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Theory & Review

The Intellectual Advancement of Human-Computer Interaction Research: A Critical Assessment of the MIS Literature (1990-2008)

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Abstract

This paper assesses the intellectual advancement of Human-Computer Interaction (HCI) scholarship as one of the five research streams of the Management Information Systems (MIS) discipline. It particularly demonstrates the vitality and maturity that the HCI stream (or sub-discipline) has achieved in recent years, and adds to the few studies that draw an overarching picture of HCI. This study uses the same approach as that of Zhang and Li (2005), and delineates the intellectual development of HCI research in MIS by employing a multifaceted assessment of the published HCI articles over a period of 19 years (1990-2008) in eight primary MIS journals. In addition, this study includes several journal special issues and two book collections in the assessment. Twenty-four specific questions are addressed to answer the following five mega-research questions about the HCI sub-discipline: (1) What constitutes HCI's intellectual substance? (2) What relationships does HCI have with other disciplines? (3) How is HCI evolving? (4) What are the patterns of HCI publication in the primary MIS journals? And, (5) Who are the contributing scholars? A number of areas for future research are predicted, along with a discussion of potential future directions for the sub-discipline. This study is of interest to researchers in the HCI sub-discipline, the MIS discipline, and other related disciplines to inform future research, collaboration, publication, and education. It should also be of interest to doctoral students for identifying potential topics for dissertation research and to identify academic institutions for future employment where such research is understood, appreciated, and encouraged.

Keywords: Human-Computer Interaction (HCI), Human Factors in Information Systems (HFIS), scientific fields, intellectual development, literature assessment, subject topics, research methods, study contexts, individual characteristics, levels of analysis, contributing disciplines, IT and service, Management Information Systems (MIS)

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INTRODUCTION

Empirical evidence demonstrates that Human-Computer Interaction (HCI) studies comprise a significant sub-discipline within the MIS discipline (Zhang and Li 2005). HCI studies in MIS are "concerned with the ways humans interact with information, technologies, and tasks, especially in business, managerial, organizational, and cultural contexts" (Zhang et al. 2002). A key aspect of these studies is the concern about humans, not in a sense that would interest a pure psychologist, but in the ways that humans interact with technologies for various purposes. Although HCI studies have always been a significant part of the MIS literature (Culnan 1986; Culnan 1987; Sidorova, et al. 2008; Zhang and Li 2005), interest in the HCI research stream within the MIS discipline should continue to surge as predicted (Banker and Kauffman 2004).

Several articles have provided various views of the HCI sub-discipline thus far. Such overviews include a top down perspective on research issues and directions of HCI studies in MIS (Zhang et al. 2002), a call to action for including HCI topics in the MIS curricula (Carey et al. 2004), a proposition for considering MIS as the home of HCI studies (Kutzschan and Webster 2006), a limited data-driven view based on an assessment of two MIS journals (*MISQ* and *ISR*) on two facets (subject topic and research method) (Zhang and Li 2004), and a comprehensive and critical literature assessment of seven primary MIS journals' publications during 1990-2002 by Zhang and Li (2005), which systematically characterized the intellectual state and development of the HCI sub-discipline, with the support of literature up to the year 2002.

HCI studies in MIS have surged significantly since 2002, coinciding with the establishment of the Association for Information Systems (AIS) Special Interest Group on Human-Computer Interaction (SIGHCI) in 2001. AIS SIGHCI has attracted a large number of scholars, making it one of the largest SIGs within AIS. In addition, SIGHCI has sponsored conference tracks and mini-tracks in all major IS conferences including the International Conference on Information Systems (ICIS), the Americas Conference on Information Systems (AMCIS), the Pacific Conference on Information Systems (PACIS), and the European Conference on Information Systems (ECIS). Additionally, the Hawaii International Conference on System Sciences (HICSS) has HCI mini-tracks; and there is a designated research workshop, the pre-ICIS Annual Workshop on HCI Research in MIS. There have also been 11 special issues in top MIS and HCI journals, two edited volumes of research studies by leading MIS and HCI scholars (Galletta and Zhang 2006; Zhang and Galletta 2006), the inclusion of HCI materials in the AIS/ACM model curriculum for Masters in Information Systems (Gorgone et al. 2005), a specially written textbook for MIS students on HCI topics (Te'eni et al. 2007), and a new AIS journal designated to HCI research: *AIS Transactions on Human-Computer Interaction* (http://thci.aisnet.org). Figure 1 depicts the major activities and outcomes sponsored by AIS SIGHCI from 2001 to 2008. Along with SIGHCI-related activities, the interest in the HCI sub-discipline has experienced a true surge over the past several years, as evidenced by publications in primary MIS journals. Thus, it is necessary to re-examine the HCI in MIS sub-discipline to reflect where it has been, where it is, and what the trend of movement is, if any. This is the primary goal of this present study.

Specifically, in this study, we expand the literature coverage to update the findings of Zhang and Li (2005). We start with a set of mega-research questions similar to those in Zhang and Li's study that can be decomposed into lower level or more detailed questions. We then address these questions by using the same classification approach to examine a collection of HCI articles from the same seven prime MIS journals, plus one additional MIS journal (CAIS), 11 journal special issues sponsored by SIGHCI since 2002, and two edited volumes, together to cover a period of 19 years (1990-2008) of the MIS literature. We take the same multifaceted view to reveal the detailed characteristics of the dynamics and richness of the HCI sub-discipline. To maintain consistency and ensure comparison, we use the same organizing framework, the same boundary for HCI research in MIS, and the same seven facets to assess the literature. We also conduct analyses similar to those in Zhang and Li (2005). For example, co-occurrence and cross-facet analyses can reveal interesting patterns by answering questions such as "what topics are often studied together," and "what methods are used to study what topics?" To reveal the social and academic side of the sub-discipline, we reexamine publication patterns and the most prolific authors and their institutions. Finally, we provide particular analyses to depict movement trends among various periods of time.

To avoid unnecessary repetition, this paper will focus primarily on research questions, methodology, data collection, data analyses, and discussions and implications. We suggest that readers review Zhang and Li (2005) for detailed background information, conceptualization of the sub-discipline, and justifications for the research method, among many other aspects.

The paper is organized as follows: research questions, methodologies, data analyses, results, syntheses, conclusions, and future research directions.

RESEARCH QUESTIONS

Table 1 lists the research questions that can be used to assess the intellectual dimensions of the HCI sub-discipline (Zhang and Li 2005). The first three mega-questions (RQ1-RQ3) address three dimensions for examining the intellectual development of a scientific field: (1) the field itself in terms of its substance; (2) relationships with other scientific fields; and (3) the evolution or changes of the first two dimensions over time. In addition, RQ4 is about the primary publication patterns of HCI studies. RQ5 is about one important component of a scientific field: its members or knowledge contributors. Together, RQ1, RQ2, and RQ3 are largely about the intellectual side of the sub-discipline, while RQ4 and RQ5 focus more on the social side.

Each mega-question is decomposed further into detailed questions that can be answered directly by the literature assessment. Because of the sensitive difference between the terms "field" and "discipline," in the latter part of this paper, starting from the section on Classification for Contributing Disciplines, we use "discipline" to represent MIS as we have discussed it so far, and "sub-discipline" for the HCI research we are assessing.

One particular goal of this paper is to depict the surge or "movement" aspect of the sub-field, which will be primarily addressed by RQ3.

Table 1: Research Questions on the Intellectual Development of the HCI Sub-Discipline

RQ1	What constitutes the intellectual substance?
	RQ1.1: What are the contexts of studies? RQ1.2: What are the research areas or subject topics? RQ1.3: What topics are often co-studied? RQ1.4: What are the research methods? RQ1.5: What methods are often used to study what topics? RQ1.6: What are the levels of analysis? RQ1.7: To what extent does the HCI sub-discipline consider IT/service as a research component? RQ1.8: To what extent does the HCI sub-discipline consider individual characteristics?
RQ2	What are the relationships with other disciplines?
	RQ2.1: What are the disciplines contributing to the HCI studies? RQ2.2: What contributing disciplines are often co-cited in HCI studies? RQ2.3: What contributing disciplines are often used to support what subject topics?
RQ3	What are the evolutions?
	RQ3.1: What are the changes in the contexts of study over the years? RQ3.2: What are the changes in the subject topics over the years? RQ3.3: What are the changes in the research methods over the years? RQ3.4: What are the changes in the level of analysis over the years? RQ3.5: What are the changes in considering IT or service as a research component? RQ3.6: What are the changes in considering individual characteristics as a research component? RQ3.7: What are the changes in the contributing disciplines over the years?
RQ4	What are the patterns of publishing HCI studies in various sources?
	RQ4.1: What%age of published works are HCI studies? What is the trend in such%age? RQ4.2: What topics are "preferred" by which sources? RQ4.3: What methods are "preferred" by which sources? RQ4.4: Which contributing disciplines are cited more frequently in which sources?
RQ5	Who are the contributing members?
	RQ5.1: Who are the most prolific authors? RQ5.2: What are the most prolific institutions housing HCI researchers?

METHODOLOGY

In order to build on and expand Zhang and Li's 2005 study, we use the same classification-based approach. Specifically, we consider the same set of seven journals, plus another journal that has been publishing HCI articles, the journal special issues sponsored by SIGHCI, and two book collections of HCI studies. We also use the same coding schemes for analyzing the new HCI articles selected (those published since 2002), combining these results

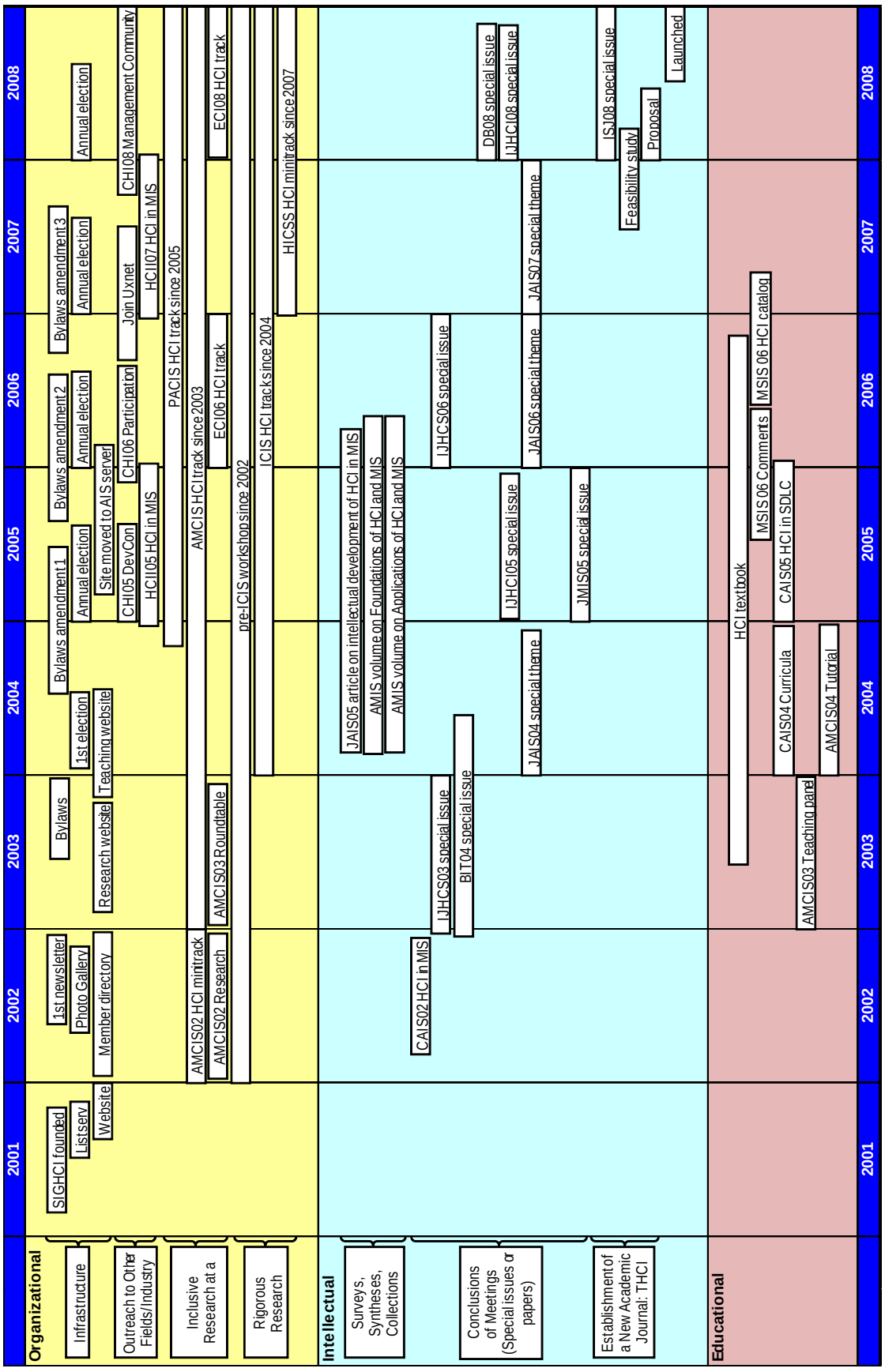


Figure 1: SIGHCI Sponsored Activities and Outcomes

with those in Zhang and Li (2005), which covered from 1990 until 2002. Thus, our coverage period is expanded to 19 years (1990-2008), much longer than the normal length of time covered in this type of research (Chua, et al. 2003).

In this section we describe the article selection criteria and process, review the classification schemes with notes on whether certain classifications need to be adjusted to reflect new studies since 2002, depict the coding procedure, and present the reliability test. Readers interested in the development and justifications of the classification schemes should read Zhang and Li (2005).

Journal and Article Selections

Our journal selection criteria are similar to those in Zhang and Li's 2005 paper. That is, we continue to cover the seven primary MIS journals in this study: *Management Information Systems Quarterly* (MISQ), *Information Systems Research* (ISR), *Journal of Management Information Systems* (JMIS), *Management Science* (MS), *Decision Sciences* (DS), *The Data Base for Advances in Information Systems* (DB), and *Journal of the Association for Information Systems* (JAIS). Among these journals, *Management Science* and *Decision Sciences* are not primarily IS journals; they have IS departments within the journals but also publish research articles in other areas such as management, decision science, and operations research, to name a few. These journals are included because they have published a good amount of HCI research from IS scholars, especially when there was a limited number of outlets for such research. In fact, as will be demonstrated in answering research question RQ4.1 (Figure 17 in particular), a very high%age of published IS articles in DS and MS are HCI articles, making these journals important outlets for HCI research. One additional MIS journal included in this study is the *Communications of the Association for Information Systems* (CAIS). Similar to JAIS, CAIS is a young journal and was founded in 1999 as a communications vehicle for the Association for Information Systems. Over the years, CAIS has published a large number of papers. Although CAIS is designed as the communications journal for AIS, among the many published papers are research articles that went through a rigorous review process and have been well cited. CAIS has been ranked highly consistently among IS scholars (Mylonopoulos and Theoharakis 2001; Peffers and Tang 2003; Rainer and Miller 2005), making it one of the important research resources in the IS field. In particular, CAIS has been very supportive of HCI research and has functioned as an effective outlet for HCI scholars and SIGHCI during its early years. Thus, it is reasonable to include CAIS in this study. We acknowledge that there are other important IS journals that can be included for the study. For example, in recent years, AIS announced a basket of six journals as top IS journals (MISQ, ISR, JMIS, JAIS, *Information Systems Journal*, and *European Journal of Information Systems*), especially for promotion and tenure evaluation purposes. Four of these six journals are included in this study. Because of their strategic focus, we excluded *Information Systems Journal* (ISJ) and *European Journal of Information Systems* (EJIS) from this study.

