Pacific Asia Conference on Information Systems (PACIS)

PACIS 2009 Proceedings

Association for Information Systems *Year* 2009

CLASSIFICATION OF INFORMATION SYSTEMS RESEARCH REVISITED: A KEYWORD ANALYSIS APPROACH

Yogesh Dwivedi* Navonil Mustafee†
Micheal D. Williams‡ Banita Lal**

*Swansea University, ykdwivedi@gmail.com
†Brunel University, navonil.mustafee@gmail.com
‡Swansea University, m.d.williams@swansea.ac.uk
**Nottingham Trent University, banita.lal@ntu.ac.uk

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Yogesh K. Dwivedi
Lecturer, Information Systems & e-Business Group
School of Business & Economics, Swansea University, Swansea, SA2 8PP, UK
Email: ykdwivedi@gmail.com

Navonil Mustafee
Research Fellow in Grid Computing and Simulation
School of Information Systems, Computing and Mathematics
Brunel University, Uxbridge, Middx UB8 3PH, UK
Email : Navonil.Mustafee@brunel.ac.uk

Michael D. Williams
Professor, Information Systems & e-Business Group
School of Business & Economics, Swansea University, Swansea, SA2 8PP, UK
Email: m.d.williams@swansea.ac.uk

Banita Lal
Lecturer, Information Management and Systems Group
Nottingham Business School, Nottingham Trent University, Nottingham, UK
Email: banita.lal@ntu.ac.uk

Abstract

A number of studies have previously been conducted on keyword analysis in order to provide a comprehensive scheme to classify information systems (IS) research. However, these studies appeared prior to 1994, and IS research has clearly developed substantially since then with the emergence of areas such as electronic commerce, electronic government, electronic health and numerous others. Furthermore, the majority of European IS outlets - such as the European Journal of Information Systems and Information Systems Journal - were founded in the early 1990s, and keywords from these journals were not included in any previous work. Given that a number of studies have raised the issue of differences in European and North American IS research topics and approaches, it is arguable that any such analysis must consider sources from both locations to provide a representative and balanced view of IS classification. Moreover, it has also been argued that there is a need for further work in order to create a comprehensive keyword classification scheme reflecting the current state of the art. Consequently, the aim of this paper is to present the results of a keyword analysis utilizing keywords appearing in major peer-reviewed IS publications after the year 1990 through to 2007. This aim is realized by means of the two following objectives: (1) collect all keywords appearing in 24 peer reviewed IS journals after 1990; and (2) identify keywords not included in the previous IS keyword classification scheme. This paper also describes further research required in order to place new keywords in appropriate IS research categories. The paper makes an incremental contribution toward a contemporary means of classifying IS research. This work is important and useful for researchers in understanding the area and evolution of the IS field and also has implications for improving information search and retrieval activities.

Keywords: IS Research, Diffusion of IS Research, IS Literature, Evolution of IS Research

1. INTRODUCTION

There are a number of reasons for producing a classification scheme for Information Systems (IS) research. According to Barki et al.'s (1988; 1993) seminal work in this area, such reasons includes: (1) attempting to define the field of IS in some detail; (2) providing a common vocabulary for IS researchers; and (3) providing a means by which the evolution of research can be studied. Researchers also argue that among the three reasons, the second is important in a rapidly changing IS domain as "*the lack of a common vocabulary among researchers is a problem that cannot be solved by computerized search systems*" (Barki et al. 1993). Barki et al.'s (1993) arguments clearly emphasize the relevance of such work for improving the purpose of information search and retrieval.

