader	2	0.26
Physician	2	0.26

3.4 Area of academic expertise/authors home department

In terms of the number of authors/contributors from different departments, the largest number of contributors were located in the Information Systems (IS) department (198, 26.1%), which is followed by Computer Science/Software Engineering (160, 21.1%), Business Administration (67, 8.8%), Management (61, 8%), IT/IT Management (53, 7%), Engineering (45, 5.9%), Information Science/Library Science (31, 4.1%), Industrial Administration/Industrial Production (22, 2.9%), Accounting and Information Management/Operations Management, both categories with 18 authors each, Decision Sciences and Economics, both with 16 authors each, Social Sciences/Studies – Philosophy/Sociology (15, 1.6%), Maths/Statistics (14, 1.8%), and Bio Informatics/Health Informatics/Medical Informatics (12, 1.6%). All other departments associated with relatively few authors, including Electronic Commerce/E-Business which associated with only 10 (1.3%) authors (see Table 4).

Table 4 Authors' academic background (i.e. home department) (approach and categories adapted from Avison et al. 2008; Dwivedi et al. 2008)

Discipline	Count	Percent
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Accounting	18	2.4
Business Administration	67	8.8
Bio Informatics/Health Informatics/Medical Informatics	12	1.6
Computer Science/Software Engineering	160	21.1
Decision Sciences	16	2.1
Economics	16	2.1
E-Commerce	10	1.3
Engineering	45	5.9
Finance	3	0.4
Information Science/Library Science	31	4.1
Information Systems/ MIS	198	26.1
Information Management/Operations Management	18	2.4
IT/ICT Management	53	7.0
Industrial Administration/Industrial Production	22	2.9
Law	5	0.7
Management/MS/OR	61	8.0
Maths/Statistics	14	1.8
Marketing	6	0.8
Communications	11	1.5
Psychology/Behavioural Research	3	0.4
Social Sciences/Studies – Philosophy/Sociology	15	2.0
Others /Industry	137	18.1

3.5 Background of authors

Table 5 illustrates the number of authors/contributors from academia or industry. The largest number of contributors were from academia (651, 85.88%) and a comparatively small proportion of authors were based in industry (107, 14.12%) (Table 5).

Table 5 Authors' background (approach and categories adapted from Avison et al. 2008; Dwivedi et al. 2008)

Authors' Background	Count	Percent
Academic	651	85.88
Industry/Others	107	14.12
Total	758	100

3.6 Co-author analysis

In terms of the number of co-authors who contributed to each article, 10.03% (C=76) of the articles were written by one author (Single Authored). Articles produced by multiple authors form the following categories: 12.27% (C=93) articles were co-authored by two authors, forming the largest category, 11.87% (C=90) articles by three authors, 3.83% (C=29) articles by four authors, 1.45% (C=11) articles by five authors, five articles were co-authored by six authors and then two articles have seven authors each. Only one article was co-authored by ten authors (see Table 6).

Table 6 Pattern of co-authorship of *ISF* articles (approach adapted from Avison et al. 2008; Dwivedi et al. 2008)

Number of Co-authors	Count	Percent
1	76	10.03
2	93	12.27
3	90	11.87
4	29	3.83
5	11	1.45
6	5	0.66

7	2	0.26
10	1	0.13
Total	307	40.50

3.7 Leading research universities

Authors/contributors from 345 organisations/universities contributed to one or more articles in *ISF* between 1999 and 2008. Table 7 presents the top 17 universities having four or more articles published in the journal. The following is a breakdown of the frequency of contributors/authors affiliated with a particular organisation or university. Two universities ranked first, contributing seven articles each. This is followed by two universities who each contributed six articles and four universities who each contributed five articles each. The remaining eight from 17 universities listed in Table 7 contributed four articles each. 25 organisations contributed three articles each, followed by 43 organisations who contributed two articles each. Finally, the largest number (C=260) of universities had affiliations with one contribution from each.

Table 7 Top 17 universities (with four or more publications) published in *ISF* (1999-2008) (approach adapted from Avison et al. 2008; Dwivedi et al. 2008; Palvia et al. 2007)

	Universities	Country	Count
1	Arizona State University	USA	7
2	Claremont Graduate University	USA	7
3	Carnegie Mellon University	USA	6
4	University of Arizona	USA	6
5	Brunel University	UK	5
6	IBM	Various	5
7	University of Illinois at Urbana-Champaign	USA	5
8	Old Dominion University	USA	5
9	University of Twente	The Netherlands	5
10	Telcordia Technologies Inc.,	USA	4
11	University of Texas at Austin	USA	4
12	University of Waterloo	Canada	4
13	Louisiana State University	USA	4
14	George Mason University	USA	4
15	City University of Hong Kong	Hong Kong	4
16	State University of New York at Buffalo	USA	4
17	Penn State University	USA	4