Additional inclusions are the special issues in various journals that are sponsored by SIGHCI, and all the chapters in two edited books on HCI in MIS in the *Advances in MIS* series. Since 2003, SIGHCI has fast-tracked expansions of the best complete papers from all of its sponsored conference sessions, workshops, tracks or mini-tracks to various HCI and MIS journals. Up to 2008, a total of 11 such special issues have been published in the following journals: *International Journal of Human-Computer Studies* (IJHCS, 2003, 2006), *Behaviour and Information Technology* (BIT, 2004), *International Journal of Human-Computer Interaction* (IJHCI, 2005, 2008), JAIS (2004, 2006-2007, 2008), JMIS (2005), *Information Systems Journal* (ISJ, 2008), and DB (2008). Two edited books of HCI research in MIS (Galletta and Zhang 2006; Zhang and Galletta 2006) were published in 2006. These two books contained a total of 37 chapters that were authored by some of the most well-known and respected scholars in the field. These articles addressed timely topics and were intended to guide research in the HCI sub-discipline; thus, they add significant contributions to the current state of the sub-discipline and have strong research implications. Similar to journal articles, these chapters went through a rigorous peer review process including multiple rounds of revisions. Therefore, we feel that the works published in these books are legitimate inclusions in this paper.

The 337 papers in the previous study by Zhang and Li (2005) are included in this study. We selected new papers using the same two-step process. The first step was to form a pool of all IS research articles published in the eight MIS journals. Among these journals, six are mainly IS journals: MISQ, ISR, JMIS, DB, JAIS, and CAIS. Thus, we considered all research articles published in these journals as IS articles. For *Management Science* and *Decision Sciences*, only IS articles were considered. The pool of candidate articles excludes editorial introductions, editorial notes, executive summaries, book reviews, dissertation abstracts, letters, and announcements. We included Issues and Opinion articles only if they were closely related to research.

In the second step, we formed a pool of HCI articles from the IS article pool discussed above, plus all the research articles in the special issues and all the articles in the two volumes of AMIS books. An HCI paper should address one or more human-computer interaction issue (Zhang and Li 2005). A paper was excluded if: (1) it was about pure system design or development methods or processes without linking to human considerations; (2) it was concerned with group support systems but did not approach it from a human perspective either at the individual or group level; or (3) it was purely concerned with the personnel or human resource management issues related to IT.

We then coded each paper in the HCI pool according to the classification schemes to be reviewed below. During the

coding process, each paper was evaluated again for its relevance to HCI. As a result, we included 421 additional HCI articles, making a total of 758 articles for the final analysis in this study. Appendix A provides a list of these 758 articles by sources.

Classification for Context

Context refers to the setting or environment where a study is conducted, and for this paper we considered only the immediate context. The following six contexts are applicable for examining HCI studies (Table 2).

Table 2: Context Classification Scheme

A	Organizational or workplace setting. This also includes colleges or universities if students are subjects and the tasks are related to their studies or schoolwork
B	Market place, where commerce, banking, and marketing take place
C	Home setting, where issues such as home PC adoption and use behavior are examined
D	Social environment, which differs from the former three categories in that it refers to a general setting in a less organizationally constrained environment. For example, studies on online communities tend to be conducted in a social setting
E	Cultural, national, and geographical context if such are specifically concerned in studies. A good example of this category would be a cross-culture /cross-nation study of IT acceptance or the relationship between email use and Japanese character input method
F	Other context for those papers whose contexts do not fit in any of the above five

Classification for Level of Analysis

Level of analysis refers to the level at which data are collected and analyzed, or main issues and discussions are addressed. Our assessment on level of analysis includes individual and group. Examples of analysis at the individual level can be those relevant to cognitive styles, individual reactions toward IT, and individual productivity or performance related to IT. Group performance in decision-making and group member conflict/agreement are typical topics for analysis at the group level. Analyses might also be conducted at both individual and group levels.

Classification for Individual Characteristics

Individual characteristics refer to individual differences in two categories: the predetermined disposition or personality and the demographics of individuals. Table 3 details the individual characteristics considered in this study. Typically, if these characteristics are covered in the articles, they are used as independent variables or moderating factors, although there are some situations where personality traits or other individual factors are the targets or dependent variables of the studies (Agarwal and Prasad 1998; Webster and Martocchio 1992).

Table 3: Individual Characteristics Classification Scheme

A	Disposition/personality	Personality, affective trait, cognitive style (e.g. visual vs. verbal oriented, field dependent/independent), locus of control, learning style
B	Demographics	Age, gender, education, cultural background, experience, knowledge, socioeconomic status

Classification for Topic

Zhang and Li (2005) presented a topic classification scheme that has proven to be adequate for examining HCI studies in the MIS field up to 2002. In this paper, we reuse Zhang and Li's classification scheme to reflect the unique interest IS scholars have in HCI. IS/HCI researchers are not particularly interested in humans *per se*, which would be the interest of psychologists, and they are not particularly interested in artifacts *per se* either, which would engage computer scientists. IS/HCI researchers apply a unique perspective to study humans interacting with technologies in certain contexts. One way of classifying related research topics would be to consider the human interactions or human interventions during the lifecycle of an IT artifact. The IT artifact lifecycle can be divided into two main stages: *during* IT development and *after* IT development (Whitten et al. 2004). In the MIS literature, issues occurring during IT development include programmer or analyst cognition studies, user participation, user-analyst interaction, and information presentation designs and evaluation, to name a few. This is the *Design* stage. In the topic classification scheme, the phase "IT Development" is used to cover a broad range of issues related to the development stage. After development, IT is used in real contexts, and has impacts on individuals, groups, organizations, and societies. This is

the *Use and Impact* stage. There are many MIS issues arising during this stage, such as an individual's reactions toward technology, IT use behavior and attitude, trust, user satisfaction, and group task performance or conflict, to name a few.

Table 4 represents the topic classification scheme, which reflects the issues *during* and *after* development discussed above. Within each stage, we further categorized the topics into various aspects. As in several existing literature assessment studies, we included one broad category to classify articles that are concerned with general research issues such as future research directions, methodology, or education-related issues. The topic classification scheme in Table 4 has proven to be able to reflect the topical coverage of the HCI studies during the 19 years.

Two points are worthy of mention. First, Motivation (B04) was in the original coding scheme for topics (Zhang and Li 2005). Since very few empirical studies addressed motivational concerns during 1990-2002, this code was dropped from the final result in the Zhang and Li 2005 paper. In this study, there are more empirical articles addressing motivational concerns. Thus, we have reintroduced the code and reapplied it to those applicable articles from 1990-2002. Second, as more studies on education-related matters have emerged, we have created a sub-category under C to consider those papers that detail Education.

Table 4: Topic Classification Scheme

ID	Category		Description and Examples
A	*IT Development*		*Concerned with issues that occur at the stage of IT development and/or implementation that are relevant to the relationship between human and technology. Focus on the process where IT is developed or implemented. The artifact is being worked on before actual use.*
	A01	Development methods and tools	Structured approaches, Object-oriented approaches, CASE tools, Social-cognitive approaches for developing IT that consider users/IT personnel's roles.
	A02	User analyst involvement	User involvement, User participation, User-analyst difference, User-analyst interaction
	A03	Software/hardware development	Programmer/analyst cognition studies, Design and development of specific or general applications or devices that consider some human aspects
	A04	Software/hardware evaluation	System effectiveness, efficiency, quality, reliability, flexibility, and Information quality evaluations that consider people as part of the factors.
	A05	User interface design & development	Interface metaphors, Information presentations, multimedia
	A06	User interface evaluation	Instrumental usability (e.g. ease of use, error rate, ease of learning, retention rate, satisfaction), Accessibility, Information presentation evaluation
	A07	User training	User training issues during IT development (prior product release or use)
B	*IT Use and Impact*		*Concerned with issues that occur when humans use and/or evaluate IT; issues related to the reciprocal influences between IT and humans. The artifact is released and in use in real context.*
	B01	Cognitive belief and behavior	Self-Efficacy, Perception, Belief, Cognition, Mental process, Incentives, Expectation, Intention, Behavior, Acceptance, Adoption, Resistance, Use
	B02	Attitude	Attitude, Satisfaction, Preference
	B03	Learning	Learning models, Learning processes, Training in general (different from user training as part of system development)
	B04*	Motivation	Motivation (intrinsic, extrinsic), Expectancy, Incentives
	B05	Emotion	Emotion, Affect, Hedonic quality, Flow, Enjoyment, Humor, Intrinsic motivation
	B06	Performance	Performance, Productivity, Effectiveness, Efficiency
	B07	Trust	Trust, Risk, Loyalty, Security, Privacy
	B08	Ethics	Ethical belief, Ethical behavior, Ethics
	B09	Interpersonal relationship	Conflict, Interdependence, Agreement/Disagreement, Interference, Tension, Leadership, Influence, Norms
	B10	User support	Issues related to information center, end-user computing support, general user support
	B11	Other	
*C**	*Generic Research Topics*		*Concerned with general research or education issues and concerns*
	C01	Research	
	C02	Education	

*slightly different from that in Zhang and Li (2005)

Classification for Method

At the highest level, the method framework distinguishes between empirical and non-empirical articles. The empirical articles capture the essence of research relying on observation and are further classified into those that describe objects and those that describe events or processes. Non-empirical articles are those that are primarily based on ideas, frameworks, and speculation rather than on systematic observation. Table 5 provides descriptions of method classification and some specific examples from the papers collected for this study.

Table 5: Method Classification Scheme

ID	Category Name and Description	Examples of HCI Papers
1	*Non-Empirical*	
1.1	Conceptual Orientation	
1.1.1	Frameworks: Proposes a framework for defining the content and scope of HCI in an MIS context, and provides directions.	
1.1.2	Conceptual model of a process or structure: presents an integrated, schematic representation of an HCI-related process, structure, behavior, activity, organization, method, etc.	(Orlikowski and Iacono 2001), (Zigurs and Buckland 1998)
1.1.3	Conceptual overviews of ideas, theories, concepts, etc.: contains an overview of many concepts or theories in one or more areas, and does not propound or support any individual theory, idea, or approach.	(Gerlach and Kuo 1991), (Melone 1990)
1.1.4	Theory from reference disciplines: presents theory or theories drawn from outside the HCI sub-discipline but applied within an HCI context	
1.2	Illustration	
1.2.1	Opinion (pure, or supported by examples): gives advice and guidance for practice, in the form of rules and recommendations, steps or procedures to be followed, hints and warnings, etc. May be supported by examples and applications.	(Silver 1991), (Hawk and Raju 1991)
1.2.2	Opinion (supported by personal experiences): as for 1.2.1., but also describes the author's experience in some relevant context.	
1.2.3	Description of a tool, technique, method, model, etc.: usually highly specific and detailed, as well as technically or methodologically precise.	(Tan and Hunter 2002), (Gordon and Moore 1999)
1.3	Applied Concepts	
1.3.1	Conceptual frameworks and applications: contains both conceptual and illustrative elements. May present some concept or framework and then describe an application of it.	(Vessey 1991), (Te'eni 2001)
2	*Empirical*	
2.1	Objects	
2.1.1	Descriptions of types or classes of products, technologies, systems, etc.	
2.1.2	Descriptions of a specific application, system, installation, program, etc.	(Chen 1995), (Shibata, et al. 1997)
2.2	Events/process	
2.2.1	Lab experiment: manipulates independent variable; controls for intervening variables; conducted in controlled settings.	(Zhang 2000), (Morris, et al. 1999)
2.2.2	Field experiment: as for lab experiment, but in a natural setting of the phenomenon under study.	(Hunton 1996), (Webster and Ho 1997)
2.2.3	Field study: No manipulation of independent variables, involves experimental design but no experimental controls, is carried out in the natural settings of the phenomenon of interest.	(Barki and Hartwick 1994), (Lee, et al. 1995)
2.2.4	Positivist case study: investigates one or a few cases in detail from a positivist perspective, assumes an objective reality existing independent of humans, may involve hypothesis testing to discover the reality.	(Hitt and Frei 2002), (Lawrence and Low 1993)
2.2.5	Interpretive case study: studies one or a few cases from an interpretive perspective, assumes interactions between researchers and the phenomenon under investigation, attempts to understand the phenomenon through assessing meanings.	(Kawalek and Wood-Harper 2002), (Davidson 2002)
2.2.6	Action research	
2.2.7	Survey: Involves large numbers of observations with no manipulations of variables.	(Compeau, et al. 1999), (Carr 2002)
2.2.8	Development of instruments: description of development of instrument/measurement or classification scheme, validation of instruments.	(Gefen 2002), (McKinney, et al. 2002)
2.2.9	Ex-post description of some project or event: interest in reporting the results of the project develops after the project is complete (or is partially complete)	
2.2.10	Secondary data: Uses data from secondary sources, i.e., data collected by sources other than the researchers.	(Dennis, et al. 2001), (Beath and Orlikowski 1994)
2.2.11	Interview: conducted on an individual basis.	(Srinivasan and Te'eni 1995), (Geissler, et al. 2001)
2.2.12	Delphi study (evolving and iterative developing surveys)	(Nambisan, et al. 1999), (Conrath and Sharma 1992)
2.2.13	Focus group	(Geissler, et al. 2001), (Kekre, et al. 1995)
2.2.14	Other	

Classification for Technology or Service

Zhang and Li (2005) classified technologies into two groups: end-user computing technologies and organizational computing technologies. The former supports individual needs such as productivity and communication, while the latter supports organizational functions, usually centralized or across organizations, and sometimes in group settings. Besides technologies, services have become a focus of inquiry during recent years, owing to the shift of IS/IT departments' responsibilities in some organizations and Internet-based services. During this study, we found that this classification is still applicable, in general, yet some technologies might be better considered social computing technology, as they support society or community functions and characteristics. Thus, we changed the second category into Organizational or Social Computing. The classification scheme is shown in Table 6.

Table 6: Classification Scheme for IT and Service

ID	Category	Description and Example
TA	*End User Computing*	*Mainly supporting individual needs such as communication and productivity*
TA1	Individual communication	email, voice mail, instant messaging (IM), chat rooms
TA2	Individual productivity	MS office suites, word processors, presentation software, spreadsheets, GUIs, windows, linux
TA3*	Web	World Wide Web (WWW), specific websites
TA4	Other	Digital libraries, personal assistants, mobile devices, PCs, or others that belong to end-user computing
*TB**	*Organization or Social Computing**	*Mainly supporting organizational or social functions and reflecting organizational or social characteristics or nature*
TB1	Group/org communication	Listservs, BBS's, audio/video conferencing, LANs, Intranet, telecommuting
TB2	DSS	DSS, EIS, Intelligent systems, expert systems, knowledge systems and repositories that support people's productivity
TB3	MIS	ERP, MIS, organizational database systems to support organization productivity. Community database systems to support community functions
TB4	CSCW, GDSS	Mainly for supporting group productivity and performance
TB5	Other	If it does not fit any of the above and it supports organization/society functions, e.g., centralized application servers, learning management systems, and open source software
TC	*Service*	*Internet service, Information center*

* Slightly different from that in Zhang and Li (2005)

Classification for Contributing Disciplines

Contributing disciplines refer to the disciplines that support or contribute to the development of research questions, theories, models, and hypotheses. Thus, not all references in a paper should be counted toward contributing disciplines. Zhang and Li (2005) used the Research Fields, and Courses and Disciplines Classification (RFCD 2002), which was developed for higher education study programs and sponsored research funding purposes. RFCD 2002 is sponsored by the Australian Research Council. It has a comprehensive coverage of 24 divisions/fields, 139 disciplines and 898 subjects. To illustrate the RFCD codes, Table 7 lists the 24 divisions, the disciplines inside the 280000 division, and the subjects inside the 280100 discipline. Although there are efforts to develop new codes to replace RFCD, to maintain consistency with the coding in Zhang and Li, we have decided to keep the same discipline scheme. In coding the papers for our study, we focused only on the disciplinary level, not the subject level, although we used subjects to justify a discipline when necessary. A discipline D is considered a contributing discipline for article A only if one or more referenced papers used in A (a subset of the entire set of references of A) support the conceptual and theoretical development of the study in A and address issues rooted in discipline D.