Taking the above three motivations as a starting point, Barki et al. (1988) published their seminal work on a classification scheme of IS keywords. The paper aimed to provide a description of the discipline, introduce a common language and enable exploration of the field's development (Barki et al. 1988). The same authors further published an updated scheme in 1993 for incorporating "*the new research topics and methods, hence better reflecting the evolution of the IS discipline*" (Barki et al. 1988). These two papers formed the basis of activity in this area, and were utilized by a number of further investigations focusing upon investigating IS research. These studies are briefly discussed in the next section. One clear limitation of both Barki et al.'s original studies is that they were based on the analysis of keywords appearing in a few selected IS publications before the year 1994. As IS research and practice are characterized by a rapidly changing nature, it is appropriate to assume that research in this area will have evolved since then. For example, the development of electronic commerce, electronic government, electronic health, and numerous other subfields emerged in the mid to late 1990s. Furthermore, IS researchers have borrowed, developed and utilized new concepts, theories and methods over the last 15 years. A number of studies have raised the issue of the differences between European and North American IS research topics and approaches. However, the majority of European IS outlets such as the *European Journal of Information Systems* and the *Information Systems Journal* were founded in the early 1990s, and keywords from these journals were not included in previous keyword analysis work which suggests that a large number of recently employed keywords are likely to be missing from Barki et al.'s (1998; 1993) scheme, which also makes it largely representative only of North American IS research. Moreover, in considering such limitations, a subsequent study argued that there is a need for further work in order to create a comprehensive keyword classification scheme (Gorla and Walker, 1998). Therefore, in order to evaluate Barki et al.'s (1988; 1993) scheme for its comprehensiveness and representativeness, the aim of this paper is to undertake a keyword analysis on keywords appearing in major peer-reviewed IS publications after the year 1990. This overall aim is realized by means of the following two objectives: (1) collect all keywords appearing after 1990 in 24 peer reviewed IS journals; and (2) identify keywords not included in a previous IS classification scheme. This research in progress paper then describes further research required to appropriately place new keywords in Barki et al.'s (1993) nine IS research categories. The paper makes an incremental contribution towards classifying IS research, and is argued to be important and useful for researchers wishing to understand the area and evolution of the IS field, and also has implications towards improving information search and retrieval activities of IS research.

The remainder of this paper is structured as follows. In Section 2, we present a brief discussion of the existing literature in the area, particularly if they have utilized Barki et al.'s (1988; 1993) study. In Section 3 we provide a brief discussion of the method we employed in our keyword analysis research. Our findings are presented in Section 4 and, finally, Section 5 presents our conclusions from this work and the limitations of our approach.

2. LITERATURE REVIEW

Barki et al.'s (1988; 1993) work has had an enormous influence, particularly in the area of investigating IS research. A number of studies (See Table 1) have utilized and cited these studies as the basis for

investigating various issues within IS research and education. Gorla & Walker (1998) attempted to extend Barki et al.'s study by gathering keywords from a larger number of journals and identified a number of keywords that were not included in Barki et al.'s (1988; 1993) original work. Gorla & Walker's study however, collected data only up until 1994, which further supports our motivation for conducting further research in order to identify and report advances in IS research over the past 15 years. Gorla & Walker (1998) posit that "*While Barki has made great strides in beginning to develop such a classification scheme, additional work needs to be done. To date, a comprehensive keyword classification scheme does not exist*". We support this view, as the majority of IS researchers will agree that IS research is constantly evolving, and therefore continuous efforts are required to identify and document new developments within the field.

Many lines of investigation on researching IS research have emerged since Barki et al. (1993) published their work. Although (due to space limitation) it is not possible to discuss all these studies within the scope of this paper, these works are listed in Table 1. All the studies listed in Table cite Barki et al.'s (1993) work which makes them relevant to this paper. Major lines of enquiry that have emerged include classification of IS research (Cheon et al. 1992; Glass et al. 2002; Ivari et al. 2004; Ramesh et al. 2004; Vessey et al. 2002;2005), and profiling research published in various IS journals and conferences. Concerning the latter, Avison et al. (2008) profiled 17 years of publications appearing in the Information Systems Journal and Dwivedi et al. (2008) profiled 8 years of publications appearing in the Journal of Electronic Commerce Research; both studies utilizing Barki et al.'s original classification scheme. Other lines of enquiry include profiling research on a particular topic (such as Abraham & Wankel's (1995) work on DSS and Lai's (1996) work on Database), examining the evolution of IS research in the national context (for example, Grant & Koop, 1995 examined the evolution of Canadian IS research and Ji et al. (2007) examined IS research within the Chinese context), North American vs. European IS research and authors and institutional productivity. These studies are briefly mentioned here, however interested readers may refer to the original sources.