An observation similar to the most productive authors has been made in terms of most productive institutions. Only a few institutions appear in more than one study including the list of institutions obtained in our research. Such examples include Arizona State University, University of Arizona, City University of Hong Kong and George Mason University (Dwivedi et al. 2008; Palvia et al. 2007). This supports the argument provided in the methodology section that the findings of such studies in terms of institutional productivity should be regarded as ‘indicative and not an authoritative declaration’ (Dwivedi et al. 2008; Palvia et al. 2007). However, one significant difference that can be noted from the analysis of *ISF* publications is the large number of commercial organisations, many of whom are leaders in IT industry, such as IBM and HP.

3.8 Country and geographical regions

A total of 33 countries’ authors published in *ISF* between the years 1999 and 2008 (Table 8). In terms of the number of authors/contributors from different countries, the largest number of contributors were located in the USA (369, 48.68%), followed by the UK (51, 6.73%). The third largest category (44, 5.80%) was formed by German authors and Canadians (42, 5.54%) are in fourth place. Table 8 illustrates the proportion of contributors from the 33 countries.

Table 8 Contributors' geographical location (approach adapted from Avison et al. 2008; Dwivedi et al. 2008)

SL	Country	Count	Percent	SL	Country	Count	Percent
1	USA	369	48.68	18	Denmark	5	0.66
2	UK	51	6.73	19	Norway	5	0.66
3	Germany	44	5.80	20	India	3	0.40
4	Canada	42	5.54	21	Argentina	3	0.40
5	China	34	4.49	22	Turkey	3	0.40
6	Australia	31	4.09	23	Singapore	3	0.40
7	The Netherlands	25	3.30	24	Jamaica	2	0.26
8	South Korea	22	2.90	25	Iran	2	0.26
9	Hong Kong	21	2.77	26	New Zealand	2	0.26
10	Italy	20	2.64	27	Austria	2	0.26
11	Sweden	13	1.72	28	Spain	2	0.26
11	Taiwan	12	1.58	29	Brazil	2	0.26
13	Japan	10	1.32	30	Switzerland	2	0.26
14	Greece	8	1.06	31	Slovenia	1	0.13
15	Israel	6	0.79	32	Ireland	1	0.13
16	Belgium	6	0.79	33	Oman	1	0.13
17	Finland	5	0.66		Total	758	100

In terms of the number of authors from different geographical regions (as per the Association of Information Systems (AIS)), the largest number of authors were from the AIS Region 1 – USA and Canada (411, 54.22%), followed by the AIS Region 2 – Europe and UK with 25.07% (C=190) of the authors. The third largest category was formed by the AIS Region 3 – South Korea, Singapore, Hong Kong, Taiwan, China, Japan, India with 13.72% (C=104) of the authors (Table 9) followed by AIS-R3- Australia & New Zealand with 4.49% (C=34) of the authors. The other three less active regions are also illustrated in Table 9.

Table 9 Geographical regions of *ISF* authors (approach adapted from Dwivedi et al. 2008)

Geographical Region (AIS Classification)	Count	Percent
AIS-R1- USA & Canada	411	54.22
AIS-R2- Europe & UK	190	25.07
AIS-R3- South Korea, Singapore, Hong Kong, Taiwan, China, Japan, India	104	13.72
AIS-R3- Australia & New Zealand	34	4.49
AIS-R2- Middle East & Africa	12	1.58
AIS-R1-Other (Latin American & South American Countries)	7	0.92
AIS-R3- Other	0	0
Total	758	100

Avison et al.'s (2008) research on the review of ISJ and Dwivedi et al.'s (2008) review of JECR show that a number of geographical regions (such as South America, the Middle East, the Former Soviet Union and many underdeveloped countries of Asia) are under-represented in terms of undertaking and publishing information systems and electronic commerce research (Avison et al. 2008; Dwivedi et al. 2008). Our investigation also reveals highly under-represented levels of information systems from the Southern and Central American Regions and no representation from AIS-R3 – other countries, such as Afghanistan, Bangladesh, Cambodia, Indonesia, Malaysia, Nepal, Pakistan, Sri Lanka, and Thailand (see Tables 8-9). Like previous works (Avison et al. 2008; Dwivedi et al. 2008), this highly imbalanced picture certainly raises an important research agenda for IS researchers to investigate: whether this situation is a consequence of a global IS digital divide or whether it is due to a lack of interest or lack of necessary expertise to undertake IS research within such countries (Dwivedi et al. 2008). In either case, the problem of a potential global IS divide needs to be investigated and academics from IS hotspots such as the USA, UK, Australia, Hong Kong, Taiwan, Korea, and European countries should consider collaboration with

researchers from under-represented regions in order to undertake more fruitful research which is critical to the global emergence of information systems (Dwivedi et al. 2008).