Classification Procedure and Coding Reliability

As in the previous work by Zhang and Li (2005), we allow each of the seven facets to have multiple codes assigned to a single paper if they are all primarily important in the study (such as multiple research topics, multiple research methods, etc.). The coding of these articles required an evaluation of textual material, making the raw agreement and inter-rater reliability appropriate indicators in assessing the reliability of the coding results (Miles and Huberman 1994; Boudreau et al. 2001). In this study, to calculate inter-rater reliability, we consider each paper to have seven judgments (corresponding to the seven facets), although the actual code numbers can be higher due to multiple codes assigned to each facet. The raw agreement score is calculated at this facet level, even though each facet can have multiple values in a single paper. Such an agreement is a conservative estimate of inter-rater reliability.

Due to the workload of handling a large number of papers with seven facets for each paper, we decided to code the papers in the following way. We four authors formed two groups; each included a new coder and an experienced

coder. The 421 new articles were divided into two sets, and each group handled one set of papers. For each group, a subset of articles (fewer than 10) was used for training purposes. Then raw-agreement scores were calculated for this subset. We discussed disagreements to reach consensus. The process was repeated for another subset of papers until the raw-agreement within the group reached 95% or higher. From this point on, each member coded a separate subset of the remaining papers. After each member finished his or her own subset, one experienced coder sampled several articles from each of the other three researchers' subsets and found that the lowest raw-agreement score was 92%. This largely satisfied the acceptable inter-rater reliability level, which is normally 75% raw agreement. Given our raw agreement score is more conservative than the actual number of judgments involved, we are confident that our coding results have high reliability and validity.

Table 7: The Research Field, Discipline, and Subject code (RFCD) – Partial List

Broad Research Fields/Divisions	230000 MATHEMATICAL SCIENCES 240000 PHYSICAL SCIENCES 250000 CHEMICAL SCIENCES 260000 EARTH SCIENCES 270000 BIOLOGICAL SCIENCES 280000 INFORMATION, COMPUTING AND COMMUNICATION SCIENCES 290000 ENGINEERING AND TECHNOLOGY 300000 AGRICULTURAL, VETERINARY AND ENVIRONMENTAL SCIENCES 310000 ARCHITECTURE, URBAN ENVIRONMENT AND BUILDING 320000 MEDICAL AND HEALTH SCIENCES 330000 EDUCATION 340000 ECONOMICS 350000 COMMERCE, MANAGEMENT, TOURISM AND SERVICES 360000 POLICY AND POLITICAL SCIENCE 370000 STUDIES IN HUMAN SOCIETY 380000 BEHAVIOURAL AND COGNITIVE SCIENCES 390000 LAW, JUSTICE AND LAW ENFORCEMENT 400000 JOURNALISM, LIBRARIANSHIP AND CURATORIAL STUDIES 410000 THE ARTS 420000 LANGUAGE AND CULTURE 430000 HISTORY AND ARCHAEOLOGY 440000 PHILOSOPHY AND RELIGION
Disciplines for INFORMATION, COMPUTING AND COMMUNICATION SCIENCES (280000)	280100 INFORMATION SYSTEMS 280200 ARTIFICIAL INTELLIGENCE AND SIGNAL AND IMAGE PROCESSING 280300 COMPUTER SOFTWARE 280400 COMPUTATION THEORY AND MATHEMATICS 280500 DATA FORMAT 289900 OTHER INFORMATION, COMPUTING AND COMMUNICATION SCIENCES
Subjects for the INFORMATION SYSTEMS discipline (280100)	280101 INFORMATION SYSTEMS ORGANISATION 280102 INFORMATION SYSTEMS MANAGEMENT 280103 INFORMATION STORAGE, RETRIEVAL AND MANAGEMENT 280104 COMPUTER-HUMAN INTERACTION 280105 INTERFACES AND PRESENTATION (EXCL. COMPUTER-HUMAN INTERACTION) 280106 INTERORGANISATIONAL INFORMATION SYSTEMS 280107 GLOBAL INFORMATION SYSTEMS 280108 DATABASE MANAGEMENT 280109 DECISION SUPPORT AND GROUP SUPPORT SYSTEMS 280110 SYSTEMS THEORY 280111 CONCEPTUAL MODELLING 280112 INFORMATION SYSTEMS DEVELOPMENT METHODOLOGIES 280199 INFORMATION SYSTEMS NOT ELSEWHERE CLASSIFIED

ANALYSES AND RESULTS

This section presents analyses and results, organized around the research questions (see Table 1). Within each of the five mega-research questions, we present the answers to the specific questions. To address RQ1 and its specific questions, we present aggregated data showing any trends of movement over three periods of time: 1990-1995, 1996-2002, and 2003-2008. These periods correspond to some significant events in the field that created profound impact on research in the sub-discipline. For example, studies on the World Wide Web (available in 1994) began being published in 1996; the first special issue sponsored by the AIS SIGHCI was published in 2003.

RQ1: What Constitutes the Intellectual Substance?

RQ1.1: What are the contexts of studies?

Table 8 summarizes the frequencies of various contexts employed in the collected studies. Among the 758 papers, 671 or 88% considered one context, 32 or 4% considered two contexts, three papers considered three contexts, and 52 or nearly 7% had no context specified in their studies. The last column indicates among all 758 papers, the percentage of papers considering a particular context or a combination of contexts. For example, 62.3% of the 758 papers consider organization and workplace as the only context of study.

The predominant context was organizations and workplace, considered by about 66% of papers (all rows of Table 8 that contain A, that is, 62.3%+ 1.7% + 0.5% + 0.9% + 0.5% + 0.1% + 0.3%). This is consistent with the nature of most IS studies being situated in the organizational and workplace context. The second most dominant setting was the marketplace, considered by about 21% of the papers. This is also consistent with the overall IS focus on firms and their profit concerns. The low frequencies of other settings indicate that IS researchers paid much less attention to issues that are relevant to contexts such as home, social environment, and cultural/geographical settings. The frequency of no-context studies (56 or 7% of the articles) ranks third in Table 8, right after the marketplace. It is a bit surprising to see that studies with no particular context specified could get published in high quality MIS journals. Social context has started to attract research interest since 1997, and has been steadily increasing since 2004, though the total number of papers considering this context is still small.

Table 8: Frequency of Contexts

		90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	Total	% by no. papers
A	Organization, work place	17	15	15	13	25	30	29	27	22	21	19	27	13	39	26	29	44	23	41	475	62.3%
B	Market place		1		2		1	1		2	1	1	4	14	5	16	16	30	22	27	143	18.8%
C	Home										1		1			2	1				5	0.7%
D	Social								1		1	1	1			3	4	6	6	9	32	4.2%
E	Cultural, national, geo.					1				1							2	1	3	1	9	1.2%
F	Other										2	2	2						1		7	0.9%
A, B										1					2	2	1	3		4	13	1.7%
A, D									1				1				1			1	4	0.5%
A, E										1		1						5			7	0.9%
A, F														3	1						4	0.5%
B, D																		1			1	0.1%
B, E												1						1			2	0.3%
D, E																		1			1	0.1%
A, B, D														1							1	0.1%
A, B, E																		2			2	0.3%
Blank	No context	2	5	1	3				3	1	2		1	2	1		2	20	7	2	52	6.8%
	Total	19	21	16	18	26	31	30	32	28	28	25	37	33	48	49	56	114	65	86	758	

RQ1.2: What are the research areas or subject topics?

Table 9 summarizes the frequencies of topics from 1990 - 2008. We draw the following observations from the table:

1. Among the 1,974 times all the 20 topics were studied, the most dominant topics fell within the IT Use and Impact category (83.3% of the overall topics studied). About 12.2% of the topics fell in the category of IT development. Only 4.6% of the topics addressed issues surrounding research or education.

2. The percentage of papers considering each particular topic is represented by "% by # of papers" (the last column) in Table 9. It shows that 61.7% of the articles addressed Cognitive belief and behavior (B01), followed by 35.9% on Attitude (B02), 35.1% on Performance and productivity (B06), 19.5% on Motivation (B04), and 14.4% on Trust (B07), all within the IT Use and Impact category. User Interface design and

development (A05) was the most studied topic in the IT Development area, involving 7.1% of the papers, followed by User interface evaluation (A06, 6.7% of the papers). The other two relatively well-studied topics within this category were Software/hardware development with human considerations (A03, 5.3%) and User analyst involvement (A02, 5 %). In Generic Topics, Research and Education issues were studied in 9.9% of the papers.

3. All topics are currently active in the literature, although some are much more active than others. For example, Development methods and tools (A01), Software/Hardware evaluation (A04), User training (A07), Ethics (B08), User Support (B10), and Education (C02) are less active than other topics. Several topics, such as Motivation (B04), Trust (B07), and Ethics (B08), did not start until about the mid-90's, and have gradually gained more attention during recent years.

Table 9: Frequency of Topics

		90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	Total	% by # topics	% by # papers
A	*IT Development*	*7*	*7*	*7*	*8*	*11*	*8*	*11*	*12*	*14*	*6*	*3*	*8*	*11*	*9*	*10*	*23*	*31*	*19*	*13*	*218*	*12.2%*	
A01	Dev. methods & tools					1			1	1				1	1	2	3	2	1		13	0.7%	1.7%
A02	User analyst involvement	2	1		1	6	1	3	4	3			1	3		2	2	5	2	2	38	2.1%	5.0%
A03	SW/HW development	2	2		4		5	5	2	3	3			1			3	5	2	3	40	2.2%	5.3%
A04	SW/HW evaluation			1				1	1								1	2	1		7	0.4%	0.9%
A05	User interface design & dev.	1	3	1		1	1	1		2	2	1	2	2	4	5	7	10	7	4	54	3.0%	7.1%
A06	User interface evaluation	2	1	3	2	2	1		4	5	1	2	4	4	1	1	5	6	5	2	51	2.8%	6.7%
A07	User training			2	1	1		1					1		3		2	1	1	2	15	0.8%	2.0%
B	*IT Use & Impact*	*29*	*29*	*22*	*20*	*33*	*41*	*34*	*40*	*34*	*42*	*46*	*67*	*45*	*121*	*125*	*143*	*246*	*137*	*240*	*1494*	*83.3%*	
B01	Cognitive beliefs & behavior	8	11	10	9	12	14	13	13	11	12	21	21	17	35	35	42	80	36	68	468	26.1%	61.7%
B02	Attitude	7	10	4	3	10	12	5	8	5	8	3	14	10	22	22	26	37	27	39	272	15.2%	35.9%
B03	Learning	3	1	3		4	2	4	5		4	2	5	4	3	2	3	7	3	8	63	3.5%	8.3%
B04	Motivation						1	1	2	2	2	2	3	2	18	13	21	25	22	34	148	8.2%	19.5%
B05	Emotion	1	1	1			2	1	3	2	1	3	2	3	5	7	7	18	4	9	70	3.9%	9.2%
B06	Performance	7	4	3	7	3	8	6	8	10	8	9	16	2	21	22	23	41	27	41	266	14.8%	35.1%
B07	Trust				1			1		2	1	1	1	5	7	13	10	31	9	27	109	6.1%	14.4%
B08	Ethics							1		1	2		1		1			1	3	1	11	0.6%	1.5%
B09	Interpersonal relationship	2	1			1	2	1	1	1	2	4	4	1	8	9	11	6	6	13	73	4.1%	9.6%
B10	User support	1	1	1		3		1			2	1		1		2					13	0.7%	1.7%
B11	Other														1						1	0.1%	0.1%
C	*Generic Topics*	*1*	*2*	*0*	*1*	*1*	*2*	*2*	*3*	*3*	*4*	*1*	*2*	*3*	*6*	*5*	*3*	*30*	*9*	*4*	*82*	*4.6%*	
C01	Research	1	2		1	1	2	1	3	3	3	1	1	3	5	3	3	29	9	4	75	4.2%	9.9%
C02	Education							1			1		1		1	2		1			7	0.4%	0.9%
	Total	*37*	*38*	*29*	*29*	*45*	*51*	*47*	*55*	*51*	*52*	*50*	*77*	*59*	*136*	*140*	*169*	*307*	*165*	*257*	*1794*	*100%*	
	1 topic	8	6	7	9	12	15	16	16	11	12	11	16	16	10	12	13	26	18	20	254		33.5%
	2 topics	6	13	7	7	10	13	11	10	12	10	6	8	10	10	9	14	31	14	20	221		29.2%
	3 topics	3	2	1	2	3	2	3	5	4	4	6	9	5	13	13	6	31	7	11	130		17.2%
	4 topics	2				1	1		1	1	2	1	2	2	10	7	9	8	18	11	76		10.0%
	5 topics			1								1	2		3	6	11	14	4	19	61		8.0%
	6 topics														2	1	2	4	1	3	13		1.7%
	7 topics															1	1			1	3		0.4%
	Average topics/paper	1.9	1.8	1.8	1.6	1.7	1.6	1.6	1.7	1.8	1.9	2.0	2.1	1.8	2.8	2.9	3.0	2.7	2.7	3.0	2.4		

4. Table 9 also shows the number of papers that covered between 1 and 7 topics in each year, and the average number of topics per paper per year. Overall, the average topics per paper is 2.4 (1,794 divided by 758). There is a trend of covering more topics in a single paper over the years. For example, the average number of topics per paper increased from under two in early 1990s to close to three in 2003, and has since remained relatively consistent.

RQ1.3: What topics are often co-studied?

Since more than half of the papers covered more than one topic, it is interesting to see which topics were studied alone and which were studied together. Table 10 shows the frequency of topics that were studied alone, that is, each of them was the only topic in a paper. The most studied-alone topics include Cognitive belief and behavior (B01, with 77 papers), Research (C01, with 34 papers), Software/Hardware development (A03, with 30 papers), Performance (B06, with 25 papers), and Learning (B03, with 20 papers).

Table 10: Frequency of the Topics that were Studied Alone

Topic	Total Number
A01: Dev. methods & tools	3
A02: User analyst involvement	10
A03: Software/Hardware dev.	30
A04: Software/Hardware evaluation	2
A05: User interface design & dev.	8
A06: User interface evaluation	2
A07: User training	4
B01: Cog. belief & behavior	77
B02: Attitude	8
B03: Learning	20
B04: Motivation	0
B05: Emotion	3
B06: Performance	25
B07: Trust	12
B08: Ethics	5
B09: Interpersonal relationship	3
B10: User support	4
C01: Research	34
C02: Education	4
Total	254

For the co-studied topics, we focused only on pairs of topics because of the complexity of analysis and interpretation. For example, for those articles that studied three topics, we considered each two-topic combination among the three, thus yielding three pairs of two-topic co-occurrence. Table 11 depicts the results of any pair of co-studied topics. We found 1,935 pairs, which involved 3,870 occurrences of topics. The last column is the total for any topic that is studied with any one of the other topics. The table shows that:

1. B01 (Cognitive beliefs and behavior), B02 (Attitude), B04 (Motivation), and B06 (Performance) were the most paired topics, occurring more than 490 times each, followed by B07 (Trust), B09 (Interpersonal relationship), B05 (Emotion), and B03 (Learning), occurring more than 100 times each.

