Methodological and Topic Trends in Information Systems Research: A Meta-Analysis of IS Journals

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Keywords: researchers | information systems | journals

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In this paper, we present trends in IS research during a 10-year period (2004 to 2013). Much like its predecessor, Palvia et al. (2004), we provide a long-overdue update. We reviewed all papers from seven major IS journals and coded them based on topics studied, methodologies used, models rendered, and paradigmatic approaches taken. We captured trends in IS research and compared them to previous trends that extend across many periods from past studies. We present major shifts and trends in IS research and discuss voids in the literature. Results reveal that electronic commerce was the most studied topic and that the survey method maintained its dominance in conducting research. Also, the majority of IS researchers used the multi-tier influence diagrams to portray their research models, and the positivist approach was still the most used research approach.

Keywords: Information Systems Research, Methodologies, Research Approaches, Topics, Paradigms, IS Journals.

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1 Introduction

Information systems (IS) is still a young field with rapidly expanding boundaries and is assimilating new topics all the time. This dynamic nature of the IS field calls for a shifting focus of effort to address the plethora of issues that require varied combinations of methodologies, models, and paradigmatic approaches. The field's diverse and rapid expansion makes it difficult for researchers to track major research trends and issues. Therefore, with this paper, we inform the IS community about research trends in topics, methodologies, models, and broader approaches. Such periodic introspection is useful and has the potential to improve the progress of research in the IS field (Webster & Watson, 2002). Similar to Palvia et al. (2004), we specifically examine the following items over a 10-year period (2004 to 2013): 1) research topics, 2) research methodologies, 3) research models, and 4) paradigmatic approaches. We also compare our results with Palvia et al.'s study, which covered the 1994 to 2003 period, and also incorporates the preferences of various journals.

Meta-analysis is a useful tool for capturing the information that we seek to generate and further analyzing it. As Stemler (2001) has pointed out, meta-analyses enable researchers to navigate a massive knowledge base with relative ease and systematic methods. In our study, we generated our data by reviewing seven important journals in the IS field to create a massive database containing information from over 2400 journal papers. This information included journal names, the papers' year of publication, and the papers' research topics, methodologies, models, and paradigmatic approaches. We conducted this study to provide an update to and enhance a previous study conducted more than ten years ago (i.e., Palvia et al., 2004). With the two papers in total, we have analyzed IS papers from 1993-2013—a 21-year period

In the early years of IS field, many researchers published meta-analyses and literature reviews. As Palvia et al. (2004) discuss, Culnan and Swanson (1986), Alavi and Carlson (1992), and Grover, Lee, and Durand (1993) conducted meta-analysis studies. Subsequently, Palvia, Mao, Salam, and Soliman (2003) and Palvia et al. (2004) did as well. However, we can find no comprehensive meta-analysis studies that have covered the overall IS literature since that time. Still, we did find specific examples addressing specific topic domains and world regions. For example, Gonzalez, Gasco and Llopis (2006) analyze the literature on information systems outsourcing for an 18-year period (1988-2005) and base their results on 131 papers. Kohli and Devaraj (2003) examine firm-level empirical research on IT investment payoffs and review 66 studies. King and He (2006) review 88 published papers on the technology acceptance model. Palvia, Pinjani, and Sibley (2007) analyze all papers in the journal Information & Management over in a 13-year period. Serenko, Cocosila and Turel (2008) examine Canadian IS research by examining 358 papers over a 30-year period in ASAC IS Division proceedings. Serenko and Jiao (2012) further examine Canadian IS research by examining papers published by Canadian researchers in peer-reviewed journals.

Thus, to the best of our knowledge, no recent comprehensive study that overviews the state and trends in IS research, taken as a whole, exists. However, it appears that we certainly need more contemporary information on the IS field's current state and trends, which the number of citations to the previous comprehensive studies and informal conversations with IS researchers and journal editors evidence. We believe that the lack of a comprehensive study is due to the huge enormity of resources required to conduct such a study. After all, collecting data about several thousand papers over a 10-year period is no small feat and requires more than a thousand hours of dedicated time.

This paper proceeds as follows: in Section 2, we briefly review the methodological framework we used to analyze the papers, which includes journal selection and coding schemes. In Section 3, we provide the results from the literature analysis and coding. This section includes trends of methodology, topics, research models, and paradigmatic approaches. It also compares the 2004-2013 period with the 1993-2003 period. In Section 4, we more deeply analyze the papers, which includes discussing major changes in the 20-year period and publication patterns in specific journals. Finally, in Section 5, we conclude the paper.

2 Methodology

Cumbie, Jourdan, Peachy, Dugo, and Craighead (2005) outline a three-phase process for meta-analysis projects. In the first phase, the researcher collects a representative pools of papers. In the second phase, the researcher classifies these papers into an appropriate framework. In the third phase, the researcher

evaluates and synthesizes the data. As such, we first reviewed and coded all papers in seven important journals for the 2004-2013 period. Second, we developed a four-dimensional framework comprising topics, methodologies, models, and paradigmatic approaches for classifying each research paper. We assigned each paper with codes for each of the four dimensions. Finally, the analysis included activities such as connecting, comparing and explaining (Levy & Ellis, 2006). This final phase helps identify research gaps and forecast future trends in research (Webster & Watson, 2002). Based on these three phases, our methodological framework is shown in Figure 1.

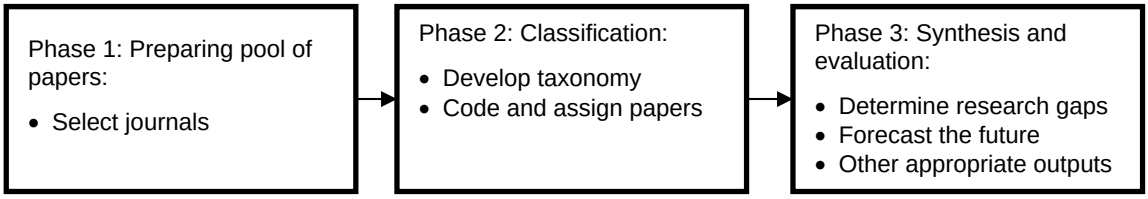

Figure 1. Research Method (Adapted from Cumbie et al., 2005; Levy & Ellis, 2006)

2.1 Journal Selection

For creating a pool of papers, Webster and Watson (2002) argue that researchers should employ a high-quality selection focused on concepts. Therefore, we focused primarily on top-ranked IS journals. Because this current paper extends Palvia et al. (2004), we focused on the journals that Palvia et al. (2004) use (with minor changes) to maintain consistency and integration with that study. The journals we selected are considered top-ranking publications in the IS field (Lowry, Romans, & Curtis, 2004; Peffers & Ya, 2003). In all, we examined seven journals' publications from 2004 to 2013. The previous study examined journals until 2003, so we started from 2004. We stopped at the year 2013 because it was the last full year of full data that was available at the time we collected data in late 2014. In all, we examined a total of 2610 papers (see Table 1).

We did not include two journals from Palvia et al. (2004): *Management Science* and *Communications of the ACM* (*CACM*). *INFORMS,* the publisher *of Management Science*, started publishing *Information Systems Research (ISR)* in the 1990s. As a result, *Management Science* has published fewer IS papers in recent years. As for *CACM*, it shifted its focus from academia to practitioners about a decade ago. While we excluded these two journals, we added two journals to our list. The first was the *Journal of the Association for Information Systems* (*JAIS*). .*JAIS* was introduced by the Association for Information Systems, the premier organization for IS academics, has a strong theory focus, and is being increasingly recognized as a top-tier journal.