Furthermore, this study also endorses arguments of a previous work (Dwivedi et al. 2008) on the appropriateness of using the AIS Regions for geographical comparison. Dwivedi et al. (2008) argued that researchers should divide the AIS Region 2 into three sub-divisions, namely European regions, the Middle East and Africa. Similarly, the AIS Region 1 should be divided into North and South America, and the AIS Region 3 should be divided into the Pacific Region (Australia and New Zealand), active Asian nations such as Singapore, Hong Kong, South Korea, Japan, Taiwan, China, and India, and comparatively less active Asian regions such as Afghanistan, Bangladesh, Cambodia, Indonesia, Malaysia, Nepal, Pakistan, Sri Lanka, Thailand, and many other countries. Without such finer divisions it will not be possible to develop a clear picture of the regional growth of information systems and electronic commerce practice and research (Dwivedi et al. 2008). Profiling of *ISF* provides empirical evidence for such a view and therefore we recommend that researchers follow the modified classification scheme described above for the purpose of future research.

3.9 Research methods

The findings suggest that although a total of eight different research methods were recorded from our data analysis activities, the majority of studies within our results employed analytical/conceptual/descriptive/theoretical methods (223, 72.6%) (this includes various related methods such as view points, commentary, review, meta-analysis, design, simulation, algorithm, and mathematical modelling), case study (22, 7.2%), experiment (21, 6.8%) and survey (18, 5.9%) methods. The other categories employed were the secondary data analysis (7, 2.3%), multi-method (3, 1%), interview (3, 1%), event study (3, 1%), observation (2, 0.7%), content analysis (2, 0.7%), case based reasoning (2, 0.7%), action research (1, 0.3%) and ethnographic method (1, 0.3%) (see Table 10). Previous such studies have argued and illustrated that more papers published in the early stages of emergence are likely to be descriptive/conceptual/theoretical in nature (Avison et al. 2008, Dwivedi et al. 2008, Wareham et al. 2005). Avison et al. (2008), Dwivedi et al. (2008) and Wareham et al. (2005) revealed a large number of descriptive/conceptual/theoretical papers in the early years of publication, which is clearly evident from this investigation too (see Table 10).

Table 10 Research methods employed (categories adapted from Avison et al. 2008, Chen and Hirschheim 2004, Dwivedi et al. 2008)

Research Methods	Count	Percent
Analytical/Conceptual/Descriptive/ Theoretical*	223	72.6
Case Study	22	7.2
Experiment	21	6.8
Survey	18	5.9
Secondary Data Analysis	7	2.3
Multi-Method	3	1.0
Interview	3	1.0
Event Study	3	1.0
Content Analysis	2	.7
Case Based Reasoning	2	.7
Observation	2	.7
Action Research	1	.3
Ethnographic Studies	1	.3

***This category includes various methods such as View Points, Commentary, Review, Meta-analysis, Design, Simulation, Algorithm, Mathematical Modelling**

3.10 Keyword analysis: popular keywords

In order to assess the most frequently utilised (employed) keywords, all the keywords were collected. These keywords were then sorted into alphabetical order to explore the most frequently utilised keywords. A total of 23 keywords were used five or more times. These 23 keywords, along with their frequency, are listed in Table 11. ‘Systems’ and ‘model’ were the most frequently used keywords, with 18 papers utilising them, followed by ‘technology’ and ‘performance’, each represented by 13 articles. ‘Management’ emerged as the fifth most utilised keyword as 12 studies used this keyword. This was closely followed by ‘web services’ (9), ‘design’ (9), ‘information’ (8), and ‘knowledge management’ (7). Table 11 summarises the frequency of usage of the 23 most frequently utilised keywords. The trend of keyword utilisation suggests that *ISF* are frontiers of novel research in the area of IS design, applications, and management. We also identified a few keywords that have influenced the thinking and publication practices of *ISF*’s audience. These keywords include ‘performance’, ‘model’, ‘knowledge’, ‘knowledge management’, and ‘outsourcing’ (Table 11).