2. B topics were mostly co-studied with other B topics; the frequency of such co-studies was 1,600 (82.6% of the 1,935 pairs).

3. Among the A topics, A05 (User interface design and development) and A06 (User interface evaluation) paired the most (14 times).

4. A05 (User interface design and development) and A06 (User interface evaluation) were also the two A topics that paired the most with B topics. The co-occurring frequency among A and B topics was 209,

about 10.84% of the total 1,935 pairs. That is, about 11% of the total co-studied topics encompassed the two stages of the IT life cycle.

Table 11: Frequency of Co-Studied Topics

		A01	A02	A03	A04	A05	A06	A07	B01	B02	B03	B04	B05	B06	B07	B08	B11	B12	Total
A01	Dev. methods & tools																		22
A02	User analyst involvement	4																	50
A03	SW/HW development	1	2																21
A04	SW/HW evaluation	1	1	1															11
A05	User interface design & dev.	2	6	2	1														90
A06	User interface evaluation	1	3	1	3	14													92
A07	User training	1	2	2	1	1	2												35
B01	Cog. beliefs & behavior	3	13	4	1	17	18	5											894
B02	Attitude	2	12	1	1	12	12	5	228										683
B03	Learning	1		1		5	2	3	31	16									113
B04	Motivation	2	1	1		4	2	5	145	119	13								494
B05	Emotion					1	5	2	61	27	6	25							179
B06	Performance		2	3		18	24	5	196	141	19	108	25						628
B07	Trust		1	2		2			86	58	3	53	7	48					281
B08	Ethics								3	1		1			3				10
B09	Interpersonal relationship	2	3			2	4		60	33	7	12	15	28	12				181
B10	User support								2	6									10
B11	Others								1						1				2
C01	Research	2			1	2	1		20	9	3	3	5	11	5	2	3	2	69
C02	Education					1		1			3								5

RQ1.4: What are the research methods?

Table 12 summarizes research methods utilized in the articles. Among the 758 papers, the majority (680 or 89.7%) used one method, 76 papers (10%) used two, and two papers used three methods. Among the total methods used, Empirical methods (700 uses, 83.5%) dramatically exceeded Non-Empirical ones (138 uses, 16.5%).

The frequency of Non-Empirical studies has been consistently low over the years. Empirical studies have been conducted almost entirely on Events/Processes. In particular, Survey (29% of the papers), Lab Experiment (28.5%), and Field study (10.4%) were the three most utilized methods. This indicates that positivist research has been conducted more often than other forms of research.

It is noteworthy that in the 1990-2002 HCI field review (Zhang and Li, 2005), five methods (Framework [1.1.1]; -Theory from reference disciplines [1.1.4]; Opinion with personal experience [1.2.2]; Description of types/classes of systems [2.1.1]; and Ex-post description [2.2.9]) were not utilized. In 2003-2008, Framework, Theory from reference disciplines, and Opinion with personal experience have been utilized by a number of papers. Description of types/classes of systems (2.1.1) and Ex-post description (2.2.9) remained unused.

Table 12 Frequency of Methods

		90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	Total	% by # of methods	% by # of papers
1	*Non-Empirical*	*6*	*6*	*0*	*0*	*1*	*3*	*2*	*4*	*3*	*6*	*0*	*5*	*4*	*9*	*11*	*9*	*42*	*17*	*10*	*138*	*16.5%*	
1.1	*Conceptual Orientation*	*3*	*1*	*0*	*0*	*1*	*0*	*1*	*0*	*2*	*2*	*0*	*2*	*1*	*8*	*11*	*8*	*22*	*14*	*7*	*83*	*9.9%*	
1.1.1	Framework										1		1		1	3	4	11	2	2	25	3.0%	3.3%
1.1.2	Conceptual model	1				1		1		2	1		1		7	8	3	9	8	3	45	5.4%	5.9%
1.1.3	Conceptual overview	2	1											1			1	2		1	8	1.0%	1.1%
1.1.4	Theory																		4	1	5	0.6%	0.7%
1.2	*Illustration*	*1*	*2*	*0*	*0*	*0*	*1*	*0*	*4*	*1*	*3*	*0*	*1*	*1*	*1*	*0*	*1*	*16*	*2*	*2*	*36*	*4.3%*	
1.2.1	Opinion (pure)	1	2				1		4	1	1		1		1			8	1	1	22	2.6%	2.9%
1.2.2	Opinion (personal exp)																	4			4	0.5%	0.5%
1.2.3	Description of tool, technique										2			1			1	4	1	1	10	1.2%	1.3%
1.3	*Applied concepts*	*2*	*3*	*0*	*0*	*0*	*2*	*1*	*0*	*0*	*1*	*0*	*2*	*2*	*0*	*0*	*0*	*4*	*1*	*1*	*19*	*2.3%*	
1.3.1	Frameworks & appl.	2	3				2	1			1		2	2				4	1	1	19	2.3%	2.5%
2	*Empirical*	*14*	*18*	*18*	*21*	*28*	*32*	*31*	*30*	*30*	*25*	*27*	*36*	*35*	*46*	*41*	*52*	*86*	*47*	*83*	*700*	*83.5%*	
2.1	*Objects*	*0*	*0*	*0*	*2*	*0*	*1*	*0*	*1*	*1*	*0*	*0*	*1*	*2*	*0*	*0*	*1*	*0*	*0*	*0*	*9*	*1.1%*	
2.1.1	Description of class of systems																				0	0.0%	0.0%
2.1.2	Description of specific application				2		1		1	1			1	2			1				9	1.1%	1.2%
2.2	*Events/Process*	*14*	*18*	*18*	*19*	*28*	*31*	*31*	*29*	*29*	*25*	*27*	*35*	*33*	*46*	*41*	*51*	*86*	*47*	*83*	*691*	*82.5%*	
2.2.1	Lab experiment	6	4	7	12	6	10	11	8	13	10	14	15	5	13	11	12	25	11	23	216	25.8%	28.5%
2.2.2	Field experiment	2	1	1		4		3	4	1		1	2	2	3		3	4	2	6	39	4.7%	5.1%
2.2.3	Field study	4	3	2		3	7	4	7	1	3	3	1	5	5	7	9	8	1	6	79	9.4%	10.4%
2.2.4	Positivist case study				1		1			2		1		1	1	3	3	1	7	1	22	2.6%	2.9%
2.2.5	Interpretive case study	1		1	1			1		2		2	1	3	2				1	1	16	1.9%	2.1%
2.2.6	Action research																			2	2	0.2%	0.3%
2.2.7	Survey		7	4	3	9	8	9	8	7	8	5	11	9	14	15	18	36	17	32	220	26.3%	29.0%
2.2.8	Instrument development		2	2		3	1	1	1	3	1		1	4	2	2	2	4	2	3	34	4.1%	4.5%
2.2.9	Ex-post description																				0	0.0%	0.0%
2.2.10	Secondary data	1			1	1	2				2	1	1	2		1	1	4	2	4	23	2.7%	3.0%
2.2.11	Interview		1		1	2	1	1	1				2	2	4	1	2	4	4	2	28	3.3%	3.7%
2.2.12	Delphi			1				1			1										3	0.4%	0.4%
2.2.13	Focus group						1						1		1		1			2	6	0.7%	0.8%
2.2.14	Other														1	1				1	3	0.4%	0.4%
Total		20	24	18	21	29	35	33	34	33	31	27	41	39	55	52	61	128	64	93	838	100.0%	

RQ1.5: What methods are often used to study what topics?

The results of cross-facet analysis of method and topic are shown in Table 13. Each pair represents one method and one topic that appeared in one article. We limited our analysis to one to one pairing due to the complexity of analysis. For example, those articles that studied three topics using two methods would yield six method-topic pairs. The last column of the table shows the total frequencies of each method's usage. For example, Survey (2.2.7) was used 553 times to study all the topics (except Topic B11, Other). Similarly, the last row shows how many times each topic was studied with various methods. For instance, Cognitive beliefs and behaviors (B01) was studied a total of 518 times, with all types of methods showing in the table except Opinion (1.2.2) and Description of a specific application (2.1.2).

The most frequently occurring pairings were between Empirical methods and IT Use and Impact (B category) topics. In particular, the four largest pairings between topics and methods are:

1. Cognitive belief and behavior (B01) by Survey (2.2.7)
2. Cognitive belief and behavior (B01) by Lab experiment (2.2.1)
3. Performance (B06) by Lab experiment (2.2.1)

4. Attitude (B02) by Survey (2.2.7).

The most used methods (Survey [2.2.7], Lab experiment [2.2.1], Field study [2.2.3]) were used to study almost all topics. In addition, one conceptual method, Conceptual model (1.1.3), was used intensively.

Table 13 also depicts what methods were utilized most for each topic. For example, Cognitive belief and behavior (B1) was studied mostly by using Survey (2.2.7). Emotion (B05) was also studied mostly by survey, while Learning (B03) was studied mostly by Lab experiment (2.2.1).

Table 13: Pair Frequency of Methods and Topics

Method		Topic																						
		Development methods and tools	User analyst involvement	Software/hardware development	Software/hardware evaluation	User interface design & development	User interface evaluation	User training	Cognitive beliefs and behavior	Attitude	Learning	Motivation	Emotion	Performance	Trust	Ethics	Interpersonal relationship	User support	Other	Research	Education	Total Paring
		A01	A02	A03	A04	A05	A06	A07	B01	B02	B03	B04	B05	B06	B07	B08	B09	B10	B11	C01	C02	
1.1.1	Framework	2	3	1	1	4	3	2	9	7		7	1	6	6		1			9	1	63
1.1.2	Conceptual model	1	1	1		4	2		29	21	3	17	7	26	8		6			11	2	139
1.1.3	Conceptual overview		1	1		2			3	1	1	1	2	2						4		18
1.1.4	Theory								1	1		1		1		1				4		9
1.2.1	Opinion (pure)	1		2			1		5	1	1		1	3	2	1		1		15	1	35
1.2.2	Opinion (personal exp)																			4		4
1.2.3	Desc. a tool, technique		1	1		4	2	1	5	2	1	2	1	3			1			4	1	29
1.3.1	Frameworks & appl.	1	2	2		6	1		8	4	1		1	5	1	1	3			5		41
2.1.2	Desc. of a specific appl.			6		3	2	1		1				2								15
2.2.1	Lab experiment	3	3	20	1	25	29	2	121	63	23	35	12	118	25		17	1		2		500
2.2.2	Field experiment		5	4		2	3	2	23	12	7	6	1	12	6		1		1	1		86
2.2.3	Field study	1	5			2	3	1	58	35	8	11	10	18	12		14	2		2	1	183
2.2.4	Positivist case study		3		2	2			14	10		4	1	6	2	1	4	1		1		51
2.2.5	Interpretive case study	1	5				1	1	10	6		2	1	4	1		3	1		1		37
2.2.6	Action research		1						2	1	1	1		1	1							8
2.2.7	Survey	2	7	3	2	3	3	4	175	107	14	57	28	57	44	6	22	6		12	1	553
2.2.8	Instrument development		2		2		4	1	20	17	4	4	5	4	7		2	2		6		80
2.2.10	Secondary data	1	2	3			2		10	6	1	1		7	2		1			4		40
2.2.11	Interview	1	2	1		4	3	2	15	7	6	6	2	7	3	1	2					62
2.2.12	Delphi				1		1		2													4
2.2.13	Focus group					2	1	2	5	5	1	4	1	4	1		1					27
2.2.14	Other					1			3				1	2			1			1		9
Total Pairing		14	43	45	9	64	61	19	518	307	72	159	75	288	121	11	79	14	1	86	7	1993

RQ1.6: What are the levels of analysis?

As shown in Table 14, 618 papers (or 81.5%) addressed the individual level only, 48 papers (6.3%) the group level only, and 59 papers (7.8%) addressed both individual and group levels. That is, the majority of papers in this collection were concerned with individual level of analysis.

Table 14: Frequency of Levels of Analysis

		90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	Total	% by no. papers
A	Individual	16	20	16	18	24	28	29	30	24	26	21	28	30	34	36	42	80	46	70	618	81.5%
B	Group	2	1			1	1			2	1	3	4	1	3	4	3	5	11	6	48	6.3%
A/B	Both	1					2		1	2	1	1	3	1	10	8	10	8	3	8	59	7.8%
	Blank					1		1	1				2	1	1	1	1	21	2	1	33	4.4%
	Total	19	21	16	18	26	31	30	32	28	28	25	37	33	48	49	56	114	62	85	758	

RQ1.7: To what extent does the HCI sub-discipline consider IT/ service as a research component?

Table 15 summarizes the frequencies of technologies or services being studied. It shows that 79.9% (606 papers) studied one type of technology or service, 4.6% two types, 0.8% three types, 0.3% four types, and 14.4% (109) did not specify technology/service in the studies. Among the 702 times technologies and services were studied, 50.3% were End-user computing tools, 46% were Organizational computing tools, and 3.7% were Services. Among the 758 papers, 23.1% studied the Web in general, some types of websites, or some specific websites, followed by 15.4% papers on Decision support systems (DSS), 12.1% on Management information systems (MIS), and 11.6% on Other types.

Table 15: Frequency of Technologies or Services

		90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	Total	% by # of tech	% by # of papers
TA	*End-user computing*	*4*	*7*	*9*	*6*	*11*	*3*	*7*	*13*	*7*	*11*	*9*	*10*	*17*	*14*	*29*	*38*	*77*	*32*	*49*	*353*	*50.3%*	
TA1	Ind. Comm.			1	1	3	1	2	4	1	3		1	1	4	3	4	5	2	1	37	5.3%	4.9%
TA2	Ind. Productivity	3	1	4	5	3	1	3	4	3	6	3	3		2	1	3	4	2	2	53	7.5%	7.0%
TA3	Web							1	2	2	1	4	4	11	8	18	21	42	24	37	175	24.9%	23.1%
TA4	Other	1	6	4		5	1	1	3	1	1	2	2	5		7	10	26	4	9	88	12.5%	11.6%
TB	*Org/Social computing*	*8*	*6*	*6*	*7*	*8*	*17*	*18*	*10*	*14*	*11*	*14*	*25*	*10*	*35*	*18*	*20*	*30*	*31*	*35*	*323*	*46.0%*	
TB1	Group/Org communication			1				1	1	4	0	1	5	1	1	1	1	0	1	2	20	2.8%	2.6%
TB2	DSS	4	5	5	3	5	9	7	4	8	4	3	9	1	14	6	8	9	6	7	117	16.7%	15.4%
TB3	MIS, ERP	1			3	2	3	7	3		4	2	4	4	16	8	7	11	7	10	92	13.1%	12.1%
TB4	CSCW, GDSS	3	1				4	2	2	2	3	6	5	4	1	1	2	3	1	6	46	6.6%	6.1%
TB5	Other				1	1	1	1				2	2		3	2	2	7	16	10	48	6.8%	6.3%
TC	*Internet service, info center*	*1*	*1*			*3*	*1*	*1*	*3*	*3*	*2*			*2*	*2*	*3*	*1*	*2*	*1*		*26*	*3.7%*	
Total		13	14	15	13	22	21	26	26	24	24	23	35	29	51	50	59	109	64	84	702	100.0%	
Blank	*No tech/service*	*7*	*7*	*2*	*5*	*6*	*11*	*6*	*7*	*7*	*5*	*2*	*4*	*6*	*3*	*3*	*4*	*17*	*1*	*6*	*109*		*14.4%*

RQ1.8: To what extent does the HCI sub-discipline consider individual characteristics?