Broad study area	Author & Year	Specific Research Issues
Keyword Analysis/ Classification	Cheon et al. (1992)	Classification
	Glass et al. (2002)	Classification
	Gorla & Walker (1998)	Keyword Analysis
	Iivari et al. (2004)	Classification
	Ramesh et al. (2004)	Classification
	Vessey et al. (2005)	Classification
	Vessey et al. (2002)	Classification
Journal/Conference Profiling Research	Avison et al. (2008)	Information Systems Journal
	Botha & Gaadingwe (2006)	SEC Conferences
	Claver, E. et al. (2000)	Information & Management & MISQ
	Dwivedi & Kuljis (2008)	European Journal of Information Systems
	Dwivedi et al. (2008)	Journal of Electronic Commerce Research
	Dwivedi et al. (2009)	Information Systems Frontiers
	Palvia et al. (2007)	Information & Management
	Whitley & Galliers (2007)	European Conference on Information Systems
Topic Profiling Research	Abraham & Wankel (1995)	DSS
	Barothy et al. (1996)	Economic information Systems
	Chen et al. (2008)	e-Learning
	Ford et al. (2003)	Hofstede's culture's consequences
	Gonzalez et al (2006)	Outsourcing
	Lai VS (1996)	Database
	Peppard et al. (2000)	Organizational Information Competencies
	Prasad & Tata (2005)	Role of Teams and Groups
	Sanders (2007)	e-business technologies
	Williams et al. (2009)	Adoption and Diffusion Research

IS Research in National Context	Grant & Koop (1995)	Canadian IS Research
	Ji et al. (2007)	IS Research in China
Comparative IS research	Evaristo & Karahanna (1997)	North American IS vs. European IS research
IS Industry & Practice	Banuls & Salmeron (2008)	Key areas in information technology industry
	Szajna (1994)	Practitioner concern
Productivity & Collaboration	Grover et al. (1992)	Institutional Productivity
	Oh et al. (2005)	Co-authorship and cross-disciplinary collaboration in IS research
	Grover & Malhotra (1999)	Interface between Operations & Information Systems
Methodological Issues	Cheon et al. (1993)	Empirical Research, IS Evolution & Maturity
	Ju et al. (2006)	Rigor in MIS survey research
	Freeman (2001)	Information Systems Knowledge
IS Education	Stolen (1993)	Development of IS Faculty

Table 1. Studies in the Area of IS Research Utilizing Barki et al.'s (1988; 1993) Studies

3. RESEARCH METHODOLOGY

The work presented in this paper employed bibliometric and keyword analysis (Barki et al., 1988; 1993; Gorla & Walker 1998) as a means of evaluating the evolution of IS research. A total of 24 IS journals were selected for the purpose of this study. The ISI Web of Knowledge *Journal Citation Report*® (JCR) *Science Edition* (Thomson Scientific Solutions, 2008) was used to compile this list of journals from the following JCR categories (a) Computer Science, Information Systems, (b) Computer Science, Software Engineering and (c). JCR was used as a reference point because of the following reasons; one, it is often used by researchers to find the journal impact factor, and two, the citation records for the journals included in JCR can usually be downloaded in ISI format from the ISI Web of Knowledge (WoK) website (Thomson Corp, 2008). The ability to download citation data in the structured ISI format was crucial for this research, since it facilitated automatic parsing of the *Author Keyword* field (ISI tag is DE) of all the 24 IS journals included in this study. ISI WoK indexes citation records associated with multiple ISI record types. Of these, citation records associated with ISI record type=(Article OR Review OR Bibliography) have only been selected for the purpose of this study (the ISI WoK website offers a user the ability to filter citation records based on ISI record type).

Table 2 lists the journals included in this study. For this paper we have only considered journals that have been published between 1990 and 2008 (see column: CLASSIFICATION PAPER-Years considered). However, for some journals the ISI database contains records only after 1990 and until 2007 (see column: ISI DATABASE-Years indexed). In this case, the years considered for the classification paper depends upon its availability in the ISI database (for example, the journal *Information Systems Frontiers* is indexed from 2001 to 2007 in ISI. Consequently, for our classification paper we consider citation records from 2001 to 2007 only). Table 2 also includes information such as the number of records that have been found (ISI record type=[Article OR Review OR Bibliography]) in the ISI database (see column ISI DATABASE-No. of records present), the total number of citation records downloaded in ISI format (see column CLASSIFICATION PAPER-No. of records taken), and the journal volume information.