Table 11 Most frequently utilised keywords

Keywords	Freq	Keywords	Freq
systems	18	information technology	5
model	18	issues	5
technology	13	scale	5
performance	13	trust	5
management	12	Information systems	5
web services	9	methodology	5
design	9	Turning point keywords (identified by CiteSpace)	
information	8	performance	13
knowledge management	7	systems	18
security	6	model	18
information-technology	6	technology	13
outsourcing	6	management	12
supply chain management	6	information	8
architecture	5	methodology	5
information systems	5	knowledge	5
knowledge	5	outsourcing	6
integration	5	knowledge management	7

3.11 Mapping the evolution of IS based on ISF publications

The Node Type *noun phrase* has been used for this analysis (see the methodology section for more details). CiteSpace defines a noun phrase as a number of consecutive nouns, which may or may not have been modified by one or more adjectives (CiteSpace Wiki 2008). CiteSpace extracts noun phrases from paper titles and abstracts that have been downloaded from the *ISI Web of Knowledge* database. It is important to note that noun phrases are not the same as user-defined keywords, although some of the noun phrases may be used as keywords by the authors. Noun phrase analysis provides insights into the evolution of IS over the years (Table 12).

Table 12 Evolution of IS through noun phrase analysis

year	noun phrase	noun phrase	noun phrase	noun phrase
2001	information systems	supply chain	inquiring systems	information systems development
	systems	methodology	science	group support systems
	technology	organisational learning	business processes	supply chain operations
	management	new approach	workflow management system	decision support systems
	design	knowledge	petri nets	systems development

	knowledge management	various types	epistemology	collaborative work
	information supply chain management	ethics New York	software engineering information system	systems approach philosophy of science
2002	information technology business process	electronic marketplaces simulation	discrete-event simulation resource management	standard methods wide variety
	architecture	data mining	object-oriented analysis	
2003	electronic markets performance	virtual organizations web	sample data aggregation	aggregate information mechanism design
	electronic commerce	information aggregation	productivity	
	experimental economics	security markets	rational expectations	risk
2004	model	scale	consumer perceptions	distributed systems
	e-commerce service providers service quality	customer satisfaction mobile services behavioural intentions	price middleware key drivers	
2005	collaborative learning			
2006				
2007	web services	integration	web service	heterogeneous environments
	security	collaboration	service-oriented computing	model-driven development
2008	IT outsourcing	issues	trust	information technology
	outsourcing success	information systems	outsourcing	

3.12 Citation analysis

A citation analysis was conducted to determine the research impact of the most influential authors and studies based on the number of *ISF* publication citations. Citation data (citation count and article frequency) from Google Scholar which was retrieved on May 1, 2008 and updated on September 12, 2008 for all 307 articles appearing in *ISF* between the years 1999 and 2008. Data obtained from Google Scholar on total citation count per article suggests that 20 articles were cited more than 50 times on average, and the 35 articles received citations above 20. Nine studies with larger values of citation counts from each year are listed in Table 13 which includes study with largest count by Ross and Vitale (2000) with a 180 citation count (as per Google Scholar). As noted by Dwivedi et al. (2008) regarding the citation count, older articles are more likely to have larger numbers of citations, while newer articles are likely to possess lower citation counts. This can be shown by the fact that articles possessing the largest number of citations were published in early volumes of *ISF* and none of the articles from a relatively recent volume had a larger count. This is not an unusual case as similar observations were recorded for the *Journal of Electronic Commerce Research* (Dwivedi et al. 2008).

Table 14 Most cited *ISF* articles (retrieved May 1, 2008, updated on September 12, 2008) (approach adapted from Dwivedi et al. 2008)

Study	GS-Citation	Article Title
Shaw M.J. (1999), Vol. 1, No. 1, pp. 95-106	46	Electronic Commerce: Review of Critical Research Issues
Ross J.W. & Vitale M.R. (2000), Vol. 2,	180	The ERP Revolution: Surviving vs. Thriving

No. 2, pp. 233-241		
Stohr E.A. & Zhao J.L. (2001), Vol. 3, No. 3, pp. 281-296	88	Workflow Automation: Overview and Research Issues
Casati F. & Shan M.-C. (2002), Vol. 4, No. 1, pp. 19-31	20	Event-Based Interaction Management for Composite E-Services in eFlow
Berg J.E. & Rietz T.A. (2003), Vol. 5, No. 1, pp. 79-93	63	Prediction Markets as Decision Support Systems
Wang Y., Lo H.-P. & Yang Y. (2004), Vol. 6, No. 4, pp. 325-340	22	An Integrated Framework for Service Quality, Customer Value, Satisfaction
Ziegler C-N & Lausen G. (2005), Vol. 7, No. 4, pp. 337-358	20	Propagation Models for Trust and Distrust in Social Networks
Baker C.J.O. & Witte R. (2006), Vol. 8, No. 1, pp. 47-57	7	Mutation Mining - A Prospector's Tale
Umapathy K. & Purao S. (2007), Vol. 9, No. 1, pp. 119-134	6	A Theoretical Investigation of the Emerging Standards for Web Services