We realized that the journals examined in Palvia et al. (2004) have a strong ethnocentric American perspective. Thus, the results may be more indicative of research contexts in the US. Therefore, we included *the European Journal of Information Systems* (*EJIS*) in our selection. *EJIS* is an important outlet for IS research outside the United States and represents research in other countries. The inclusion of this journal helps reduce the potential bias toward U.S.-centric publications.

Table 1. List of Selected IS Journals and Number of Papers (2004-2013)

Journal	Number of issues	Number of papers
Management Information Systems Quarterly (*MISQ*)	41	392
Journal of the Association for Information Systems (*JAIS*)	116	276
Journal of Management Information Systems (*JMIS*)	42	384
Decision Sciences Journal (*DS*)*	42	104
European Journal of Information Systems (*EJIS*)	56	402
Information and Management (*I&M*)	71	558
Information Systems Research (*ISR*)	40	371
Total	**408**	**2487**
* In the *Decision Science Journal*, we did not review all papers. We reviewed only the IS-relate papers (approximately one third of the total published papers).		

2.2 Classification

Researchers have developed most of the classification frameworks in IS research based on multiple dimensions. The majority of meta-analysis projects code papers based on a combination of two or more of the following four dimensions: research topic, research model, research methodology, and paradigmatic research approach. For example, Claver, González, and Llopis (2000) study the research topics and research methodology in IS research. Gonzalez et al. (2006) examine the literature on IS outsourcing based on topic and methodology. Alavi and Carlson (1992) examine IS papers for research topics, theme, and research approach. Chen and Hirschheim (2004) use two dimensions of research methodology and research approach to examine IS publications. Our review and coding captures all of these four dimensions. Due to the scope of the study, we did not examine authors and affiliated universities. In Sections 2.2.1 to 2.2.4, we describe each dimension.

2.2.1 Research Methodologies

Table 2 shows the research methodologies we used to classify the papers, which we adapted from Palvia et al. (2003). We made some minor changes and relabeled some methodologies.

Table 2. Research Methodology Classification

1.	Speculation/commentary	8.	Field experiment
2.	Frameworks and conceptual model	9.	Laboratory experiment
3.	Literature review	10.	Design science
4.	Literature analysis	11.	Mathematical modeling
5.	Case study	12.	Qualitative research
6.	Survey	13.	Secondary data
7.	Field research	14.	Content analysis

2.2.2 Research Models

Models are logical depictions for describing and explaining the relationships between variables and constructs. Levy and Ellis (2006) describe a model and a theoretical framework as "a generalized type of theory that indicates relationships between constructs or latent variables" (p. 198). Vessey, Ramesh, and Glass (2002) introduced categorization of research models. This categorization includes listing of variables, influence diagram, mathematical model, and combination. Palvia, Midha, and Pinjani (2006) extend and formalize this categorization. We use the Palvia et al. (2006) categorization as being the latest and most comprehensive to date (Table 3).

Table 3. Research Model Categorization

1.	No model	7.	Temporal influence diagram
2.	Listing of variables	8.	Simple grid
3.	Listing of variables & levels	9.	Complex grid
4.	Listing of variables & implicit relationships	10.	Venn diagram
5.	Simple influence diagram	11.	Mathematical model
6.	Multi-tier influence diagram	12.	Combination

2.2.3 Paradigmatic Research Approaches

Orlikowski and Baroudi (1991) discuss three major research approaches in information system research: positivist, interpretive, and critical. We add "mixed" and "descriptive" to this list. The mixed approach combines elements of positivist and interpretive research and qualitative and quantitative methods (Venkatesh, Brown, & Bala, 2013). The descriptive approach captures papers that only describe phenomena without attempting to build or test theory.

2.2.4 Topics

Alavi and Carlson (1992) first discussed research topics in the literature, and Barki, Rivard, and Talbot (1993) developed a keyword classification scheme that one can use as the basis for IS research topics. After these publications, different authors have improved the classification of topics. Some authors have used construct classification that the AIS has proposed for topic analysis (Levy & Ellis, 2006). In their 2004 paper, Palvia et al. (2004) use the top three levels of Barki et al. (1993) for developing their topics. In

order to maintain consistency and conformity with previous research, we continue the same approach. We added several topics to Palvia et al.'s (2004) list based on new research topics and trends in IS research. We added some topics at the outset of the study. We cleaned or eliminated a select few. We discovered and added some more topics during the coding process. Table 4 presents the final topic classification.

Table 4. List of Topic Classification

1. Big data 2. Business intelligence/data analytics/expert system 3. Business process 4. Cloud computing 5. Customer relationship management (CRM) 6. Databases 7. Decision support system & executive IS 8. E-government 9. Electronic commerce/business 10. End user computing 11. Enterprise resource planning (ERP) 12. Environment of IT: internal or external 13. Global information technology (GIT) 14. Group support systems 15. Hardware 16. Health information technology 17. Innovation 18. Internet 19. Inter-organizational systems 20. IS design and development 21. IS education 22. IS evaluation	23. IS functional applications 24. IS implementation 25. IS management and planning 26. IS research 27. IS staffing 28. IS usage/adoption 29. IT and culture 30. IT value 31. Knowledge management 32. Media and communications 33. Mobile computing 34. Organizational design 35. Outsourcing and offshoring 36. Project management 37. Security and privacy 38. Social media and social computing 39. Social networks 40. Societal issues 41. Software and programming languages 42. Supply chain management 43. Sustainability 44. Telecommunications and networking 45. Virtual teams

As we state before, prior IS meta-research studies (e.g., Chen & Hirschheim, 2004; Claver et al., 2000) have mostly used two of the above four classification dimensions and, in some cases (e.g., Alavi & Carlson, 1992; Palvia et al., 2007), three or more dimensions. McLaren and Vuong (2008) argue that using fewer dimensions results in high level clustering of SCIS that do not result in enough detail expected from classifications. As such, our study introduces a more comprehensive framework examining all four dimensions to yield richer insights. Figure 2's dimensional framework can represent three of the four dimensions; one can evaluate the fourth "topic" dimension by any combination of the other three, namely: methodology, research model, and research approach.