SN	Journal Name	CLASSIFICATION PAPER		ISI DATABASE			
		No. of records taken	Years considered	No. of records present	Years indexed	Vol from	Vol to
1	ACM Transaction on Information Systems	291	1990-2008	304	1989-2008	7(1)	26(1)
2	Decision Support Systems	1,274	1991-2008	1274	1991-2008	7(2)	44(2)

3	European Journal of Information Systems	372	1995-2008	372	1995-2008	4(1)	16(6)
4	Information & Management	1004	1990-2008	1453	1983-2007	17(1)	44(8)
5	Information Systems	627	1990-2008	956	1978-2008	3(1)	33(2)
6	Information Systems Frontiers	206	2001-2007	206	2001-2007	3(3)	9(5)
7	Information Systems Management	549	1994-2007	549	1994-2007	11(4)	24(4)
8	Journal of Computer Information Systems	835	1994-2007	835	1994-2007	34(3)	48(2)
9	Journal of Information Science	771	1990-2008	1117	1979-2008	1(1)	34(1)
10	Journal of Information Technology	370	1993-2008	370	1993-2008	8(1)	22(4)
11	Journal of Management Information Systems	317	1999-2007	317	1999-2007	16(2)	24(3)
12	Journal of Organizational Computing & Electronic Commerce	140	1999-2008	140	1999-2008	9(4)	18(1)
13	Journal of Strategic Information Systems	210	1995-2007	210	1995-2007	4(1)	16(4)
14	MIS Quarterly	457	1990-2007	619	1984-2007	8(2)	31(4)
15	Wirtschaftsinformatik	932	1990-2008	932	1990-2008	32(1)	50(1)
16	Information Society	299	1997-2008	299	1997-2008	13(2)	24(1)
17	Information Systems Journal	213	1995-2007	213	1995-2007	5(2)	17(4)
18	Information Systems Research	303	1994-2007	303	1994-2007	5(1)	18(4)
19	International Journal of Electronic Commerce	181	2000-2007	181	2000-2007	4(3)	12(2)
20	International Journal of Information Management	554	1986-2007	618	1986-2007	6(1)	27(6)
21	International Journal of Technology Management	1337	1994-2008	1337	1994-2008	9(5)	41(4)
22	Communications of the ACM	2683	1990-2008	4327	1970-2008	13(3)	51(2)
23	Industrial Management & Data Systems	732	1990-2008	732	1994-2007	94(2)	107(9)
24	Journal of the Association for Information Systems	57	2006-2007	57	2006-2007	7(8)	8(10)

Table 2. Journals Considered in this Study

We divided the task of identifying new keywords from the downloaded ISI format datasets into six specific phases. Some of these phases were automated using either JAVA or Visual Basic for Application (VBA) programs, some phases were manual, and others comprised of both automated and manual operations. Following sections describes all phases in detail, and identifies the input requirement and output from each phase.

Phase 1

Using the *ParseISData* JAVA program to parse the journal-specific citation data (in ISI format) and count the occurrences of unique keywords. The program dumps this data (keywords and their frequencies) into a temporary Excel workbook. This journal-specific data is copied and pasted manually from the

temporary Excel workbook into an Excel workbook called *ISKeywords.xls*. For each of the 24 journals, the *ParseISData* program is run using different command line arguments and the data generated is copied into separate worksheets in file *ISKeywords.xls*. So output of this phase was *ISKeywords.xls* containing a total of 24 worksheets. Each worksheet contains data specific to a journal and has columns for keywords and their respective frequencies.

Phase 2

The VB6 / VBA implementation of Porter Stemming Algorithm (PSA) (Mustafee, 2003) is applied to keywords that are output from Phase 1. PSA is used in Information Retrieval as a term normalisation process in order to remove "the commoner morphological and inflexional endings from words in English" (Porter, 2008). For example, before using PSA the words (keywords in our case) *adaptive*, *adaptability*, *adaptation*, *adaption*, *adaptivity* are usually treated as five unique words by a Information Retrieval system (Phase 1 in our case). However, through the application of PSA in Phase 2 all these keywords will be treated as the same. This is possible because PSA will subject each keyword to a set of five different rules, which in-turn will create a normalised version of the keyword. We subsequently refer to this normalized keyword as *PSA meta-data.* For example, the *PSA meta-data* for the above mentioned keywords is "*adapt"*. Phase 2 also counts the occurrences of each unique *PSA meta-data*. For example, if the occurrence of the keywords *adaptive*, *adaptability*, *adaptation*, *adaption*, *adaptivity* are 1, 1, 3, 2, 1 respectively, then the *PSA meta-data "adapt"* will have a frequency 8. Output of this phase was the unique *PSA meta-data* and their corresponding frequencies.