3.13 Intellectually significant articles

CiteSpace identifies potentially important articles in a co-citation network by enhancing the visual features of the nodes representing those articles (Chen 2004). Figure 1 shows a screenshot of articles (purple coloured nodes) that may be considered as intellectually significant for building the *ISF*'s knowledge wealth. The information obtained in the figure is transposed to Table 14. The table lists a total of 10 articles that are considered intellectually significant. Some of the rows in the table have a grey background. This shows the papers that also have a high level of citations (see next section). The identification of intellectually significant papers is only possible because CiteSpace does a time-sliced co-citation analysis, as opposed to a simplistic citation analysis. In this scheme of things, an article that has been co-cited many times within one time slice (say 1999-2000) may be considered less important than a paper that has been co-cited a fewer number of times but across different time slices (say 1999-2000, 2001-2003 and 2004-2006). This is only one example of how CiteSpace is able to detect potential intellectually significant articles, although its citation count may be less.

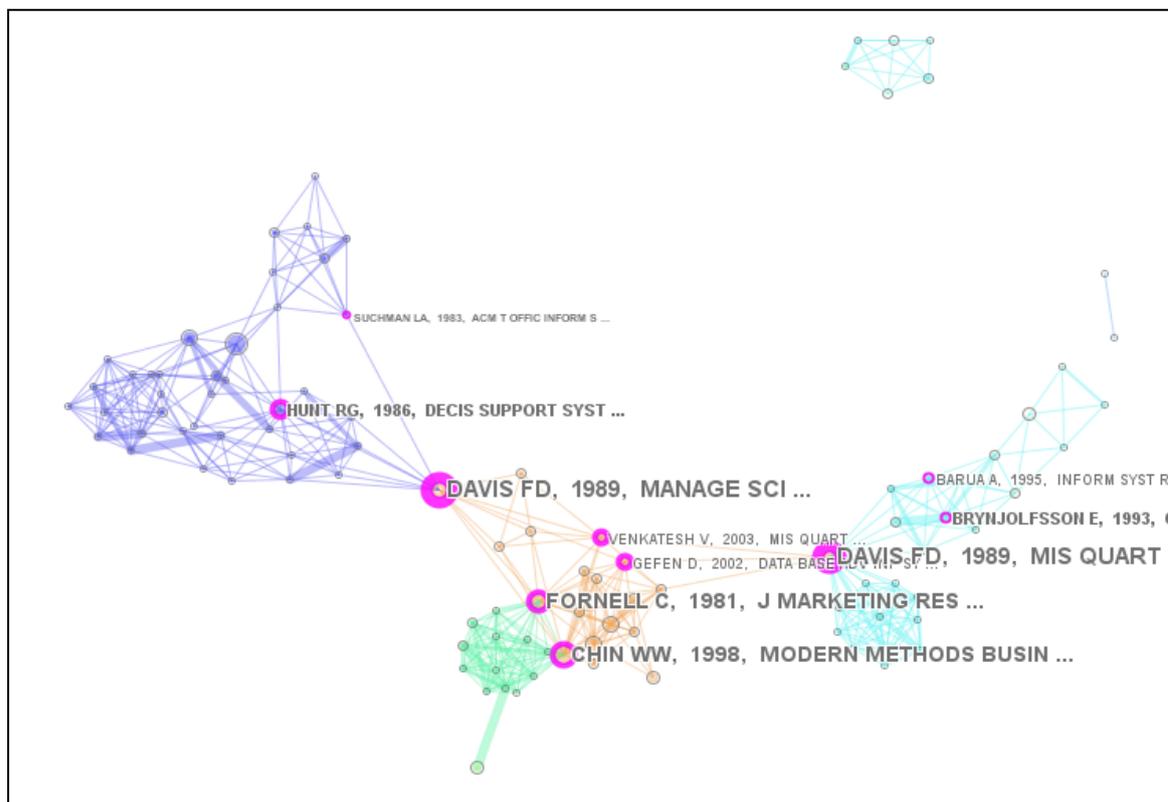


Fig. 1: CiteSpace KDViz identifying intellectually significant papers

Table 14 Articles that are considered to be intellectually significant

Cit.	Author	Year	Journal	Vol	Start page
8	DAVIS FD	1989	MANAGE SCI	V35	P982
8	DAVIS FD	1989	MIS QUART	V13	P319
4	HUNT RG	1986	DECIS SUPPORT SYST	V2	P125
3	GEFEN D	2002	DATA BASE ADV INF SY	V33	P38
3	VENKATESH V	2003	MIS QUART	V27	P425
7	CHIN WW	1998	MODERN METHODS BUSIN	V0	P295
7	FORNELL C	1981	J MARKETING RES	V18	P39
2	SUCHMAN LA	1983	ACM T OFFIC INFORM S	V1	P320
3	BARUA A	1995	INFORM SYST RES	V6	P3
4	BRYNJOLFSSON E	1993	COMMUN ACM	V36	P67