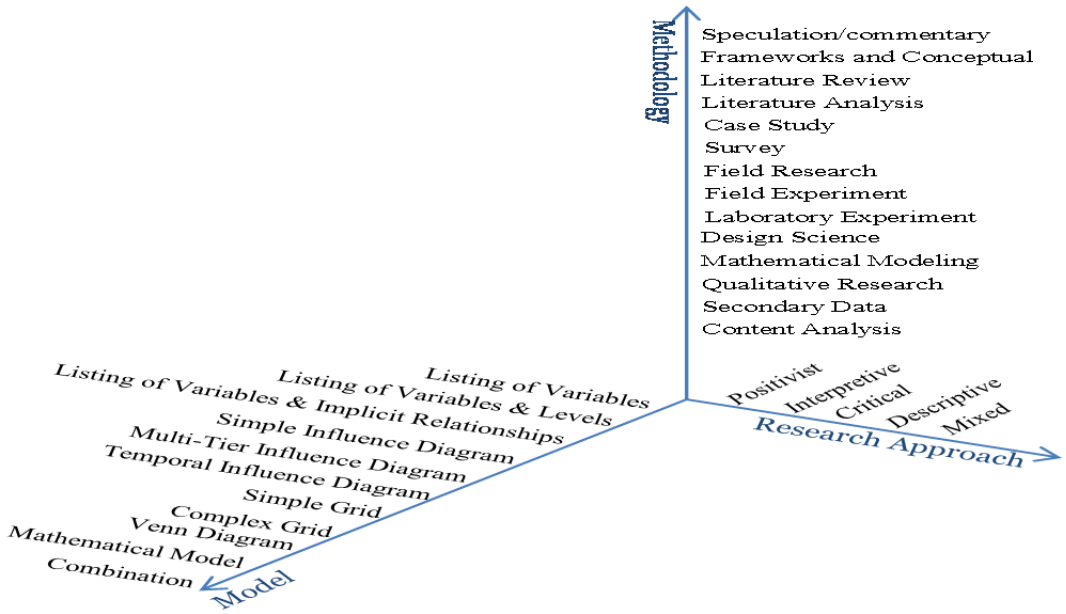

Figure 2. A Dimensional Classification Framework for IS Research

2.3 Coding

While each paper normally has one main topic, one predominant model, and one methodology, some papers deal with multiple topics, use more than one model, and may employ multiple methodologies. In order to accommodate this possibility, we allowed up to three topics, two models, and two methodologies for each paper.

We reviewed a total of 2487 papers from 2004 to 2013 from the above seven journals and coded them using the proposed framework. To determine the topic category, we analyzed each paper based on its title, keywords, and abstract, which several IS authors have used (e.g., Grover et al., 1993; Farhoomand & Drury, 1999; Ives, Hamilton, & Davis, 1980). For the other three dimensions, following the approach that Weber (1990) discusses, we examined both the abstract and the paper content.

Four IS doctoral students (also the co-authors of this paper) coded the papers during the Autumn 2014 semester. To make valid inferences from the text and to increase reliability, they observed the following rules (Stemler, 2001):

1. To enhance the uniformity of coding and to reduce the ambiguity of coding, the coders were trained on coding methods as a part of a seminar course on research methods.
2. To prevent artificially inflated similarity results (Krippendorff, 2012), we developed standard definitions for the methodology, model, and research approach categories.
3. To remove the effect of chance from our calculations, we used both inter-coder reliability (Weber, 1990) and Cohen's kappa (Cohen, 1968).

We calculated the inter-coder reliability and Kappa in a two-phase process. In the first phase, the PhD students coded 50 papers and compared them. Table 5 shows the results of the first phase.

Table 5. Phase One Inter-coder Reliability

	Coder 2		Coder 3		Coder 4	
	R*	K**	R	K	R	K
Coder 1	73%	73%	79%	79%	83%	83%
Coder 2			69%	69%	75%	75%
Coder 3					82%	82%

* Reliability, ** kappa
Since there are many different options to choose for topic, methodology, and model, the probability of getting the same result by accident is almost 0 and Kappa almost equalled inter-coder reliability.

Stemler (2001) suggests that a 61-80 percent interval for Cohen's kappa is considered substantial and a 81-100 percent interval is considered almost perfect; therefore, the results in Table 5 show that we achieved more than adequate values for all pairs. While Cohen's kappa was in good standing, inter-coder reliability for some pairs was not above the 80 percent mark as recommended in the literature. Therefore, the students discussed their results with one another in several sessions to resolve differences in interpretation. Thereafter, they individually coded another set of 30 papers. Table 6 presents the results of inter-coder reliability. This time all the student achieved a reliability greater than 80 percent. The Cohen's kappa index improved as well and was very high for all six pairs.

Table 6. Phase Two Inter-coder Reliability

	Coder 2		Coder 3		Coder 4	
	R*	K**	R	K	R	K
Coder 1	85%	85%	88%	88%	88%	88%
Coder 2			86%	86%	89%	89%
Coder 3					88%	88%

3 Results

We discuss the results first for each classification dimension. In each dimension, we examine the most significant issues and also report trends and major changes.

3.1 Topics, Usage and Trends

Table 7 shows the number of topics studied by all papers from 2004 to 2013 in the seven IS journals. Electronic commerce/electronic business, IS usage/adoption, and IS research were the most frequently studied topics. Electronic commerce/electronic business topped the list with 12 percent of the total papers. IS usage/adoption and IS research were at 9 percent and 8 percent, respectively. Besides these three topics, the next seven in the top-ten topics were: security and privacy (5%), knowledge management (4%), software and programming (4%), IS design and development (4%), IS management and planning (4%), IT value (3%), and outsourcing and offshoring (3%).

Table 8 compares topics for the last two long periods: 1993 to 2003 and 2004 to 2013. It shows that electronic commerce/business, IS design and development, IS research, IS usage adoption, resource management, and knowledge management are the most frequently studied topics in the last 32 years. Figure 3 provides a visual trend analysis of the top ten important research topics from 2004 to 2013. It is easy to see that research into electronic commerce/business, IS usage/adoption, IS research, and security and privacy have gotten pretty large over the years. Research in IT value, software and programming languages, and IS design/development has remained relatively steady, and research in knowledge management and outsourcing and offshoring has shown some decline. On a relative basis, IS management and planning research has seen the largest surge in the past few years.

Table 7. Usage and Ranking of Research Topics from 2004 to 2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total	Percent
Electronic commerce/business	36	30	43	26	33	34	33	38	39	35	347	12%
IS usage/adoption	18	24	36	35	25	19	19	24	31	29	260	9%
IS research	12	7	26	25	28	21	11	22	40	31	223	8%
Security and privacy	6	5	15	9	13	16	16	16	17	17	130	5%
Knowledge management	4	27	24	14	10	8	13	12	10	6	128	4%
Software and programming languages	9	4	9	15	9	19	18	8	13	9	113	4%
IS design and development	12	11	17	10	7	15	12	7	8	13	112	4%
IS management and planning	9	6	14	3	7	6	21	10	6	19	101	4%
IT value	9	8	6	8	7	11	9	10	18	10	96	3%
Outsourcing and offshoring	4	7	9	3	19	13	12	4	11	9	91	3%
Inter-organizational systems	2	9	8	8	11	11	7	5	11	5	77	3%
Internet	6	4	13	10	8	6	10	3	5	5	70	2%
IS evaluation	9	8	12	4	4	5	10	1	2	13	68	2%
Social networks	3	1	1	5	7	5	9	7	12	16	66	2%
Health information technology	0	5	0	13	5	9	3	17	7	7	66	2%
Social media and social computing	1	1	0	4	7	6	3	17	6	19	64	2%
Decision support system & executive IS	7	4	3	7	12	5	8	7	7	3	63	2%
Enterprise resource planning (ERP)	5	10	5	9	4	5	11	2	5	5	61	2%
Virtual teams	7	1	4	7	6	5	7	9	8	4	58	2%
IS implementation	3	2	10	5	8	2	3	7	3	7	50	2%
IS staffing	2	1	3	4	6	6	2	7	7	11	49	2%
Project management	2	0	4	7	7	6	8	2	2	11	49	2%
Innovation	4	3	4	6	4	7	7	3	2	7	47	2%