Table 16 summarizes the frequencies of individual characteristics. Among the 758 articles, only 219 or 28.9% of articles considered explicitly individual characteristics, including personality (7.9%), demographics (14%), and both (7%). The majority (539 papers or 71.1 %) didn't consider individual characteristics as primary factors in their studies.

Table 16: Frequency of Individual Characteristics

		90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	Total	% by # papers
A	Personality	1	1	2		1		2	1	4	1	2	3	2	5	3	5	13	3	11	60	7.9%
B	Demographics	1	1		1	2	2	1	5	1	1	5	1	2	11	7	14	20	11	20	106	14.0%
A, B	Both	1	1	1			1		1	2	1			1	3	3	5	16	8	9	53	7.0%
	Blank	16	18	13	17	23	28	27	25	21	25	18	33	28	29	36	32	65	40	45	539	71.1%
	Total	19	21	16	18	26	31	30	32	28	28	25	37	33	48	49	56	114	62	85	758	100%

Summary for RQ1

Several observations can be drawn from the above analyses on the intellectual substance of the HCI sub-discipline, which is largely consistent with those in Zhang and Li (2005):

1. IS scholars are mainly interested in HCI issues that are concerned with IT use and impact at the individual level in organizational and work contexts. Other topics (i.e., IT development), other contexts (e.g., social), and other analysis level (i.e., group) are gaining more attention in recent years.

2. One paper is often dedicated to multiple topics.

3. A broad range of research methods is utilized, although the predominant ones are lab experiment, survey method, and field study. Different methods are often used to explore the same topics, while the same methods are often applied to studying different topics.

4. Individual characteristics do not gain the level of attention one would anticipate for studies on humans interacting with technologies.

5. IT artifacts and services, although considered more frequently than individual characteristics in studies, are not always clearly specified. The large number of studies that do not specify IT seems consistent with some researchers' observations and calls for more attention to the IT artifact in MIS research (Benbasat and Zmud 2003; Orlikowski and Iacono 2001; Weber 2003).

RQ2: What are the Relationships with Other Disciplines?

RQ2.1: What are the contributing disciplines?

Table 17 shows the broad fields (one level higher than disciplines as shown in Table 7) that supported this set of 758 papers. Information, Computing, & Communication Sciences (2800); Behavioral & Cognitive Sciences (3800); and Commerce, Management, Tourism & Services (3500) were the most frequently referenced fields that supported theoretical or conceptual development in HCI studies. This is fairly consistent with the top global IS supporting disciplines identified by Lowry et al. (2004), though the disciplines are classified slightly differently. The last column shows that about 97% of the papers used 2800 as a contributing field, 87% of the papers used 3800, 42% of the papers used the 3500 field, and about 39% of papers used other fields.

Table 17: Frequency of Fields that Contribute to the Studies

		90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	Total	% by # papers
F2800	Information, Computing, & Communication Sciences	21	22	18	20	28	39	34	39	30	33	24	30	33	43	37	53	110	47	76	737	97%
F3500	Commerce, Management, Tourism & Services	10	9	5	9	11	14	17	16	15	10	6	17	22	18	21	24	47	16	31	318	42%
F3800	Behavioral & Cognitive Sciences	14	12	14	12	17	22	22	27	18	19	24	31	18	46	45	60	112	63	82	658	87%
	Other	7	6	3	3	7	5	8	8	9	5	10	27	16	22	26	20	38	38	37	295	39%
	Total	52	49	40	44	63	80	81	90	72	67	64	105	89	129	129	157	307	164	226	2008	

A total of 38 disciplines functioned as contributing disciplines to the 758 articles for a total of 2,008 times. Table 18 summarizes the frequencies of the 14 disciplines that were considered as contributing disciplines by at least 10 papers. Among the 2,008 references to the 38 disciplines, the three most relied-upon disciplines were Information Systems (D2801, supported 711 articles, or 93.8%), Psychology (D3801, supported 577 articles, or 76.1%), and Business and Management (D3502, supported 299 articles, or 39.4%). One caution is that D2801 is more than just MIS, as indicated in Table 7. The upper part of the last column of Table 18 (from D2302 – 1.3% to D4401 – 1.8%) demonstrates the percentages of the 758 papers supported by each discipline.

Table 18 also shows that out of the 758 articles, 58 (7.7%) articles relied on just one discipline, 264 (34.8%) articles drew upon two disciplines, 326 (43%) built on three, 92 (12.1%) on four, and 18 (2.4%) on five disciplines. Together, the average number of supporting disciplines per paper is 2.7 for the entire 19 years.

Table 18: Frequency of Top 14 Contributing Disciplines

		90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	Total	% by # Papers
D2302	Statistics	1	3		1		1		2						1	1					10	1.3%
D2801	Information Systems	18	21	16	17	25	31	28	31	27	28	23	32	30	45	45	53	111	50	80	711	93.8%
D2802	AI and Image Processing	2	1		1	2	3	1	2		1	2	1	1	2		1	2	2		24	3.2%
D2803	Computer Software	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	2.6%
D3301	Education Studies	1		2		3		2		1		3	3	2	2	2	2	5	2	4	34	4.5%
D3402	Applied Economics											1	1	3		3	1	3		3	15	2.0%
D3502	Business and Management	10	9	4	9	11	14	16	16	15	9	6	17	22	16	21	23	43	10	28	299	39.4%
D3599	Other commerce, management														2			4	6	1	13	1.7%
D3701	Sociology	3	1	1		1	1	1	2	2		1	5	4	9	8	8	9	12	15	83	10.9%
D3801	Psychology	12	11	12	10	15	22	20	25	17	18	21	28	18	43	38	51	89	51	76	577	76.1%
D3803	Cognitive Science	2	1	2	2	2		1	1	1		2	2		3	7	8	21	12	6	73	9.6%
D4001	Journalism, Comm. and Media	2	1			2	2	1	2	4	1	2	8	3	1	3	1	5	1	2	41	5.4%
D4203	Cultural Studies								2			1	1				3	3	2	2	14	1.8%
D4401	Philosophy					1		2		1	2		1					3	4		14	1.8%
	1 discipline	1	4	2	3	7	3	4	1	7	0	1	3	2	2	3	1	6	6	2	58	7.7%
	2 disciplines	6	9	7	7	7	10	7	11	5	18	14	10	12	19	18	16	37	16	35	264	34.8%
	3 disciplines	9	5	4	5	7	15	13	14	10	9	6	14	13	18	22	32	58	33	39	326	43.0%
	4 disciplines	2	3	3	3	4	3	6	5	5	1	3	7	5	8	4	6	11	6	7	92	12.1%
	5 disciplines	1	0	0	0	1	0	0	1	1	0	1	3	1	0	3	1	2	1	2	18	2.4%
	Average # of disciplines per paper	2.8	2.3	2.5	2.4	2.4	2.6	2.7	2.8	2.6	2.4	2.6	2.9	2.7	2.7	2.7	2.8	2.7	2.7	2.7	2.7	

RQ2.2: What contributing disciplines are often co-cited in HCI studies?

Table 18 shows that only 58 papers (7.7%) were built on just one discipline. The majority of papers relied on more than one supporting discipline. Hence, it is interesting to consider what disciplines are often used together to support conceptual and theoretical development in this set of research.

Similar to the co-occurrences analysis for topics, we focused on co-occurrence of two disciplines. For those articles that built on three disciplines, we considered combinations of two-discipline pairs. For example, if one study was built on disciplines A, B, and C, then this study has three pairs of co-citations of contributing disciplines: AB, AC, and BC. Among the 758 papers, there are a total of 1,974 pairs of disciplines co-cited. Table 19 summarizes the frequencies of co-citations of the top 14 disciplines (as in Table 18) with a total of 1,847 pairs (representing 94% of the 1,974 pairs). The "Total" column and the "Total" row of the table show the frequency of each discipline paired with another discipline. For example, Artificial Intelligence, Signal and Image Processing (2802) paired up with other top 14 disciplines 62 (40+22) times.

Table 19: Frequency of Top Co-Occurring Disciplines

		2801	2802	2803	3301	3402	3502	3599	3701	3801	3803	4001	Total
D2302	Statistics	10		1			2		1	7	1		22
D2801	Information Systems		22	41	33	13	287	11	75	551	71	39	1143
D2802	AI & Image Processing			5	1		9	1		18	4	2	40
D2803	Computer Software				1	1	5		1	32	7	2	49
D3301	Education Studies						5		3	27	3	2	40
D3402	Applied Economics						11		6	7		1	25
D3502	Business and Management							1	33	207	3	24	268
D3599	Other commerce, Mgmt								2	11	1		14
D3701	Sociology									63	5	8	76
D3801	Psychology					1	1	3	1	2	69	29	106
D3803	Cognitive Science							1				1	2
D4001	Journalism, Comm. & Media												0
D4203	Cultural Studies	14					2		1	11		1	29
D4401	Philosophy	10			2		4		2	7			25
Total		37	22	48	37	15	328	17	125	945	164	109	1847

The most often co-occurring discipline pairs were among the three most frequently cited disciplines: (2801 Information Systems, 3801 Psychology) appeared most frequently, followed by (2801 Information Systems, 3502

Business and Management), and (3502 Business and Management, 3801 Psychology). These three disciplines (2801, 3502, & 3801) also co-occurred with other disciplines the most, indicating that these three disciplines were often combined together or with other disciplines to support theoretical and conceptual development in HCI studies. Overall, the use of multiple disciplines in single studies and the number of different disciplines cited confirm the multidisciplinary nature of the HCI sub-discipline.

RQ2.3: What contributing disciplines are often used to support what topics?

Table 20 shows how frequently a particular topic appears in the same paper with a particular discipline (we only considered the top 14 disciplines, which represent 4,753 pairs with the topics, 98% of the 4,853 total pairs of topics, and 38 disciplines). The total in the last row for each discipline shows how many times the discipline appeared with all topics. For example, discipline 2302 (Statistics) appeared 21 times with various topics in the 758 articles. The last column shows the total frequency of each topic co-occurring with the top 14 contributing disciplines.

Table 20: Pair Frequency of Topics and Top 14 Contributing Disciplines

		Disciplines														
Topics		D2302 Statistics	D2801 Information Systems	D2802 AI & Signal/Image Processing	D2803 Computer Software	D3301 Education Studies	D3402 Applied Economics	D3502 Business and Management	D3599 Other commerce, management	D3701 Sociology	D3801 Psychology	D3803 Cognitive Science	D4001 Journalism, Communication & Media	D4203 Cultural Studies	D4401 Philosophy	Total
A01	Dev. methods & tools		12		4			3		3	8	2			1	33
A02	User analyst involvement		37		4	2		16		5	26	3	1		1	95
A03	SW/HW development		37	5	16	2	2	9		1	29	7		1	1	111
A04	Software/hardware evaluation		7		3					1	2	1				14
A05	User interface design & dev.	3	51	7	9	1	2	17	1	4	39	8	2	1		145
A06	User interface evaluation	3	49	3	10	2		14		1	34	4	5		1	126
A07	User training		15		2	7		1		2	14	4				45
B01	Cognitive beliefs & behavior	3	451	11	7	11	9	194	12	62	386	53	23	13	5	1240
B02	Attitude	2	265	6	6	6	3	84	7	35	224	40	11	9	3	702
B03	Learning		62	5	4	17		18		3	51	5	2			167
B04	Motivation		144		2	7	1	19	7	25	146	35	2	8	1	397
B05	Emotion	2	67			2	1	28	1	13	67	6	6	2	1	196
B06	Performance	5	254	7	14	14	4	81	5	30	233	50	12	8	2	720
B07	Trust		104	2	2		6	44	6	18	97	16	6	3	1	305
B08	Ethics		9					4		3	7		1		6	30
B09	Interpersonal relationship		67	2	1		4	39		24	59	1	12	2		211
B10	User support		13				1	8			2					24
B11	Other		1					1			1					3
C01	Research	3	71	2	3			32		9	43	2	3	1	3	172
C02	Education		7		1	4		1			3	1				17
Total		21	1723	50	88	75	33	613	39	239	1471	238	86	48	26	4753

The IT Development topics (A topics) seemed to be built primarily on the fields of 2800 Information, Computing, & Communication Sciences, 3500 Commerce, Management, Tourism & Services, and 3800 Behavioral & Cognitive Sciences. The overall IT Use and Impact topics (B topics) were built on much broader fields and disciplines. The three most frequently cited disciplines, Information Systems (2801), Business and Management (3502), and Psychology (3801), contributed to all the topics that were studied. The pairings of the most studied topics, Cognitive belief & behavior (B1), Attitude (B2), and Performance (B5), and the most cited contributing disciplines, Information Systems (2801), Business and Management (3502), and Psychology (3801), were the most frequently used topic-discipline pairs.

Summary for RQ2

The result continues to show that HCI studies in IS are truly multi- and interdisciplinary. The majority of studies cite more than one main supporting discipline. A large number of disciplines have contributed to the conceptual and theoretical development of the HCI sub-discipline as a whole, while the most influential disciplines are Information Systems, Business and Management, and Psychology.

RQ3: What are the evolutions?

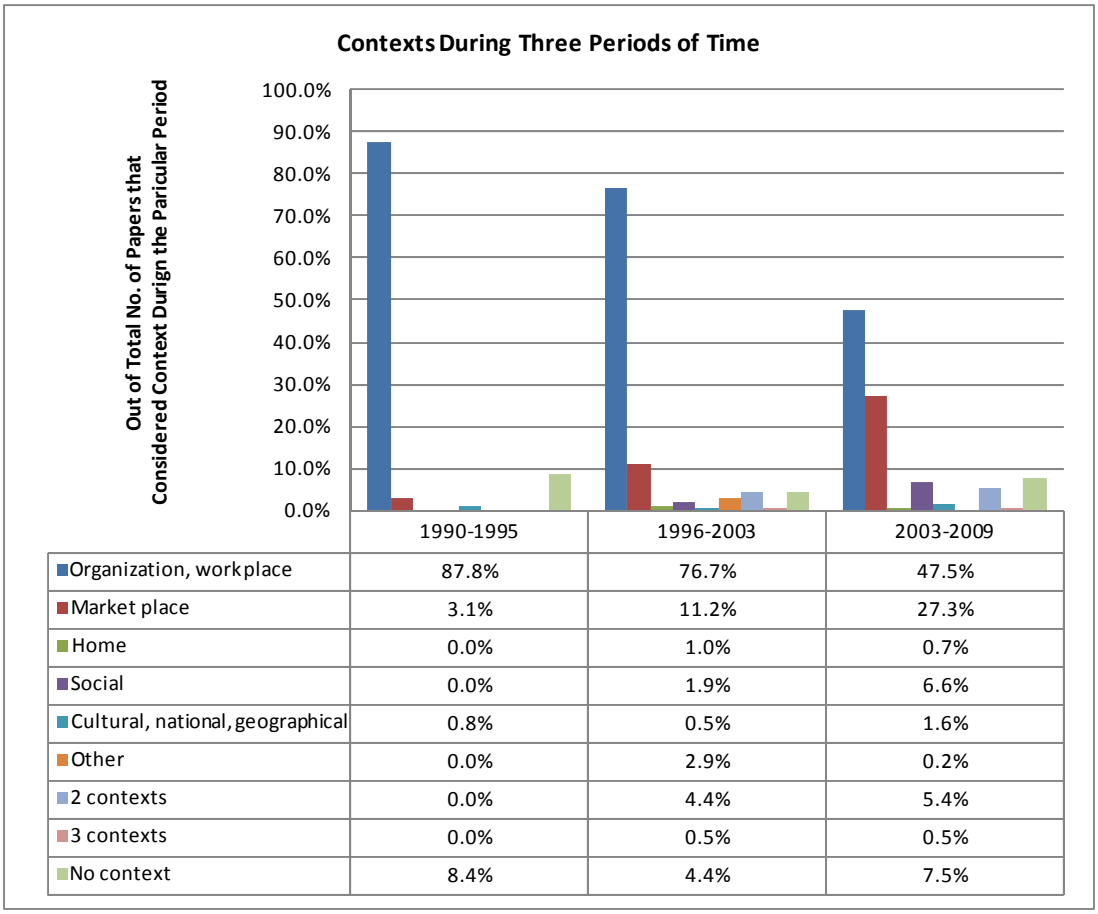
The evolutions or changes are demonstrated by comparing the data in the three periods when possible. Such comparisons are done for all seven facets.