3.14 Articles with high citations

The highly cited papers can be visually identified in CiteSpace. The higher the citation count for a paper, the more prominent the nodes will be in terms of their diameter. Figure 2 identifies some of the highly cited papers by *ISF* authors and shows its corresponding citation label. Table 15 lists the papers with five or more citations in descending order. The reader would note that a few of the articles, represented by nodes of differing sizes, are also bordered with a purple ring. This is because some of the articles not only have a high citation count (and therefore a large node size) but also they can be considered as intellectually significant (and therefore they are visually represented by a purple rim). These articles are indicated in Table 15 by a grey background.

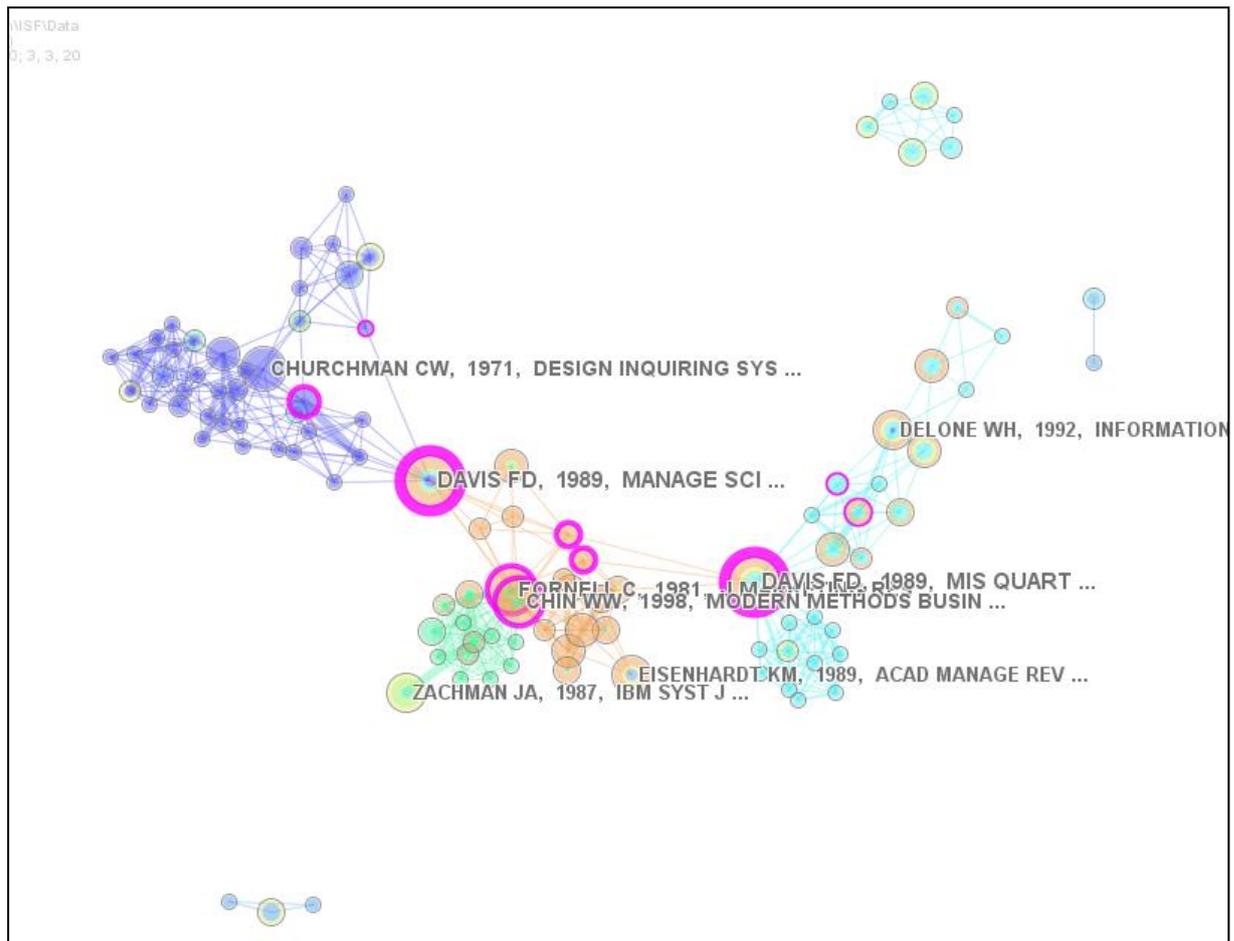


Fig. 2 CiteSpace KDViz identifying papers with a high citation count

Table 15 Articles with high citations (≥ 5)