Table 7. Usage and Ranking of Research Topics from 2004 to 2013

Supply chain management	5	5	6	2	3	11	7	4	2	1	46	2%
Business process	1	4	6	8	3	2	5	3	3	8	43	1%
Global information technology (GIT)	3	1	6	7	3	2	10	2	1	4	39	1%
E-government	1	2	2	9	4	1	5	5	2	6	37	1%
Databases	3	3	4	2	3	2	5	2	7	2	33	1%
Group support systems	6	4	3	4	5	2	4	2	2	1	33	1%
Business intelligence/data analytics/expert system	3	6	0	1	2	1	2	1	10	7	33	1%
Customer relationship management (CRM)	5	3	4	1	2	2	2	3	6	3	31	1%
IT and culture	2	1	6	4	3	4	1	3	3	3	30	1%
IS functional applications	2	2	1	1	3	6	2	9	1	2	29	1%
Societal issues	2	1	1	6	1	4	2	3	5	4	29	1%
Mobile computing	0	2	9	1	3	1	2	1	1	1	21	1%
End user computing	2	1	0	0	4	1	3	1	4	2	18	1%
Environment of IT: internal or external	1	4	0	0	1	0	1	6	1	1	15	1%
Media and communications	0	3	0	1	0	1	2	3	2	2	14	0%
IS Education	1	0	1	2	5	3	0	1	0	0	13	0%
Telecommunications and networking	0	1	2	0	0	1	1	1	2	5	13	0%
Sustainability	0	0	0	0	0	1	2	1	0	4	8	0%
Organizational design	0	0	0	1	0	0	0	1	0	0	2	0%
Big data	0	0	0	0	1	0	0	0	0	1	2	0%
Hardware	0	0	0	0	0	0	0	1	1	0	2	0%
Cloud computing	0	0	0	0	0	0	0	0	0	1	1	0%
Total	207	221	317	287	293	285	308	291	323	349	2881	100%
Note: The total number of topics is more than the number of papers because of possible multiple topics per paper.												

Table 8. Usage and Ranking of Research Topics from 2003 to 2013

	1993-2003			2004-2013			1993-2013		
	Total Papers	Total (%)	Rank	Total Papers	Total (%)	Rank	Total Papers	Total (%)	Rank
Electronic commerce/business	153	4%	6	347	12%	1	500	8%	1
IS usage/adoption	228	6%	3	260	9%	2	488	7%	2
IS design and development	258	7%	2	112	4%	7	370	6%	3
IS research	134	4%	11	223	8%	3	357	5%	4
Resource management/ IS issues	343	9%	1	0	0%	46	343	5%	5
Knowledge management	193	5%	5	128	4%	5	321	5%	6
IS Evaluation	201	6%	4	68	2%	13	269	4%	7
Software and programming languages	139	4%	10	113	4%	6	252	4%	8
IS management and planning	102	3%	18	101	4%	8	203	3%	9
Internet	114	3%	15	70	2%	12	184	3%	10
Security and privacy	49	1%	26	130	5%	4	179	3%	11
Decision support system & executive IS	113	3%	16	63	2%	17	176	3%	12

Table 8. Usage and Ranking of Research Topics from 2003 to 2013

Telecommunications and networking	147	4%	7	13	0%	39	160	2%	13
IS functional applications	129	4%	13	29	1%	33	158	2%	14
Group support systems	118	3%	14	33	1%	28	151	2%	15
Environment of IT: internal or external	132	4%	12	15	1%	37	147	2%	16
IT value	46	1%	27	96	3%	9	142	2%	17
Theory of MIS	141	4%	9	0	0%	46	141	2%	18
EUC	141	4%	8	0	0%	46	141	2%	18
IS implementation	79	2%	20	50	2%	20	129	2%	20
IS staffing	73	2%	21	49	2%	21	122	2%	21
Databases	84	2%	19	33	1%	28	117	2%	22
Innovation	69	2%	23	47	2%	23	116	2%	23
Enterprise resource planning (ERP)	55	2%	24	61	2%	18	116	2%	23
Global information technology (GIT)	71	2%	22	39	1%	26	110	2%	25
Outsourcing and offshoring	19	1%	31	91	3%	10	110	2%	25
Organizational design	105	3%	17	2	0%	42	107	2%	27
Supply chain management	55	2%	0	46	2%	24	101	2%	28
Inter-organizational systems	0	0%	0	77	3%	11	77	1%	29
Social networks	0	0%	0	66	2%	14	66	1%	30
Health information technology	0	0%	0	66	2%	14	66	1%	30
Social media and social computing	0	0%	0	64	2%	16	64	1%	32
Virtual teams	0	0%	0	58	2%	19	58	1%	33
Media and communication	52	1%	25	0	0%	46	52	1%	34
Project management	0	0%	0	49	2%	21	49	1%	35
IS education	35	1%	28	13	0%	39	48	1%	36
Business process	0	0%	0	43	1%	25	43	1%	37
Customer relationship management	6	0%	33	31	1%	31	37	1%	38
E-government	0	0%	0	37	1%	27	37	1%	38
Bus. intelligence/analytics/expert system	0	0%	0	33	1%	28	33	1%	40
Multimedia	32	1%	29	0	0%	46	32	0%	41
IT and culture	0	0%	0	30	1%	32	30	0%	42
Societal issues	0	0%	0	29	1%	33	29	0%	43
Mobile computing	0	0%	0	21	1%	35	21	0%	44
EIS	20	1%	30	0	0%	46	20	0%	45
Hardware	18	0%	32	2	0%	42	20	0%	45
End user computing	0	0%	0	18	1%	36	18	0%	47
Media and communications	0	0%	0	14	0%	38	14	0%	48
Sustainability	0	0%	0	8	0%	41	8	0%	49
Big data	0	0%	0	2	0%	42	2	0%	50
Cloud computing	0	0%	0	1	0%	45	1	0%	51