Phase 3

VBA code is used to construct a matrix which shows the frequency of occurrence of each *PSA meta-data* in the 24 journals. Each row of the matrix thus contains a unique *PSA meta-data*; each column (except the first) refers to one of the 24 IS journals that is used in this study. Thus, if the *PSA meta-data "adapt"* is used in *EJIS*, *ISJ* and *MISQ*, then the columns associated with these journals will show the occurrence of *"adapt"* with its corresponding frequencies. This matrix is henceforth referred to as "*PSA meta-data and Frequency Matrix" (PmdFM)*. Output of this phase was the occurrences of *PSA meta-data* in the different journals *(PmdFM)*.

Phase 4

This phase is also referred to as PSA-destemmed. In this phase the *PSA meta-data* contained in *PmdFM* is destemmed, that is, the normalized keyword (see Phase 2) is de-normalized to show the all the unique keywords appearing in the different journals and their corresponding frequencies. Thus, if the keyword *adaptive*, *adaptability* and *adaptation* appeared once in *EJIS*, *ISJ* and *MISQ* respectively, then the *PmdFM* would have shown the frequency for *PSA meta-data "adapt"* as 1 for *EJIS*, *ISJ* and *MISQ* respectively. However, after Phase 4 it would show (1) a total frequency of 3 for *PSA meta-data "adapt"*, and (2) It will show the de-normalized form of *PSA meta-data "adapt"* and its corresponding occurrences and the respective journals. For example, *adaptive* (*EJIS*, 1), *adaptability* (*ISJ*, 1), *adaptation* (*MISQ*, 1). Output of this phase was the de-normalized forms of each *PSA meta-data*, along with its frequency and the journal they appear in.

Phase 5

A new worksheet called "KEYWORDS" is created in Excel workbook *ISKeywords.xls.* It lists all the keywords that have appeared in a previous classification paper (Barki et. al., 1993) in different columns, based on their hierarchy.

Phase 6

The PSA-de-stemmed keywords (see Phase 4) are compared with the keywords that have been identified in a previous study (see Phase 5). The PSA-destemmed keywords are contained in the worksheet "PORTERDESTEMMED", whilst the latter is present in worksheet "KEYWORDS". The keywords

already existing are explicitly indicated using a different colour in both the worksheets. Moreover, in the worksheet "PORTERDESTEMMED", the main category and sub-category/sub-categories (in relation to the previous study) that the PSA-destemmed keyword belongs to is also written (in Excel column starting from AW). Output of this phase was the *ISKeywords.xls* that highlights the keywords which have already been identified in a previous study, thereby implicitly indicating the new keywords.

4. FINDINGS

The findings of our analysis are presented in the following six subsections as per the six phases of methodology previously described.

Phase 1: Total keywords collected and most frequently used keyword from each source

Table 3 presents the number of keywords collected from each of the 24 journals. The largest number of keywords (C=4372) was collected from the *International Journal of Technology Management*, followed by *Decision Support Systems* with a keyword count of 3967. Table 3 also presents the most frequently utilized keywords: "innovation" was found to be the most frequently used with a keyword count of 159 followed by "decision support systems" (C= 125).

Journal Name	Unique keywords	Most occurring Keyword	Freq
ACM Transaction on Information Systems	1050	experimentation	87
Decision Support Systems	3967	decision support systems	54
European Journal of Information Systems	603	e-government	7
Information & Management	3290	decision support systems	56
Information Systems	1720	data mining	28
Information Systems Frontiers	879	web services	9
Information Systems Management	95	IS organization of the future	6
Journal of Computer Information Systems	1020	Knowledge Management	13
Journal of Information Science	874	Knowledge management	19
Journal of Information Technology	435	Information systems	8
Journal of Management Information Systems	1367	Knowledge management	22
Journal of Organizational Computing & Electronic Commerce	637	Electronic Commerce	22
Journal of Strategic Information Systems	698	Information Technology	18
MIS Quarterly	1575	IS management	19
Wirtschaftsinformatik	2667	Internet	18
Information Society	1031	Internet	42
Information Systems Journal	791	Information Systems	21
Information Systems Research	1355	Electronic Commerce	19
International Journal of Electronic Commerce	730	Electronic Commerce	19
International Journal of Information Management	775	Information technology	26
International Journal of Technology Management	4372	Innovation	159
Communications of the ACM	632	Design	8
Industrial Management & Data Systems	970	Information Systems	72
Journal of the Association for Information Systems	244	Information Systems	5