RQ3.1: What are the changes in the contexts of study over the years?

Figure 2 shows comparisons of the three periods where we present aggregated data of a particular period. Several significant movements over the years can be identified:

1. The percentage of papers within the organization and workplace context decreased over the years.
2. The percentage of papers considering the market place context increased, which seems to coincide with e-commerce related research since the inception of the Web.
3. The percentage of papers considering the social context also increased, although the total number of such papers is still small.
4. The percentage of papers with two or three contexts increased slightly.

By looking at the most recent period of data (2003-2008), it seems that the contexts of studies are very diverse, and the most considered contexts are Organization/Workplace, Market place, and Social.

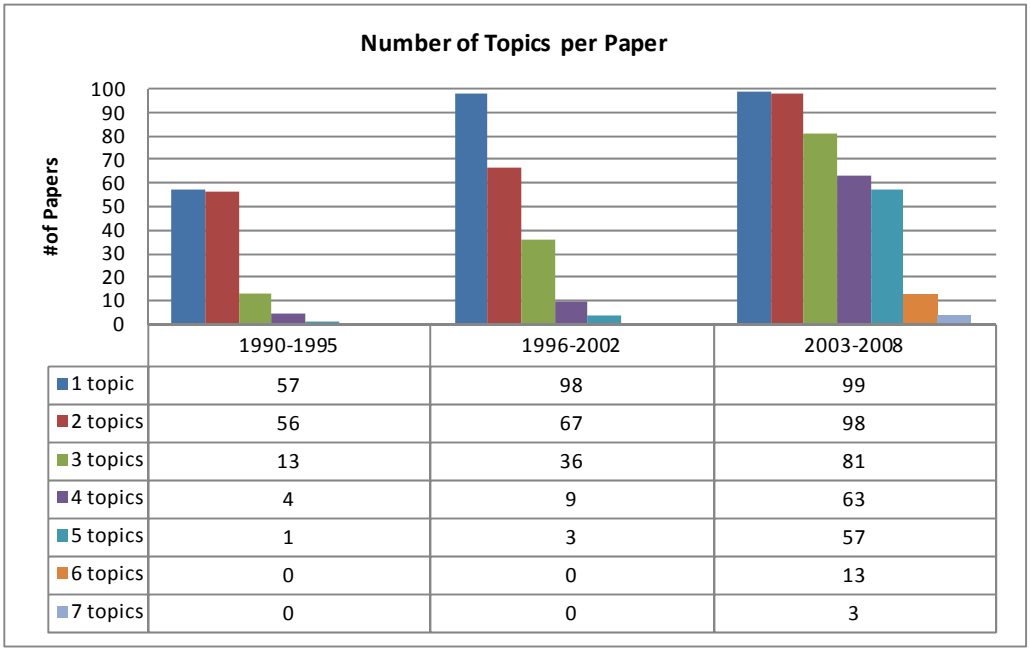


	1990-1995	1996-2003	2003-2009
Organization, workplace	87.8%	76.7%	47.5%
Market place	3.1%	11.2%	27.3%
Home	0.0%	1.0%	0.7%
Social	0.0%	1.9%	6.6%
Cultural, national, geographical	0.8%	0.5%	1.6%
Other	0.0%	2.9%	0.2%
2 contexts	0.0%	4.4%	5.4%
3 contexts	0.0%	0.5%	0.5%
No context	8.4%	4.4%	7.5%

Figure 2: Contexts during the Three Periods of Time

RQ3.2: What are the changes in the subject topics over the years?

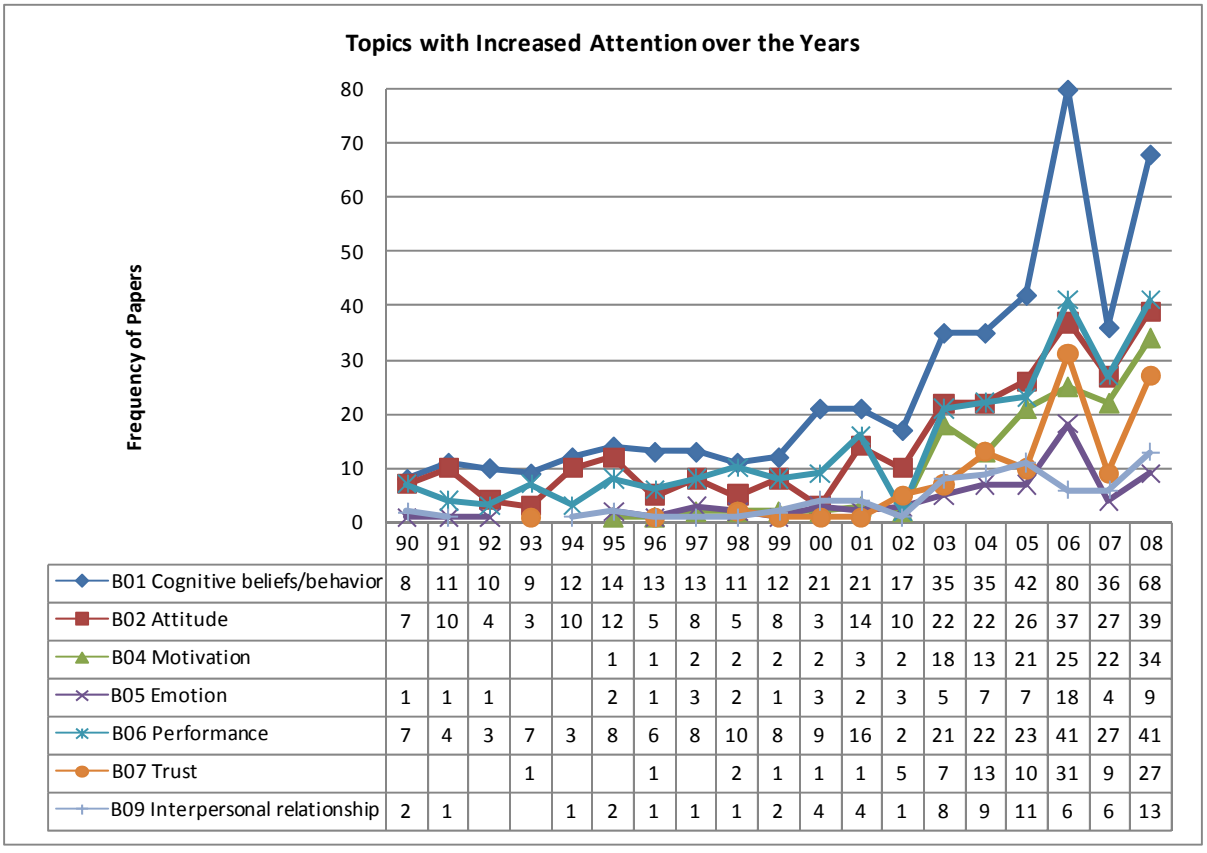
Figure 3 shows the frequencies of papers covering various numbers of topics per paper over the three time periods. It clearly shows a dramatic increase in the number of papers covering multiple topics over the years. In particular, it illustrates that as the field has continued to evolve, authors are increasingly including more topics in their papers.



	1990-1995	1996-2002	2003-2008
1 topic	57	98	99
2 topics	56	67	98
3 topics	13	36	81
4 topics	4	9	63
5 topics	1	3	57
6 topics	0	0	13
7 topics	0	0	3

Figure 3: Frequencies of Papers Covering Various Numbers of Topics during the Three Periods

Several topics have gained increasing attention in recent years. Figure 4 shows seven such topics: Cognitive beliefs/behavior (B01), Attitudes (B02), Motivation (B04), Emotion (B05), Performance (B06), Trust (B07), and Interpersonal Relationship (B09).



	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08
B01 Cognitive beliefs/behavior	8	11	10	9	12	14	13	13	11	12	21	21	17	35	35	42	80	36	68
B02 Attitude	7	10	4	3	10	12	5	8	5	8	3	14	10	22	22	26	37	27	39
B04 Motivation						1	1	2	2	2	2	3	2	18	13	21	25	22	34
B05 Emotion	1	1	1			2	1	3	2	1	3	2	3	5	7	7	18	4	9
B06 Performance	7	4	3	7	3	8	6	8	10	8	9	16	2	21	22	23	41	27	41
B07 Trust				1			1		2	1	1	1	5	7	13	10	31	9	27
B09 Interpersonal relationship	2	1			1	2	1	1	1	2	4	4	1	8	9	11	6	6	13

Figure 4: Topics with Increased Attention over the Years

Figure 5 depicts the topic frequencies of the three categories (IT Development, IT Use and Impact, and General Topics related to Research or Education) over the years. It indicates that this collection of papers has a strong emphasis on issues during the Use/Impact stage where IT is post-development. This trend is also depicted by Figure 6 and Figure 7, the former indicating the frequencies of studies, and the latter, the distributions among the total number of studies within a period (thus, reporting on percentage). Although the total number of papers on IT Development has increased as shown in Figure 6, Figure 7 indicates that such studies constitute a smaller percent of all studies during each of the two recent periods.

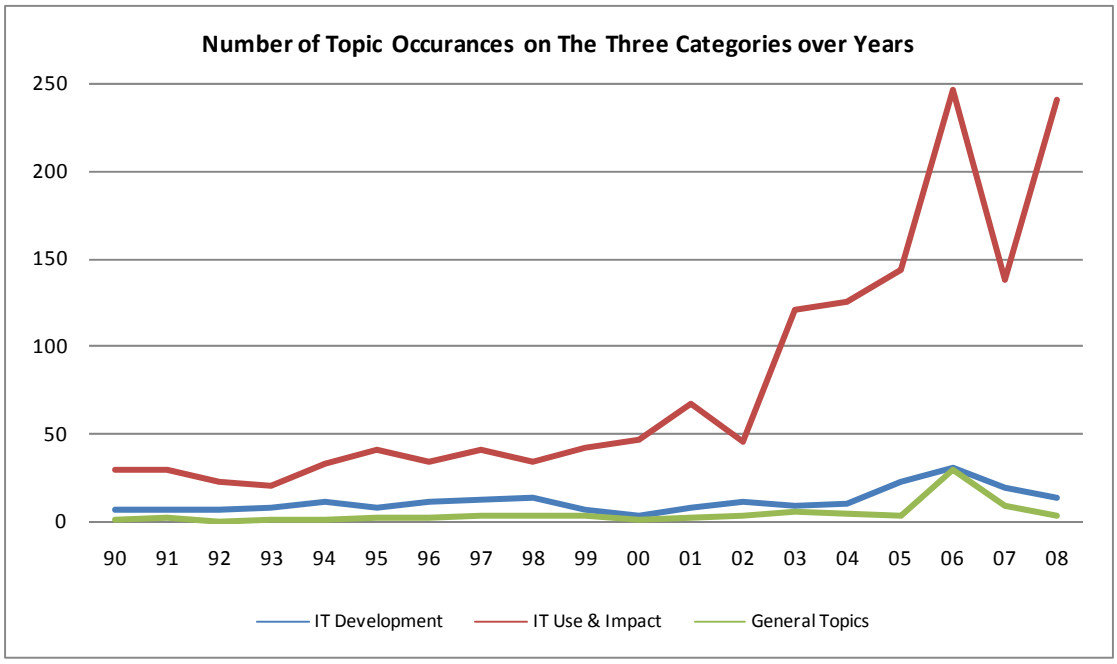
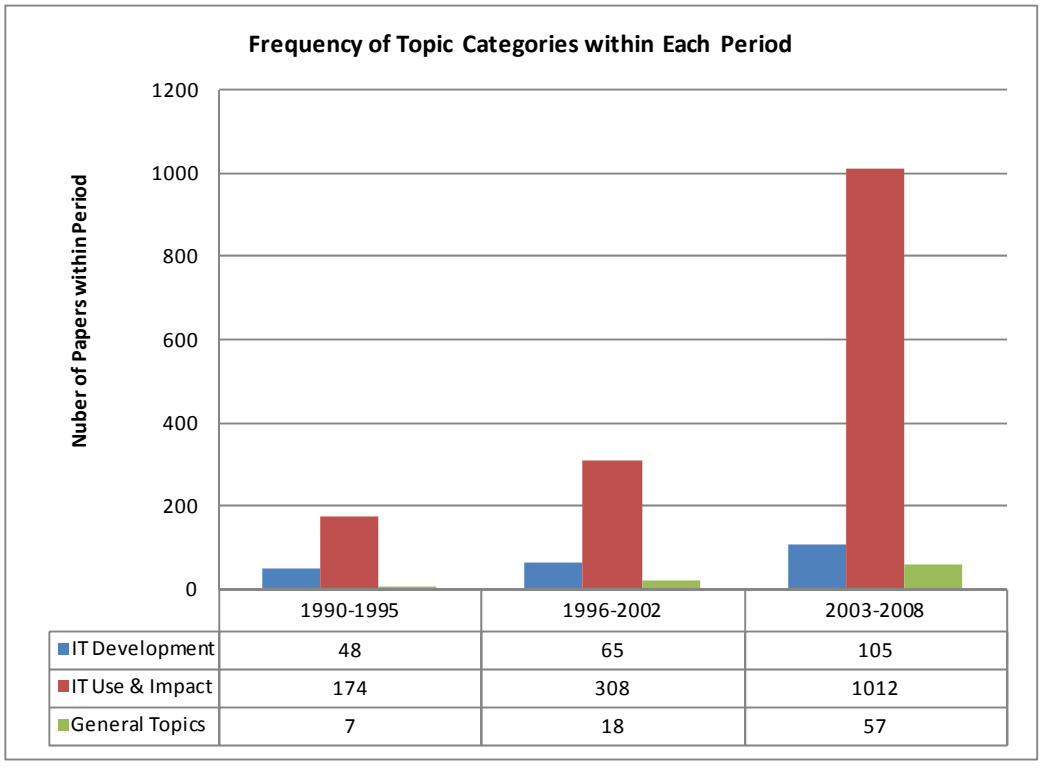
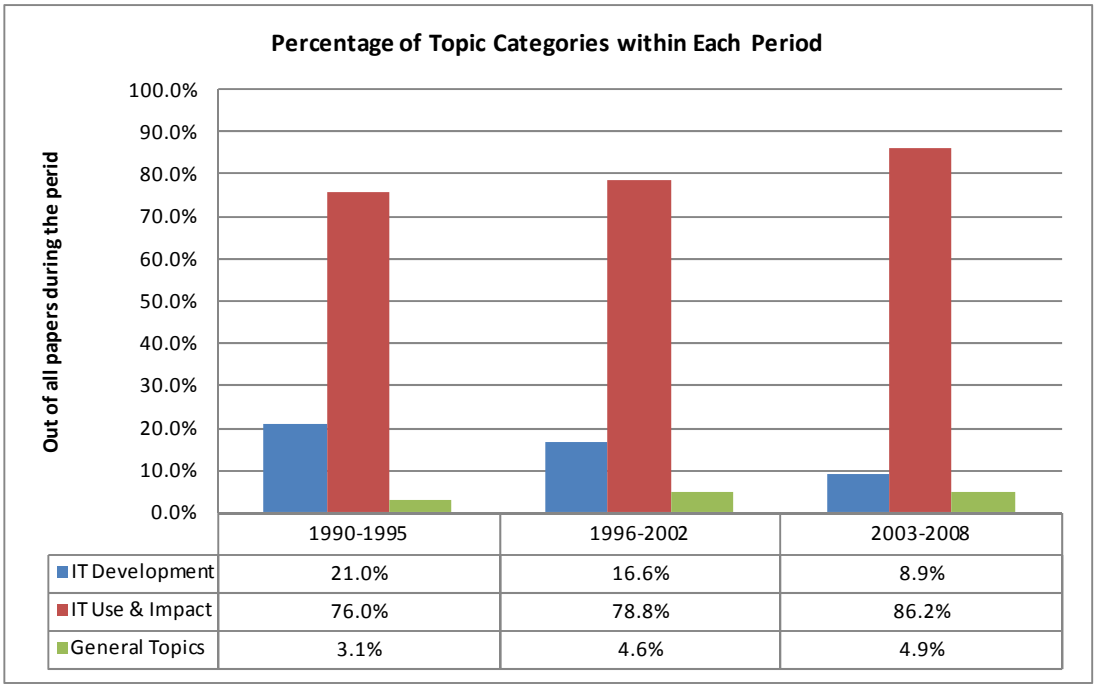