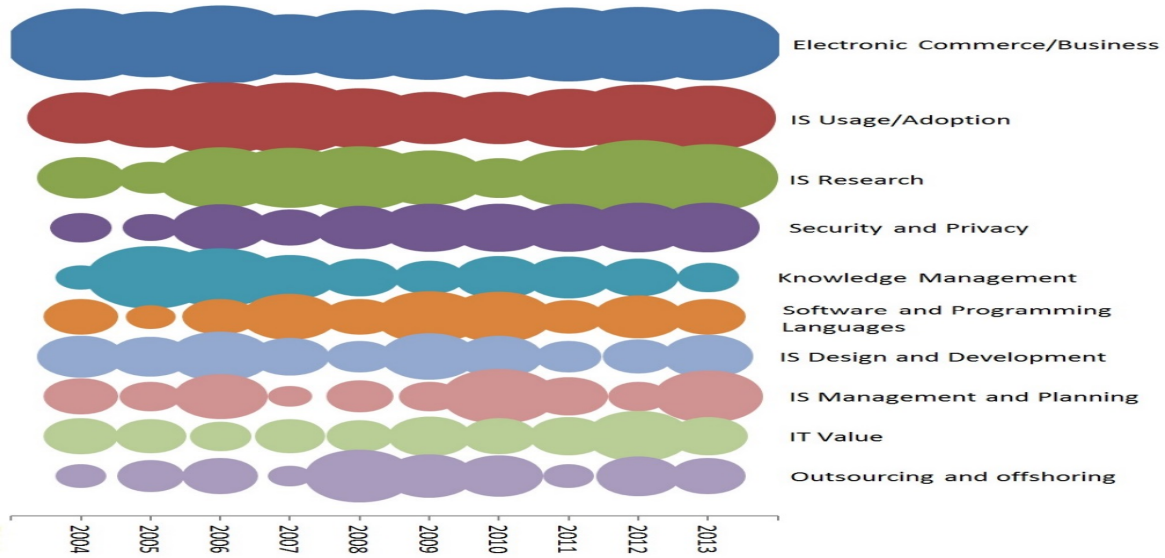

Figure 3. Important Research Topic Trends in IS from 2004 to 2013

3.2 IS Methodology Trends

Table 9 compares the most frequent IS research methodologies from 1993 to 2003 and 2004 to 2013. Survey was the most commonly used methodology for these two periods. The table illustrates that 21.5 percent of the papers used survey as their primary methodology during 1993 to 2003, and 26 percent used survey as their primary methodology during 2004 to 2013. Other popular methodologies from 2004 to 2013 were: laboratory experiment (10.4%), case study (9.9%), secondary data (10.1%), and mathematical modeling (7.5%). Table 10 provides the trend year by year for each methodology from 2004 to 2013. Figure 4 graphically represents these trends, and it clearly shows that survey was consistently the dominant methodology followed about equally by laboratory experiment, secondary data, and case study. The methodologies receiving the least traction were field experiments, literature review, and design science. However, note that design science's emergence as an accepted methodology in the 2004-2013 has been phenomenal compared to its virtual non-existence during 1993-2003. Also note that we did not include "interviews" as a separate methodology in our study because it is often a part of case studies and other qualitative methodologies.

Table 9. Rank of Research Methodology Based on Count and Percentage of Papers Using it

	1993-2003				2004-2013				1993-2013	
	Primary methodology count	Secondary methodology count	Total (%)	Rank by total	Primary methodology count	Secondary methodology count	Total (%)	Rank by total	Total (%)	Rank by total
Survey	482	55	537 (21.5%)	1	655	27	682 (26%)	1	1219 (23.8%)	1
Laboratory experiment	233	45	278 (11.1%)	3	263	10	273 (10.4%)	2	551 (10.7%)	2
Case study	203	31	234 (9.3%)	5	251	10	261 (9.9%)	4	495 (9.6%)	3
Frameworks and conceptual model	260	28	288 (11.5%)	2	167	4	171 (6.5%)	7	459 (8.9%)	4
Mathematical modeling	212	45	257 (10.3%)	4	195	2	197 (7.5%)	5	454 (8.8%)	5
Secondary data	67	44	111 (4.4%)	10	246	19	265 (10.1%)	3	376 (7.3%)	6
Field research	134	28	162 (6.4%)	7	171	10	181 (6.9%)	6	343 (6.7%)	7
Speculation/ commentary	202	24	226 (9%)	6	89	0	89 (3.4%)	10	315 (6.1%)	8

Literature analysis	84	32	116 (4.6%)	8	85	2	87 (3.3%)	11	203 (3.9%)	9
Qualitative research	8	12	20 (0.8%)	14	138	18	156 (5.9%)	8	176 (3.4%)	10
Content analysis	25	8	33 (1.3%)	13	89	15	104 (3.9%)	9	137 (2.6%)	11
Interview	58	56	114 (4.5%)	9	0	0	0 (0%)	15	114 (2.2%)	12
Literature review	32	19	51 (2%)	12	42	5	47 (1.7%)	13	98 (1.9%)	13
Field experiment	52	14	66 (2.6%)	11	30	2	32 (1. 2%)	14	98 (1.9%)	13
Design science	N/A	N/A	0 (0%)	15	66	5	71 (2.7%)	12	71 (1.3%)	15
Total	2052	441	2493		2487	129	2616		5109	
Note: we added design science to methodologies in this current study We include interview with case study and quantitative research										

Table 10. Methodology Trends over 2004-2013

	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**Total**
Survey	55	52	81	86	70	71	61	70	73	63	682
Laboratory Experiment	27	27	32	19	31	27	22	40	18	30	273
Secondary Data	14	11	28	11	17	24	35	30	50	45	265
Field Research	7	14	25	18	14	11	30	9	18	35	181
Case Study	16	25	38	25	30	27	24	21	23	32	261
Frameworks and Conceptual Model	16	11	24	12	16	17	17	15	19	24	171
Mathematical Modeling	11	21	10	19	13	20	29	26	31	17	197
Qualitative Research	27	18	13	9	12	12	15	22	19	9	156
Speculation/commentary	6	3	10	8	11	4	17	8	9	13	89
Literature Analysis	6	4	7	12	9	10	2	10	15	12	87
Design Science	1	7	4	11	14	9	7	4	4	10	71
Literature Review	1	3	5	5	7	7	7	3	6	3	47
Content Analysis	5	8	10	10	4	6	13	6	16	26	104
Field Experiment	2	5	1	4	5	1	0	7	3	4	32
Total	194	209	288	249	253	246	279	271	304	323	2616

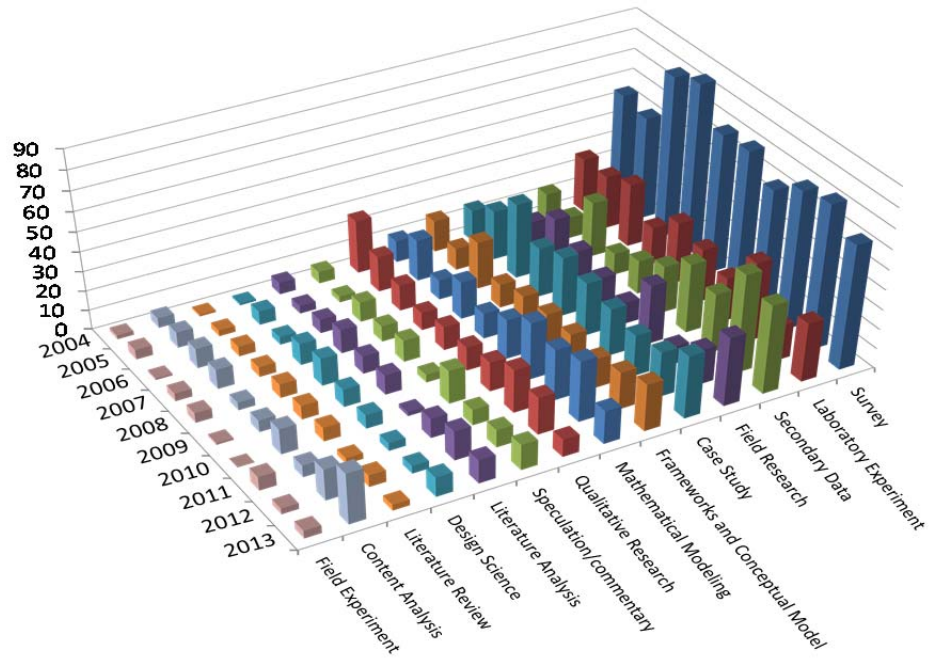

Figure 4. Methodology Trends (2004-2013)

3.3 Models Trend

Table 11 presents IS research model trends. Multi-tier influence diagram was by far the most frequent research model in IS research from 2004 to 2013. Note that a significant number of publications employed "no model", simple influence diagram, listing of variables, and mathematical models.