Table 3. Total Number of Keywords Collected from Various Sources, and Most Frequently Used Keyword From Each Source

Phase 2: Total numbers of PSA meta-data and most frequently used PSA meta-data from each source

Table 4 presents the number of PSA meta-data collected from each of the 24 journals. Data presented in this Table is similar to Table 3 with minor variations as meta-data is converted from the most frequently utilized keywords. Table 4 illustrates that the most frequently utilized PSA meta-data is "decis support system" as opposed to "innovation" in Table 3. This variation is a result of combining the count of all the variance of keyword "decision support systems".

Journal Name	Unique PSA meta-data	Most occurring PSA meta-data	Freq.
ACM Transaction on Information Systems	1016	experiment, algorithm	87
Decision Support Systems	3764	decis support system	179
European Journal of Information Systems	590	e-govern, inform system, case studi	7
Information & Management	3290	decis support system	67
Information Systems	1720	data mine	28
Information Systems Frontiers	879	web servic	12
Information Systems Management	95	IS organ of the futur	6
Journal of Computer Information Systems	1020	knowledg manag	13
Journal of Information Science	874	knowledg manag	19
Journal of Information Technology	435	inform system	8
Journal of Management Information Systems	1367	knowledg manag	22
Journal of Organizational Computing & Electronic Commerce	637	electron commerc	22
Journal of Strategic Information Systems	698	inform technolog	18
MIS Quarterly	1575	IS manag	19
Wirtschaftsinformatik	2667	Internet	18
Information Society	1031	Internet	42
Information Systems Journal	791	inform system	21
Information Systems Research	1355	electron commerc	19
International Journal of Electronic Commerce	730	electron commerc	19
International Journal of Information Management	775	inform technolog	26
International Journal of Technology Management	4372	innov	159
Communications of the ACM	632	design	21
Industrial Management & Data Systems	970	inform system	72
Journal of the Association for Information Systems	244	inform system	5

Table 4. Total Numbers of PSA Meta-data Collected from Various Sources, and Most Frequently used PSA Meta-data from each Source

Phase 3

The *PmdFM* matrix takes into consideration all 24 IS journals. From this matrix we get a total of 20194 unique PSA meta-data. However, the number of unique PSA meta-data that appears in more than one journal is 4020. The *PmdFM* matrix also shows that the total count of PSA meta-data is 49705.

Phase 4: Top ten occurrences of PSA meta-data

Table 5 presents the 10 most frequently occurring PSA meta-data which indicates that **"**decis support system" most frequently occurred followed by "information systems" and "information technology". The least occurring keyword in the top 10 list is "design".

PSA meta-data	PSA destemmed word	Freq
decis support system	decision support system, decision support systems	301
inform system	information system, information systems	296
inform technolog	information technology, information technologies	285
knowledg manage	knowledge management	281

electron commerc	electronic commerce	270
Innov	innovation, innovativeness, innovations	248
Internet	internet	243
case studi	case studies, case study	156
expert system	expert systems, expert system	153
Design	design	137

Table 5. The top ten occurrences of PSA meta-data, taking into consideration all the 24 IS journals

Phase 5

The analysis undertaken in this phase is not presented here as this phase only lists the keywords that have appeared in a previous classification paper (Barki et al. 1993).