Figure 5: Number of Topic Occurrences in the Three Topic Categories over the Years



	1990-1995	1996-2002	2003-2008
IT Development	48	65	105
IT Use & Impact	174	308	1012
General Topics	7	18	57

Figure 6: Frequencies of Topic Categories within Each Period

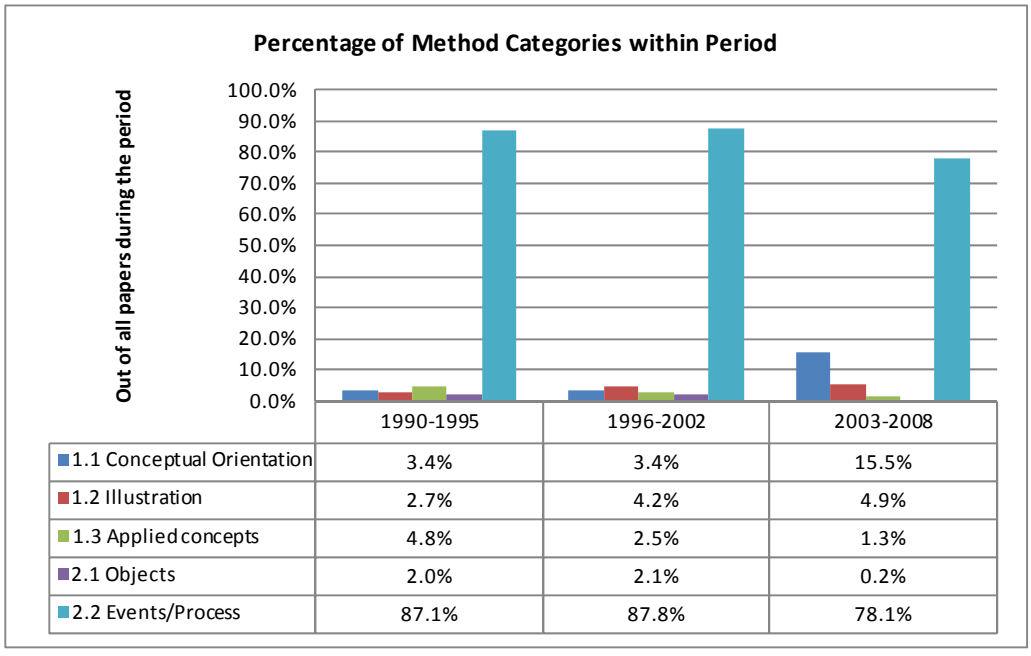


	1990-1995	1996-2002	2003-2008
IT Development	21.0%	16.6%	8.9%
IT Use & Impact	76.0%	78.8%	86.2%
General Topics	3.1%	4.6%	4.9%

Figure 7: Percentage of Topic Categories within Each Period

RQ3.3: What are the changes in the research methods over the years?

Figure 8 depicts the distributions of method categories among the total number of studies within each period (thus percentage). The proportion of papers using empirical methods on Events/Processes (e.g., lab experiment, survey, field study, etc.) have dominated, although there has been a decrease during the period of 2003-2008. There is a great increase in the proportion of papers utilizing Conceptual orientation methods (e.g., framework, conceptual model, conceptual overview, theory) during the periods of 1996-2002 and 2003-2008. The proportion of papers utilizing Illustration methods (e.g., opinion, description of a tool or technique) also increased steadily, albeit slightly. The proportion of papers using Applied concept methods (e.g., framework and application) decreased over the three periods.

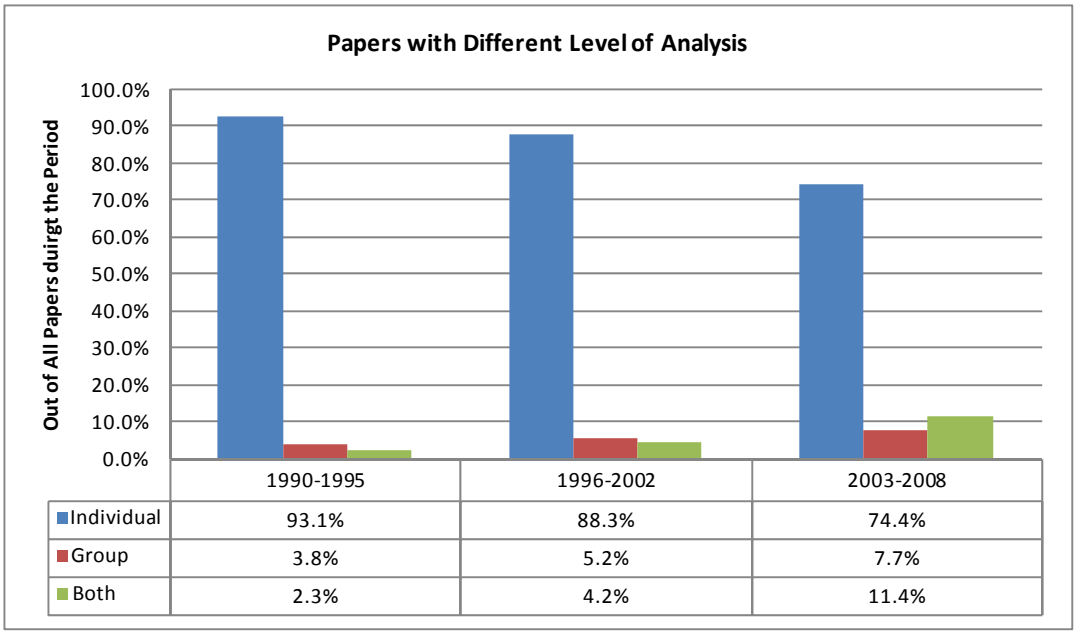


	1990-1995	1996-2002	2003-2008
1.1 Conceptual Orientation	3.4%	3.4%	15.5%
1.2 Illustration	2.7%	4.2%	4.9%
1.3 Applied concepts	4.8%	2.5%	1.3%
2.1 Objects	2.0%	2.1%	0.2%
2.2 Events/Process	87.1%	87.8%	78.1%

Figure 8: Percentage of Method Categories within each Period

RQ3.4: What are the changes in the level of analysis over the years?

Figure 9 shows that over the periods of 1990-1995, 1996-2002, and 2003-2008, the percentage of papers covering individual level of analysis decreased, while the percentage of papers covering group levels and both levels increased slightly. Of note, the percentages in each period do not add up to 100% due to the small proportion of papers that did not specify any context.

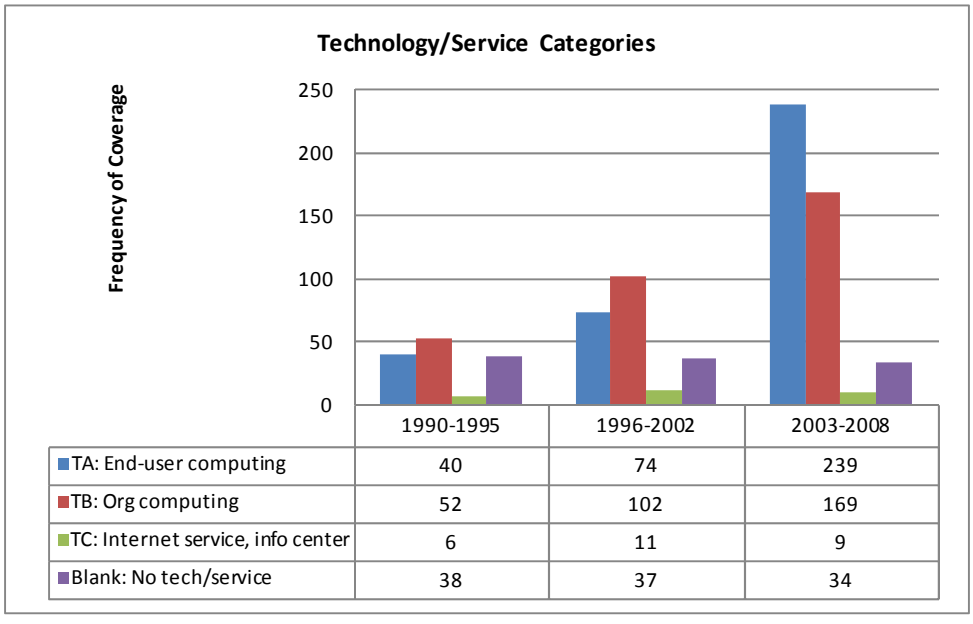


	1990-1995	1996-2002	2003-2008
Individual	93.1%	88.3%	74.4%
Group	3.8%	5.2%	7.7%
Both	2.3%	4.2%	11.4%

Figure 9: Percentage of Papers with Different Levels of Analysis

RQ3.5: What are the changes in considering IT or service as a research component?

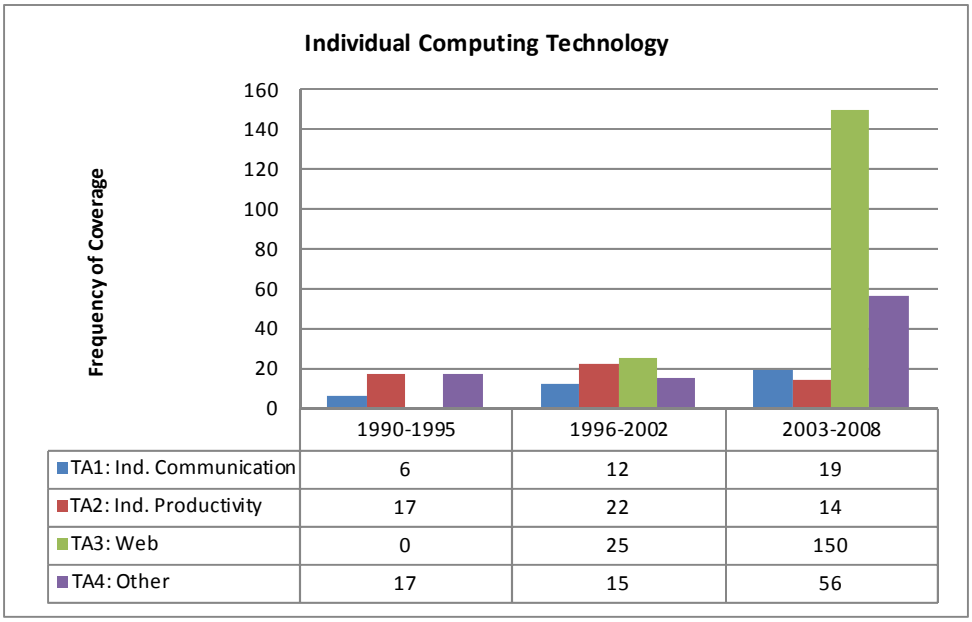
Figure 10 shows the frequencies of coverage among the three categories of technology/service over the three periods of time. Both the Individual Computing and the Organizational/Social Computing categories gained increased coverage over time. The number of studies on the Service category remained about the same, which actually indicates a fall of interest due to the overall increased number of studies in the last two periods.



	1990-1995	1996-2002	2003-2008
TA: End-user computing	40	74	239
TB: Org computing	52	102	169
TC: Internet service, info center	6	11	9
Blank: No tech/service	38	37	34

Figure 10: Coverage of Individual Computing Technologies

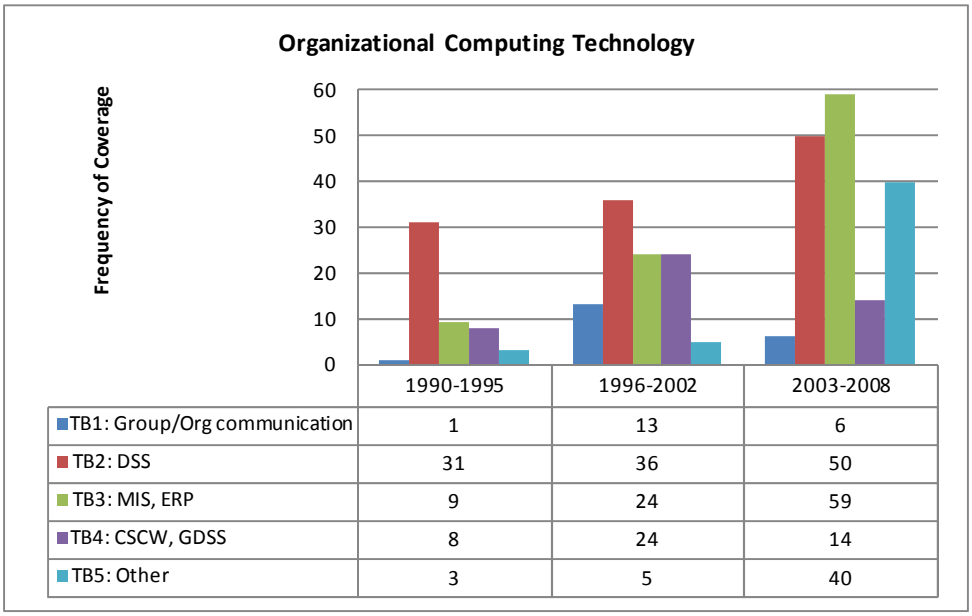
Figure 11 shows the frequencies of studies covering individual computing technology over the three periods of time. Apparently, the Web gained tremendous interest in 2003-2008. Other types of technologies also gained more attention in this period. The majority of the Others type is mobile devices and PDAs that may have more than communication or productivity purposes.



	1990-1995	1996-2002	2003-2008
TA1: Ind. Communication	6	12	19
TA2: Ind. Productivity	17	22	14
TA3: Web	0	25	150
TA4: Other	17	15	56

Figure 11: Coverage of Individual Computing Technologies

Figure 12 indicates the frequency of coverage on organizational/social computing technologies over each period. The number of studies covering DSS and MIS/ERP has increased over the years. The sharp increase in number of studies on MIS/ERP can be attributed to increased research interest in ERP systems. Other types of Organizational/Social Computing Technologies have also gained more attention in recent years. Some examples of the Other types are learning management systems and open source software.