Table 11. Model Trends During 2004-2013

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total	Total (%)
Multi-tier influence diagram	72	78	115	99	108	86	94	105	109	115	981	39%
No model	23	26	37	43	34	48	54	29	39	53	386	16%
Simple influence diagram	29	27	42	33	33	31	39	37	27	37	335	13%
Listing of variables	30	21	38	26	28	28	24	39	53	29	316	13%
Mathematical model	14	18	17	22	24	29	23	34	42	36	259	10%
Listing of variables & levels	9	11	9	3	11	5	9	7	10	6	80	3%
Combination	1	3	7	6	3	1	2	5	4	18	50	2%
Listing of variables & implicit relationships	6	7	1	3	3	2	4	1	2	1	30	1%
Temporal influence diagram	0	6	2	2	2	1	2	1	3	3	22	1%
Venn diagram	0	1	1	0	1	1	3	0	0	0	7	0%
Simple grid	2	1	0	2	2	1	4	2	1	3	18	1%
Complex grid	0	0	0	0	0	0	1	0	1	0	2	0%
Total	186	199	269	239	249	233	259	260	291	301	2486	100%

3.4 Research Approach

Table 12 presents IS research approach trends. Positivist research was the most frequently used research approach from 2004 to 2013. In total, 72.3 percent of the papers in this period used the positivist paradigm of research. Around one-fifth of the papers took an interpretive approach for their research. Although Palvia et al. (2004) do not capture this dimension, we contend that the interpretive approach is

now taken by a significant number of papers and is commanding healthy respect from many IS researchers. We can readily observe this trend by comparing the interpretive approach's use year-to-year during 2004 to 2013 (i.e., the number of papers more than doubled in the ten years).

Table 12. IS Research Approach During 2004-2013

Approach	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Total	Total (%)
Positivist	147	157	180	156	182	167	189	196	214	210	1798	72.3%
Interpretive	30	31	62	71	58	59	53	51	60	65	540	21.7%
Descriptive	8	9	19	12	8	6	11	8	10	18	109	4.4%
Critical	0	0	8	0	0	0	1	2	2	7	20	0.8%
Mixed	1	1	0	0	1	1	0	1	0	2	7	0.3%
Not applicable	0	1	0	0	0	0	5	2	5	0	13	0.5%
Total	186	199	269	239	249	233	259	260	291	302	2487	100%

4 Discussion and Insights

4.1 Major Changes in the Twenty Years

Figure 5 compares the top five gainers and losers in term of their rank based on topics studied for the period of 1993-2003 and 2004-2013. Security and privacy and outsourcing and offshoring gained in their rank by more than 20 spots. IT value, IS research, and IS management and planning were also among topics receiving greater attention. Note that, in recent years, issues related to IT value and speed of IT delivery have become prominent (Kappelman, McLeon, Luftman, & Johnson, 2013) in part due to the global economic turmoil of the past decade. It is heartening to observe that IS researchers have paid attention to this need.

Research into topics of telecommunications, environment of IT, organizational design, supply chain management, and functional applications has been less fervent, and the ranks of these three topics decreased by more than 20 spots. These topics peaked in the earlier 10-year period and have been pushed out by new and emerging IT topics.

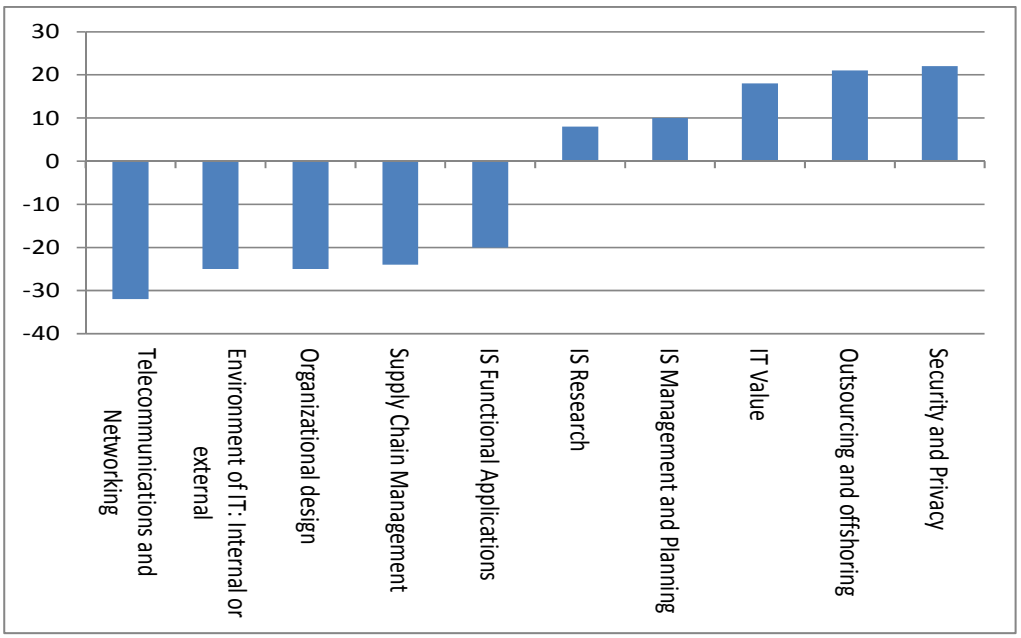

Figure 5. Topics with Major Change in Their Ranks (1993-2013)

Some topics have remained stable. While the ranking of many changed between the two periods, some topics received about the same amount of attention during these times. Table 13 shows the topics with the least rank fluctuation. Among them were customer relation management, IS usage/adoption, knowledge

management, and IS implementation. It is interesting to note that the avalanche of research that was unleashed on IS usage/adoption since the publication of the technology acceptance model by Davis (1989) continues to persist even today.

Table 13. Topics with the Least Change in their Rank (1993-2013)

Topic	Rank change
Customer relationship management (CRM)	2
IS usage/adoption	1
Knowledge management	0
IS implementation	0
IS staffing	0
Innovation	0
Decision support system & executive IS	-1

Comparing the 1993-2003 period with the 2004-2013 period, Figure 6 shows that methodologies used in IS research have changed somewhat as well. Qualitative research, secondary data, and content analysis were among the top gainers; in our view, this is a healthy trend reflecting the acceptance of diverse research methods in IS. Field experiments declined perhaps due to the continuing difficulty in conducting them; frameworks declined as well, which reflects the emphasis on completed research with data analysis and validated results.