Phase 6: List of Extracted Keywords

This is the final output of this study, highlighting the list of limited number of keywords with frequency equal to or more than 50 occurrences. Given an extremely large number of keywords (total count = 42050), it was not possible to present all keywords identified within this paper, therefore, we reduced the total number by restricting the minimum count of occurrences to 50. In the list presented in Table 6, keywords with a red font represent unique meta-data, regular (black) font represents keywords that were not included in Barki et al.'s (1993) study and keywords in blue font suggest that match for these keywords were found in Barki et al.'s classification scheme. Due to space limitation it is not possible to include the full list but it can be found at the web site http://resedata.googlepages.com/pacis2009. The length of the list clearly suggests that substantial changes/advancement in IS research occurred following Barki et al.'s (1993) classification. We also examined which keywords from Barki et al.'s (1993) study were not utilized by any study in the last 15 years of published research. Our findings suggest that there are many keywords which can be considered obsolete in today's context.

measur (76)	learn (61)	electron data interchang	simul (81)
measure	learning	electronic data interchange	simulations
measurement	collabor (63)	product (73)	simulation
measur	collaboration	production	integr (63)
measures	groupwar (62)	productivity	integration
measuring	groupware	product	integrity
e-commerc (127)	network (64)	products	integrated
e-commerce	networks	telecommun (56)	integrator
algorithm (101)	network	telecommunications	system develop (76)
algorithm	networking	telecommunication	systems development
algorithms	user interfac (54)	inform manag (72)	system development
internet (243)	user interfaces	information management	systems developers
internet	user interface	information managment	execut inform system (58)
model (94)	inform retriev (105)	competit (56)	executive information systems
model	information retrieval	competitiveness	executive information system
modeling	human factor (57)	competition	databas (53)
models	human factors	develop countri (59)	databases
modelling	manag (87)	developing country	database
world wide web (63)	management	developing countries	softwar develop (53)
world wide web	managers	qualiti (61)	software development
xml (53)	experiment (96)	quality	software developers
organiz chang (56)	experimentation	manufactur (54)	neural network (79)

organizational change	design (137)	manufacturing	neural network
organizational changes	design	suppli chain (55)	neural networks
group support system (99)	perform (118)	supply chain	inform system (296)
group support systems	performance	supply chains	information systems
group support system	performability	innov (248)	information system
data mine (117)	artifici intellig (55)	innovation	knowledg manag (281)
data mining	artificial intelligence	innovativeness	knowledge management
electron commerc (270)	expert system (153)	innovations	inform technolog (285)
electronic commerce	expert systems	trust (109)	information technology
machine learning	expert system	trust	information technologies

Legend: keywords in "red font" represent unique PSA meta-data; keywords in "regular (black) font" represent keywords not been included in Barki et al.'s (1993) study; keywords in "blue font" suggest that match for these keywords was found in Barki et al.'s classification scheme; and numbers in () represent the number of times each unique meta-data item appeared

Table 6. Example of some of the most frequently utilized keywords

5. CONCLUSIONS, LIMITATIONS, AND FUTURE WORK

This paper presents the results of a keyword analysis on keywords appearing in major peer-reviewed IS publications after 1990, by collecting all keywords in 24 peer reviewed IS journals and then identifying keywords not included in a previous IS classification scheme. The paper achieved this set aim by collecting and identifying all keywords as was planned in six distinct phases. Findings from the different phases are illustrated and described in the preceding section. The diversity of newly emerged keywords clearly suggests that the IS field has progressed and continuous efforts of IS researchers are required to monitor and document such evolution. We are therefore convinced that the comments by Gorla & Walker (1998) continue to hold true: "*While Barki has made great strides in beginning to develop such a classification scheme, additional work needs to be done. To date, a comprehensive keyword classification scheme does not exist*". Our efforts therefore make an incremental contribution toward classifying IS research, and are useful for researchers in developing an understanding of the area and evolution of the IS field, and also has implications for improving information search and retrieval activities within IS research.

As with any research, this paper suffers from a number of limitations. There are numerous journals within the IS field, however, due to time and resource constraints, we have only considered 24 of them for analysis. There is a possibility that some unique keywords may have appeared in journals excluded from this study. However, this provides an avenue for future research.

This research in progress work has identified and presented the keywords appearing within the last 15 years of IS publications in a selected number of journals. The full potential of this research can only be realized once keywords identified within this research can be consolidated with previous works (Barki et al, 1993; Gorla and Walker 1998) to form an updated IS classification scheme. Our next effort will be to form a refined list of keywords and then to follow Barki et al.'s (1988; 1993) approach to allocate each keyword to an appropriate category. By doing so, we will evaluate if the Barki et al's (1993) nine categories for classifying IS research are still relevant or whether it is time to make appropriate modifications.

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