Cit.	Author	year	Journal	Vol	Start page
8	DAVIS FD	1989	MIS QUART	V13	P319
8	DAVIS FD	1989	MANAGE SCI	V35	P982
7	CHURCHMAN CW	1971	DESIGN INQUIRING SYS	VBOOK	P0
7	FORNELL C	1981	J MARKETING RES	V18	P39
7	CHIN WW	1998	MODERN METHODS BUSIN	V0	P295
6	ZACHMAN JA	1987	IBM SYST J	V26	P276
6	EISENHARDT KM	1989	ACAD MANAGE REV	V14	P532
6	DELONE WH	1992	INFORMATION SYSTEMS	V3	P60
5	CHURCHMAN CW	1979	SYSTEMS APPROACH ITS	VBOOK	P0
5	ROGERS EM	1995	DIFFUSION INNOVATION	VBOOK	P0
5	GROVER V	1996	J MANAGEMENT INFORMA	V12	P89
5	DOSSANTOS BL	1993	INFORMATION SYSTEMS	V4	P1
5	NAM K	1996	COMMUN ACM	V39	P36
5	HITT LM	1996	MIS QUART	V20	P121
5	DIBBERN J	2004	DATA BASE ADV INF SY	V35	P6

3.15 Journals highly cited by ISF authors

For this analysis, the Node Type *cited journal* has been selected. Table 16 shows the journals that have been cited most frequently by the *ISF* authors. Only journals with 15 or more citations are listed. It is noticeable that sources that have contributed to building the intellectual wealth of *ISF* are the most respected outlets from both IS disciplines and its references disciplines (Business, Management, Decision Science, Computing, Economics and Organisation Science). This again indicates that *ISF* should not be seen only as frontiers of new IS research but is truly multi-disciplinary/trans-disciplinary in nature.

Table 16 Journals with a high citation count

SN	Journal Name	C Count	SN	Journal Name	C Count
1	COMMUN ACM	86	12	DECIS SUPPORT SYST	21
2	MIS QUART	80	13	LECT NOTES COMPUT SC	21
3	MANAGE SCI	50	14	J MARKETING	20
4	INFORM SYST RES	41	15	INFORM MANAGE	19
5	INFORMATION SYSTEMS	40	16	SLOAN MANAGE REV	19
6	J MANAGEMENT INFORMA	34	17	J MANAGE INFORM SYST	18
7	HARVARD BUS REV	32	18	ORGAN SCI	18
8	ACAD MANAGE REV	27	19	STRATEGIC MANAGE J	16
9	IBM SYST J	26	20	ACAD MANAGE J	15
10	DECISION SCI	24	21	AM ECON REV	15
11	IEEE T SOFTWARE ENG	23	22	EUR J OPER RES	15

3.16 Use of Theory and Model

Our exploration of *ISF*'s publications regarding theory and models suggest that *ISF* articles have utilised a large and diverse number of theories and models from almost all reference disciplines. The diversity of utilised theories and models is not surprising after observing the diverse range of knowledge sources that *ISF* authors have consulted and cited in their articles (see Table 16). Although it is not possible to list all the theories and models utilised within all 307 articles of *ISF*, we are providing some examples to illustrate our point regarding the theoretical diversity of research published in *ISF*. These theories include: Team Theory,

Evolutionary Game Theoretic Approach, Sitkin's Theory of Intelligent Failure, Aesthetics, Ethics, Global Ethical Management, Hegelian Inquiring System, Theory of Metaphor, Systems Theory, Singerian Model of Inquiring, Value Conflicts, Barriers to Rationality, Decision Science, Nomology, General System Theory, Freedom of Speech, Feminist Philosophy, Feminist Epistemology, Semiotics, Richness, Critical Realism, Structuration Theory, Morphogenetic Theory, Power, Coercion, Complementarism, Rational Decision Making, Self-efficacy, Performance Analytic Models, Flow Studies, Ontology, Self-integration, Semantics, Facility Location, Strategic Multiechelon, Supply Chain Operations Reference (SCOR) Model, Quality of Service, Language-Action Perspective, Organisational Semiotics, Document Archaeology, Natural Language Processing, Theory of Object Oriented Design, Software Design Theory, Information Retrieval, Information Dynamics, Software Life Cycle Control Model, Transaction Cost Economics, Production Theory Economics, Modern Financial Theory, Change Management, Balance Theory, Game Theory, Markov Chain Model, Coordination Theory, Privacy, Business Process Management, Language-Action Theories, Institutional Theory, Network Flow Theory, Systems Dynamics, Security Policy Domain Model, Social-Exchange Theory, Trust Theory, Belief Logic, Network Investment Economics, Resource Dependency Theory, Core Competency, Chaos Theory, Mclean Success Model, Balanced Scorecard, Organisational Learning, Cost-benefit Analysis, Business Continuity Planning, Model of Adoption of Technology in Household, Network Effect Theory, Theory of Planned Behaviour, Decomposed Theory of Planned Behaviour, Social Shaping of Technology (SST), Cognitive Theory, Diffusion of Innovations, Theory of Reasoned Action, Unified Theory of Acceptance and Usage of Technology (UTAUT), and Technology Acceptance Model (TAM).