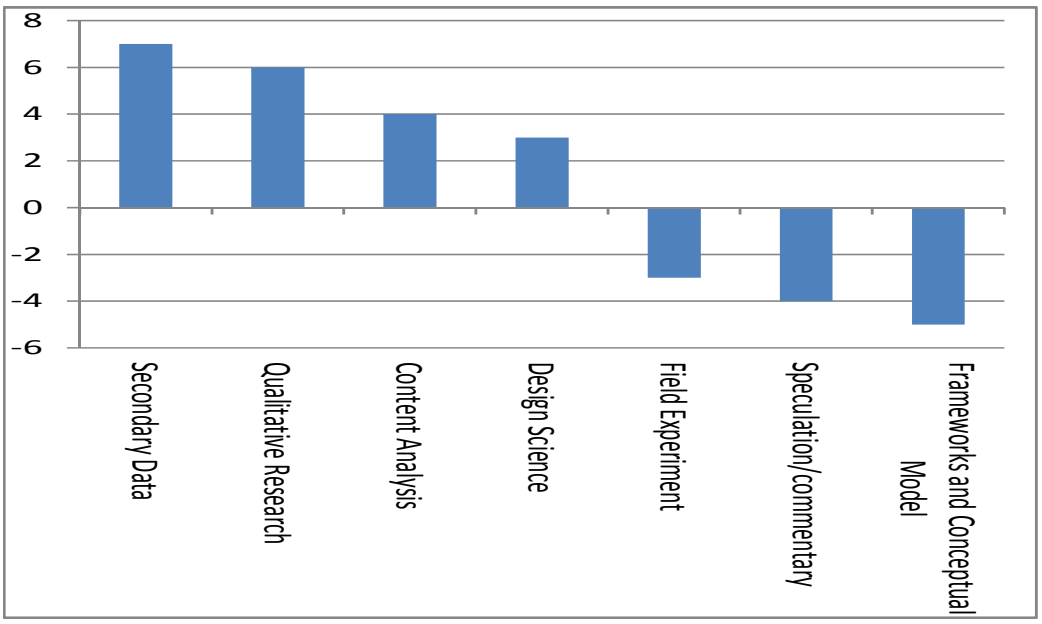

Figure 6. Methodologies with Major Changes in their Ranks (1993-2013)

4.2 Publication Patterns of Journals

Table 14 shows the publication patterns of the top ten topics in the seven journals. IS usage and adoption papers were published mainly in *I&M, MISQ*, and *JAIS*. Most of the papers examining e-commerce were published in *ISR, JMIS*, and *I&M,* followed by *MISQ.* Papers on technical topics, such as software and programming languages, appeared more in *ISR* and *JMIS.* Papers about IS research were predominantly in *MISQ, JAIS, and EJIS.*

Table 14. Research Topics in IS Journals

	MISQ	*ISR*	*JMIS*	*DS*	*I&M*	*JAIS*	*EJIS*
IS usage/adoption	35	19	11	10	69	32	28
IS design and development	9	6	12	2	19	22	24
Electronic commerce/business	40	74	74	22	74	16	26
IS research	71	13	6	1	7	56	57
Knowledge management	24	8	18	5	40	2	17
IS evaluation	4	11	5	1	30	4	4
Software and programming languages	9	28	23	3	7	8	23
IS functional applications	2	5	2	0	16	3	1
Telecommunications and networking	1	5	0	3	1	0	2
Environment of IT: internal or external	1	4	1	0	2	5	0

Table 15 shows the methods that papers employed broken down by the IS journals they appeared in. As we discuss above, survey had the highest rank with extensive use by IS researchers in all major journals. A vast majority of *I&M* papers used survey methodology. Laboratory experiment methodology received more attention in *MISQ, ISR,* and *JMIS.* Interestingly, the use of secondary data was the highest in *ISR*. *ISR* and *JMIS* heavily employed mathematical modeling. Europeans seem to have an affinity for case studies and qualitative research as evinced by the high number of such research methods in published papers in *EJIS.*

Table 15. Research Methods in IS Journals

	MISQ	*ISR*	*JMIS*	*DS*	*I&M*	*JAIS*	*EJIS*
Survey	50	55	88	40	301	44	76
Laboratory experiment	49	65	56	14	33	27	19
Secondary data	32	93	59	9	19	17	17
Field research	24	12	37	4	49	24	21
Case study	46	11	23	4	44	26	97
Frameworks and conceptual model	39	12	14	1	16	45	40
Mathematical modeling	22	70	63	14	14	9	3
Qualitative research	32	18	10	6	16	5	51
Speculation/commentary	8	13	7	1	3	35	22
Literature analysis	43	0	1	1	14	6	20
Design science	10	1	5	2	17	17	14
Literature review	21	0	1	0	2	12	6
Content analysis	12	18	20	3	20	7	9
Field experiment	4	3	0	4	10	2	7

In terms of the research approach, all journals predominantly and almost equally published positivist research (see Table 16). Interpretive research was published mainly in *MISQ* and *EJIS. ISR, JMIS*, and *DS* published little descriptive research. Mixed research and critical research have not made much headway in IS research, although a few pieces have begun to appear.

Table 16. Paradigmatic Research Approaches in IS Journals

	MISQ	*ISR*	*JMIS*	*DS*	*I&M*	*JAIS*	*EJIS*
Positivist	230	331	302	92	484	154	205
Interpretive	120	27	71	10	55	96	161
Descriptive	27	6	9	1	18	26	22
Critical	15	0	0	0	0	0	5
Mixed	0	2	2	1	0	0	2
Not applicable	0	5	0	0	1	0	7

As for research models (see Table 17), the most common research model used by IS researchers was the multi-tier influence diagram. This research model was widely used across all the journals. It is interesting to note that, with the exception of *ISR* and *DS*, most journals published papers without any explicit models. These are most likely conceptual and framework papers. Also worthy of note is that very simple models, such as simple influence diagrams and listing of variables, were used in papers across all journals.

Table 17. Research Models in IS Research

	MISQ	*ISR*	*JMIS*	*DS*	*I&M*	*JAIS*	*EJIS*
Multi-tier influence diagram	149	166	128	47	292	83	116
No model	103	16	59	6	32	62	108
Simple influence diagram	58	31	62	18	75	37	54
Listing of variables	22	44	26	15	68	60	81
Mathematical model	27	79	101	18	21	9	4
Listing of variables & levels	1	9	0	0	43	19	8
Combination	19	2	4	0	12	0	13
Listing of variables & implicit relationships	2	15	2	0	6	0	5
Temporal influence diagram	5	1	0	0	4	5	7
Venn diagram	1	1	0	0	3	1	1
Simple grid	4	6	2	0	2	0	4
Complex grid	0	1	0	0	0	0	1

4.3 Deeper Multidimensional Analysis

Our research and multidimensional framework allows researchers to evaluate past research from multiple perspectives. We present some examples here for illustrative purposes only. In a sense, the large research database of this study can be queried to answer different questions depending on the needs of the investigator and the audience. Although we have not employed them yet, one may also use data mining tools to discover revealing and insightful patterns.

The following charts show the research model and methodology used for four important topics (electronic commerce, ERP systems, health IT, and inter-organizational systems). We can see that there was no definitive framework for e-commerce and few case studies examined e-commerce. In case of ERP, no framework development activity existed in these journals. In addition, little field research existed. Health information technology again needs a framework. Comparatively, health IT studies have employed more case studies and secondary data. Interestingly, the patterns of model usage are similar across all four topics.

We realize that there are many more interesting insights that we can derive from the rich research database. However, the confines of one single paper prevent us from doing more than what we present here. Nonetheless, we will entertain requests from readers, editors, and reviewers for further analyses and studies to be disseminated via additional outlets.

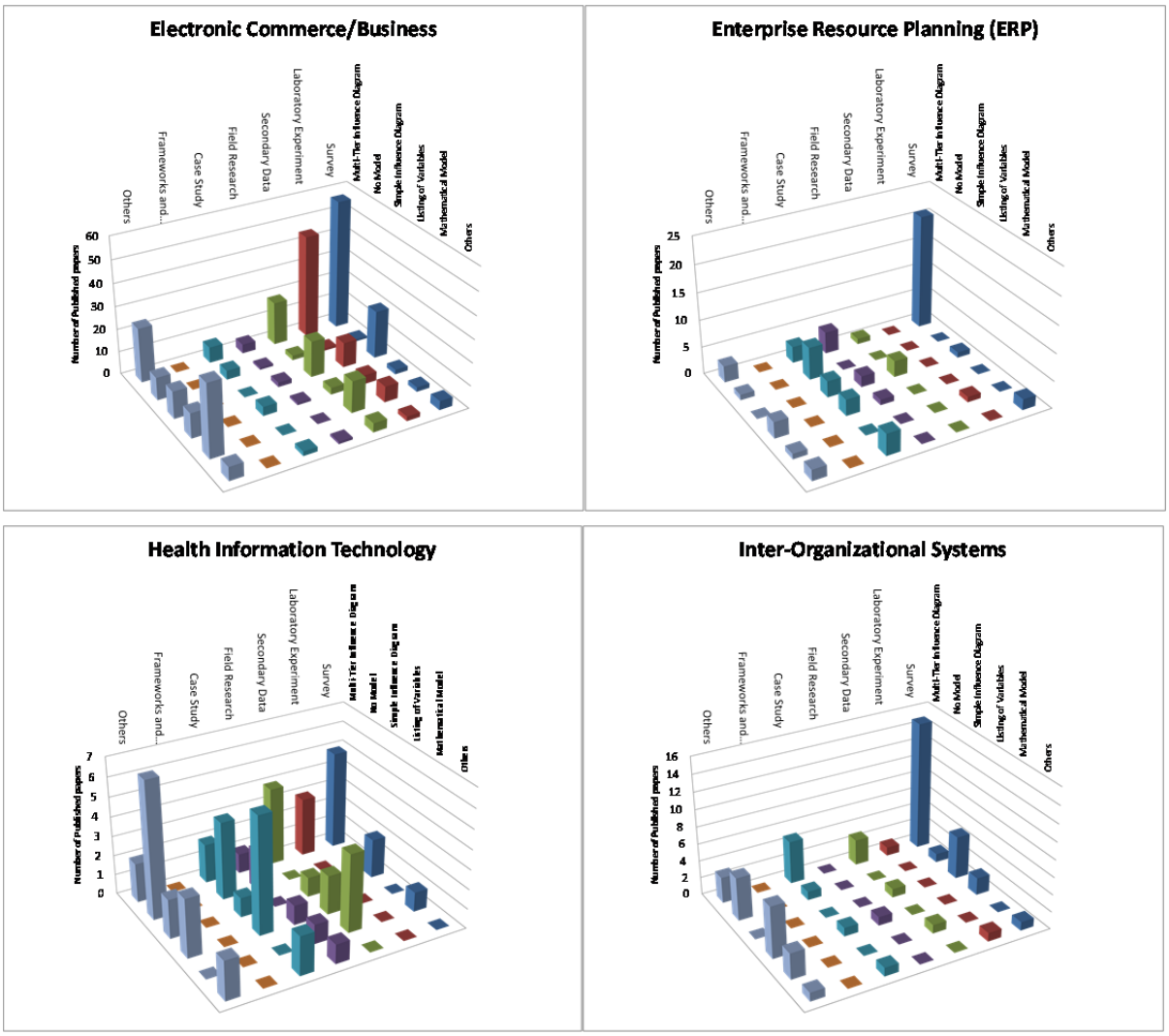

Figure 7. Status of Research Based on the Multidimensional Framework

4.4 Implication and Usefulness

This study has many implications for researchers, both new and established. We develop a taxonomy for classifying IS research. This taxonomy organizes research topics, methods, models, and research approaches, and it identifies trends and gaps in the field. This framework along with other classification and visualization tools used in the paper provides researchers with a multifaceted insight about the status of research in IS. By providing the patterns and trends for the topics and research methods, this study acts as a guide for researchers in selecting relevant topics and methods. Established researchers can focus on topics and methods that have been neglected but have potential to yield novel insights. They may also be able to augment the topics based on their own experience and discretion. Our study shows the topics and methods that are appealing to each top-tier IS journal, and it provides a good guide for authors considering a proper avenue for publishing their work. Furthermore, based on prior history of publications in journals, editors and reviewers can mentor potential authors and point them in fruitful direction for inquiry based on topics and methodologies. Equally importantly, each journal editor can evaluate their own journal in relation to the other journals and exercise some influence in redirecting the efforts of future research in terms of over-usage or under-usage of topics and methodologies as evident from this meta-analysis.

Quickly comparing our findings with the IS issues in business that Kappelman et al. (2013) discuss shows that, while some research topics are aligned with the business issues, others are neglected or over emphasized. ERP systems and business intelligence/analytics are two top prominent topics in business, and they received much attention from researchers. Big data, mobile apps, and cloud computing are

important and recently have received much business interest, yet they are ranked low in the number of published papers. Enterprise application integration and customer relationship management are two other important business topics, but they have not been heavily researched. On the other hand, virtualization and business process management systems are topics with relatively low business interest, but they command higher ranks in the number of published papers. Such mismatches highlight the need to improve the alignment between IS research and business needs, which will ultimately enhance the value and relevance of IS research. Thus, both individual researchers and journal editors can take steps to redirect the focus of research towards issues of practical relevance. We do realize that we examined only the top journals in the field and not the practitioner journals such as *MISQ Executive* and *Communications of ACM*. Nonetheless, we make our point about the need to keep the IS research relevant.

4.5 Limitations

The primary limitation of this study is that we did not review all journals in IS. While reviewing the entire spectrum of journals is a virtual impossible, we reviewed seven top journals in the field. We were able to gather a huge sample of over 2400 journal papers, which represents a massive data collection effort representing more than one thousand hours of effort by the research team. Moreover, our data is from the best journals in the field, and our sample represents arguably the best practices in IS research.

One of the critiques of past such efforts is that the research reflects U.S.-centric views; we obviated this deficiency to some degree by including the *European Journal of Information Systems*. Another limitation is the classification scheme for the topics of research. While we developed a fairly comprehensive list of topics to begin with based on prior lists and newer additions, we realized that the topic list was not completely exhaustive and some of the papers did not fit anywhere. Therefore, we had to add some topics as the coding proceeded. Another concern has to do with the granularity of the topics: it should not be too large or too small in order to be meaningful. Hopefully, we reached an optimal point in this regard. Finally, the coding of this large number of papers required division of labor and four different coders together accomplished the mammoth task. There can be differences in coding between the coders; we minimized these concerns with all coders evaluating two common sets of papers and developing a common understanding. The inter-coder reliability and Cohen's kappa on these common sets were above the recommended values and suggest that we achieved the objective of common understanding.

5 Conclusion

In this study, we examine IS research trends based on research published in leading IS journals from 2004 to 2013. It is a much needed and long overdue update and extension of the Palvia et al. (2004), which was published more than ten years ago. The IS field continues to thrive because of both incremental and quantum changes in information technology. While the 1990s saw the emergence of the Internet, the 21st century has witnessed new innovations in technology such as the smart phones, tablets, big data, business intelligence and cloud computing, to name a few. In such an environment, we need to examine what we have been doing and what we have not been doing so that such introspection can guide our research efforts in the future. In spite of all the high-velocity changes in IT, it is interesting to observe that electronic commerce ranks the highest among the research topics in IS followed by IS usage and adoption. Another key observation is that the survey method is consistently the dominant methodology followed about equally by laboratory experiment, secondary data, and case study. Thus, while many things have changed, much has remained the same in conducting IS research. Perhaps the IS researcher is slow to change and an introspection is clearly in order.

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