4 Conclusions

This paper aimed to depict the current state of IS research published in *ISF* by presenting the results of a systematic and comprehensive review of 307 articles that appeared between the years 1999 and 2008. The paper presented the results of an investigation along a series of dimensions including most productive authors, research impact of most influential authors, authors' backgrounds, universities, country, region, most frequently used keywords, and methodological practice.

The following are the main conclusions that have emerged from the analysis presented in this study.

- In terms of productivity of authors, with four publications each, Amjad Umar and Michael J. Shaw have emerged as the two most productive authors of *ISF*.
- Authors from the male category were predominantly higher than that of the female category.
- A large proportion of *ISF* authors hold professorships, followed by associate and assistant professors.
- In terms of the home department of *ISF* authors, the largest number of researchers are from MIS/IS backgrounds, followed by Computer Science and Software Engineering.
- One of the significant observations from this study suggests that *ISF* authorship includes a high proportion of industry experts from renowned organisations such as IBM and HP. This indicates that the journal's audience is composed of both academics and practitioners and therefore its publications represent highly relevant and useful contributions.
- *ISF* publications exhibited a very strong level of collaborative works both amongst academic authors and between academic and industry experts. The largest numbers of papers are co-authored by two authors followed by three authors. There are a number of articles jointly co-authored by five, six, seven and ten authors.

- The universities with the largest number of contributions (seven contributors from each) are the Arizona State University and Claremont Graduate University, both of which are based in the United States. The top 17 list also includes a number of universities from outside USA, for example: Brunel University from UK, University of Twente from The Netherlands, University of Waterloo from Canada and the City University of Hong Kong from the Asia region.
- It is also interesting to note that two commercial organisations (IBM and Telcordia Technologies Inc.) also appeared within the list of most productive institutions.
- USA is the single largest contributor of *ISF* authors and their institutions. Consecutively, AIS-R1- USA and Canada emerged as the most dominant region, followed by AIS-R2- Europe and UK.
- The analytical/descriptive/theoretical/conceptual methods were the most dominant research approaches utilised by *ISF* authors within the 10 years studied, followed by case study, experiment and survey.
- A keywords analysis indicated that ‘systems’, ‘model’, ‘technology’, ‘performance’ and ‘management’ were the most utilised and turning point keywords, or in other words, the most investigated research issues.
- The highest research impact is reported for the paper published by Ross and Vitale (2000) followed by Stohr and Zhao (2001), which was assessed by citations obtained from *Google Scholar* for all articles published in *ISF*.
- There are a number of studies published in other journals that have had a great influence on the work of *ISF* authors as they frequently cited them. These include Davis (1989) and Davis et. Al. (1989).
- Literature sources that *ISF* authors frequently refer to consist of high-quality and respected IS and Management journals including *Communications of ACM*, *MIS Quarterly*, *Management Science*, *Information Systems Research*, *Journal of Management Information Systems*, *Harvard Business Review* and *IBM Systems Journal*. This makes it clear that *ISF*’s intellectual wealth has been built upon very strong foundations, which reflects well on its own quality and recognition.
- By considering the theoretical and methodological richness in *ISF*’s articles and the relevance and usefulness of its publications for both academia and industry, it would not be inappropriate to conclude that the journal’s approach is in a true sense multidisciplinary in nature drawing from fields such as computer science, telecommunications, operations research, economics, cognitive sciences, object/web technologies, information economics, IT integrated manufacturing, medical informatics, digital libraries, mobile computing, and electronic commerce.
- Finally, the data presented within this paper clearly indicates that *ISF* provides a common forum for both frontline industrial developments as well as pioneering academic research.

We anticipate that this paper will prove to be a useful source of information for *ISF* readers who wish to learn more about the various facets pertaining to the existing body of published IS research in *ISF*.

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