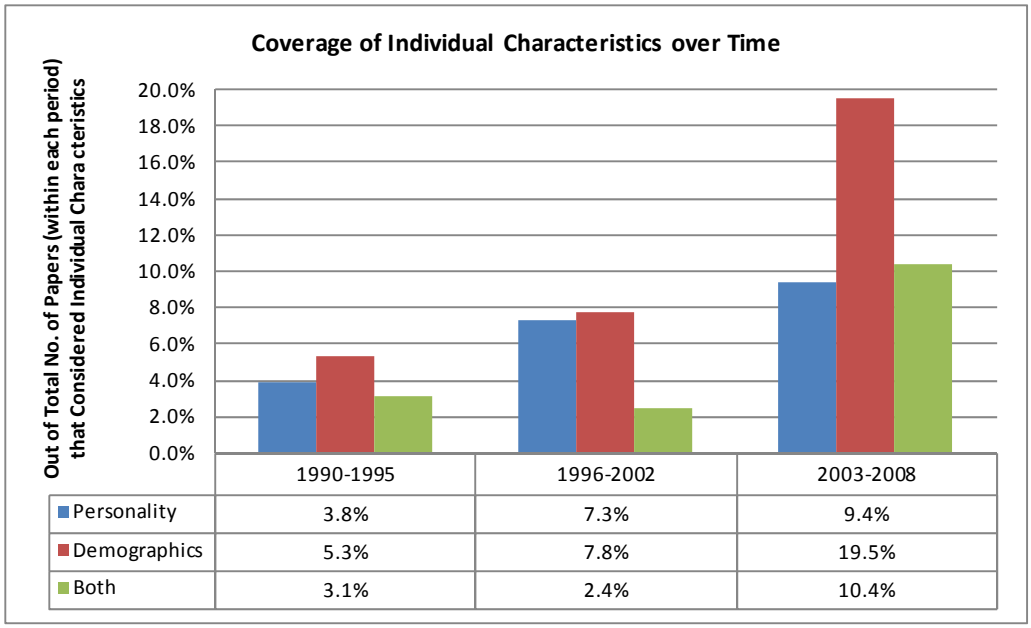
	1990-1995	1996-2002	2003-2008
TB1: Group/Org communication	1	13	6
TB2: DSS	31	36	50
TB3: MIS, ERP	9	24	59
TB4: CSCW, GDSS	8	24	14
TB5: Other	3	5	40

Figure 12: Coverage of Organizational/Social Computing Technologies

RQ3.6: What are the changes in considering individual characteristics as a research component?

Figure 13 shows the trend of change over time on considering individual characteristics in studies. There is a clear

upward trend showing an increase of such considerations. During the most recent period of 2003-2008, more than 40% of the papers considered one or both types of individual characteristics. Of note, the percentages in each period do not add up to 100% due to the proportion of papers that did not consider any individual characteristics.

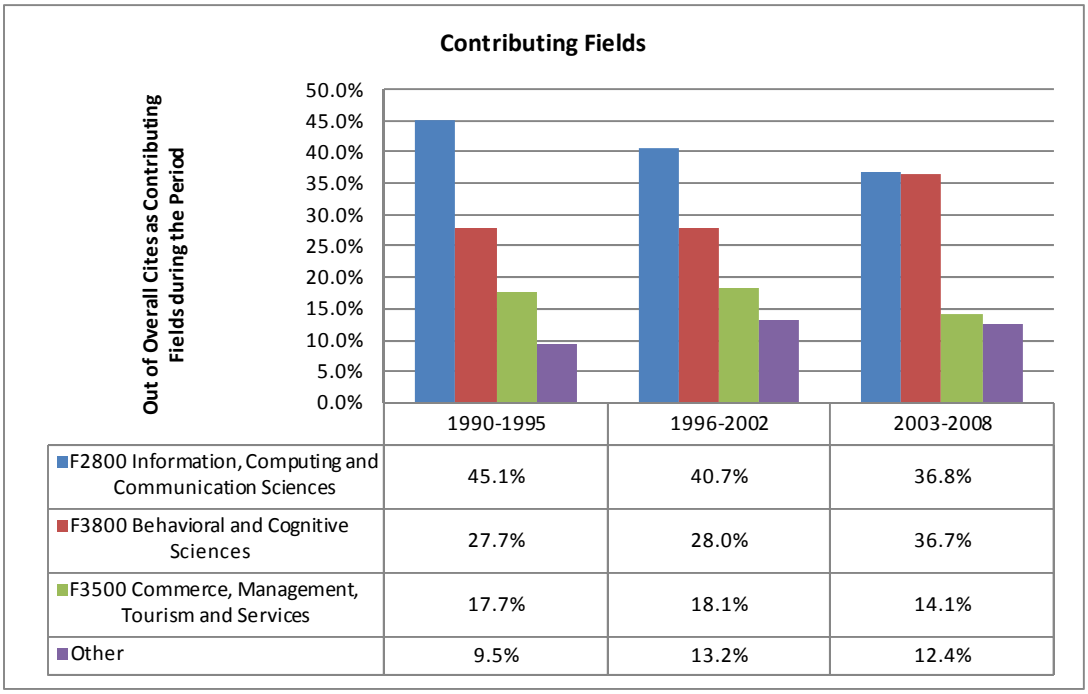


	1990-1995	1996-2002	2003-2008
Personality	3.8%	7.3%	9.4%
Demographics	5.3%	7.8%	19.5%
Both	3.1%	2.4%	10.4%

Figure 13: Coverage of Individual Characteristics During the Three Periods

RQ3.7: What are the changes in the contributing disciplines over the years?

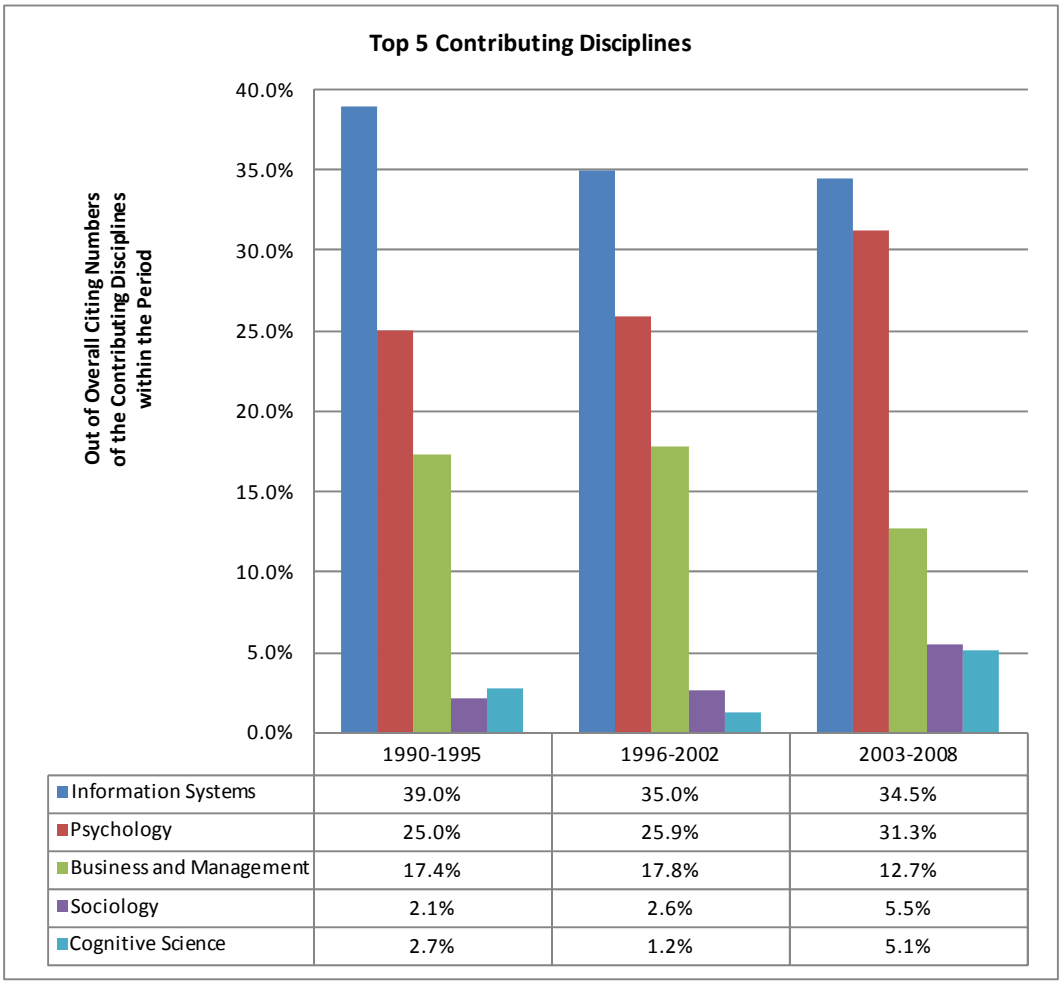
Figure 14 shows the changes in distributions of the fields over the three periods. Note that a field includes multiple disciplines. It indicates that citations to Information, Computing and Communication Sciences (the 2800 fields) as a contributing field decreased over time. Citations to Behavioral and Cognitive Sciences (3800) and Other disciplines increased at a considerable rate over time. Citations to Commerce, Management, Tourism and Services (3500) increased slightly in 1996-2002 but dropped in 2003-2008.



	1990-1995	1996-2002	2003-2008
F2800 Information, Computing and Communication Sciences	45.1%	40.7%	36.8%
F3800 Behavioral and Cognitive Sciences	27.7%	28.0%	36.7%
F3500 Commerce, Management, Tourism and Services	17.7%	18.1%	14.1%
Other	9.5%	13.2%	12.4%

Figure 14: Contributing Fields During the Three Periods

Figure 15 illustrates the percentage changes of the top 5 contributing disciplines during the three periods. Information Systems was the top contributing discipline across all periods, constituting 39% of studies during 1990-1995, 35% during 1996-2002, and 34.5% during 2003-2008. Business and Management increased slightly in 1996-2002, but dropped in 2003-2008. Slight increases occurred in regard to Psychology and Sociology while Cognitive Science decreased in 1996-2002 but increased in 2003-2008.



	1990-1995	1996-2002	2003-2008
Information Systems	39.0%	35.0%	34.5%
Psychology	25.0%	25.9%	31.3%
Business and Management	17.4%	17.8%	12.7%
Sociology	2.1%	2.6%	5.5%
Cognitive Science	2.7%	1.2%	5.1%

Figure 15: Top 5 Contributing Disciplines During the Three Periods

Summary for RQ3

The evolution data clearly confirms the prediction Banker and Kauffmann (2004) made about the (re)surge of the HCI sub-discipline within IS. The total number of studies during 2003-2008 (421) exceeds the total number of those published during 1990-2002 (337). There are changes in almost all of the seven facets. The contexts become broader and more outside organizations and workplaces. There are new or increased interests in certain topics as time progresses. There is an increasing trend of studying multiple topics within one paper. Papers on conceptual orientation have increased in recent years, although the dominating methods are still empirically based. The level of analysis has shifted slightly from the individual level to the group level. IT and service has gained more attention over the years, as both the frequency and percentage of papers specifying IT/service in the studies increased, and the percentage of papers not specifying IT/service decreased. Similarly, the number and percentage of papers covering individual characteristics increased over the years. Finally, there are also some changes among the various contributing disciplines for HCI studies. The reliance on Information Systems decreased over the years, while the reliance on Psychology and other disciplines increased.

RQ4: What are the Patterns of Publishing HCI Studies in the Various Sources?

RQ4.1: What percentage of published works are HCI studies? And what is the trend in such percentages?

Since this question has to do with the general interest in, and track records of, the HCI studies being published, we will focus on regular IS journals (the eight primary IS journals). These include the three special issues for JAIS, one for JMIS, and one for DB, because being published in these journals as special issues is an indication of the journals' interest in HCI. In addressing this question, we exclude the AMIS books and the six special issues outside the eight journals.

Table 21 summarizes the number of IS articles, the number of HCI articles, and the percentage of HCI articles within the IS journals in each journal for each year. Overall, 30% of the IS articles in the eight journals focused on HCI issues during the entire 19 years. Generally speaking, the "Total" percentage data at the bottom of the table shows an increase in the collection of the eight journals over the 19 years, as depicted in Figure 16. The increasing trend of percentage of HCI studies within the eight journals over the years is additional evidence of the (re)surge of interest in HCI.

Table 21: Number and Percentage of IS and HCI Articles Published in the Eight Journals

IS Articles	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	Total
CAIS										43	31	60	57	88	67	88	85	98	65	682
DB	13	11	15	11	13	12	12	12	16	18	14	13	13	12	13	18	25	29	14	284
DS	7	17	15	15	12	8	7	17	8	17	7	10	6	8	3	3	9	4	14	187
ISR	20	12	16	13	20	16	26	21	21	20	24	21	27	15	20	21	21	23	25	382
JAIS											10	8	7	23	18	14	33	34	31	178
JMIS	27	27	31	34	33	34	35	35	30	36	35	34	36	35	36	41	43	41	41	664
MISQ	27	30	31	26	23	23	20	17	18	21	23	16	16	18	21	27	41	30	35	463
MS	5	4	4	1	10	15	11	17	12	3	10	4	4	8	8	6	9	8	5	144
Overall	99	101	112	100	111	108	111	119	105	115	123	106	109	119	119	130	181	169	165	2302
HCI Articles	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	Total
CAIS										2	1	3	1	6	6	11	11	10	10	61
DB	2	2	3	1	3	3	1	7	5	1	2	4	6	1	6	6	10	3	7	73
DS	2	7	5	2	8	2	3	9	4	7	1	8	2	2	2	3	5	2	2	76
ISR	5	4	3	1	5	6	6	3	5	7	7	8	11	6	8	6	10	3	13	117
JAIS											3	4	2	7	9	4	7	17	10	63
JMIS	4	3	1	5	3	7	12	4	8	4	4	3	5	10	7	9	10	13	16	128
MISQ	3	4	4	8	6	7	6	8	5	7	6	7	5	8	8	7	16	13	14	142
MS	3	1		1	1	6	2	1	1		1		1	2	1	3	5	1	3	33
Overall	19	21	16	18	26	31	30	32	28	28	25	37	33	42	47	49	74	62	75	693
HCI Percentage	90	91	92	93	94	95	96	97	98	99	00	01	02	03	04	05	06	07	08	Total
CAIS										5%	3%	5%	2%	7%	9%	13%	13%	10%	15%	9%
DB	15%	18%	20%	9%	23%	25%	8%	58%	31%	6%	14%	31%	46%	8%	46%	33%	40%	10%	50%	26%
DS	29%	41%	33%	13%	67%	25%	43%	53%	50%	41%	14%	80%	33%	25%	67%	100%	56%	50%	14%	41%
ISR	25%	33%	19%	8%	25%	38%	23%	14%	24%	35%	29%	38%	41%	40%	40%	29%	48%	13%	52%	31%
JAIS											30%	50%	29%	30%	50%	29%	21%	50%	32%	35%
JMIS	15%	11%	3%	15%	9%	21%	34%	11%	27%	11%	11%	9%	14%	29%	19%	22%	23%	32%	39%	19%
MISQ	11%	13%	13%	31%	26%	30%	30%	47%	28%	33%	26%	44%	31%	44%	38%	26%	39%	43%	40%	31%
MS	60%	25%	0%	100%	10%	40%	18%	6%	8%	0%	10%	0%	25%	25%	13%	50%	56%	13%	60%	23%
Overall	19%	21%	14%	18%	23%	29%	27%	27%	27%	24%	20%	35%	30%	35%	39%	38%	41%	37%	45%	30%

Note: CAIS: Communications of the Association for Information Systems; DB: Data Base; DS: Decision Science; ISR: Information Systems Research; JAIS: Journal of the Association for Information Systems; JMIS: Journal of Management Information Systems; MISQ: MIS Quarterly; MS: Management Science.

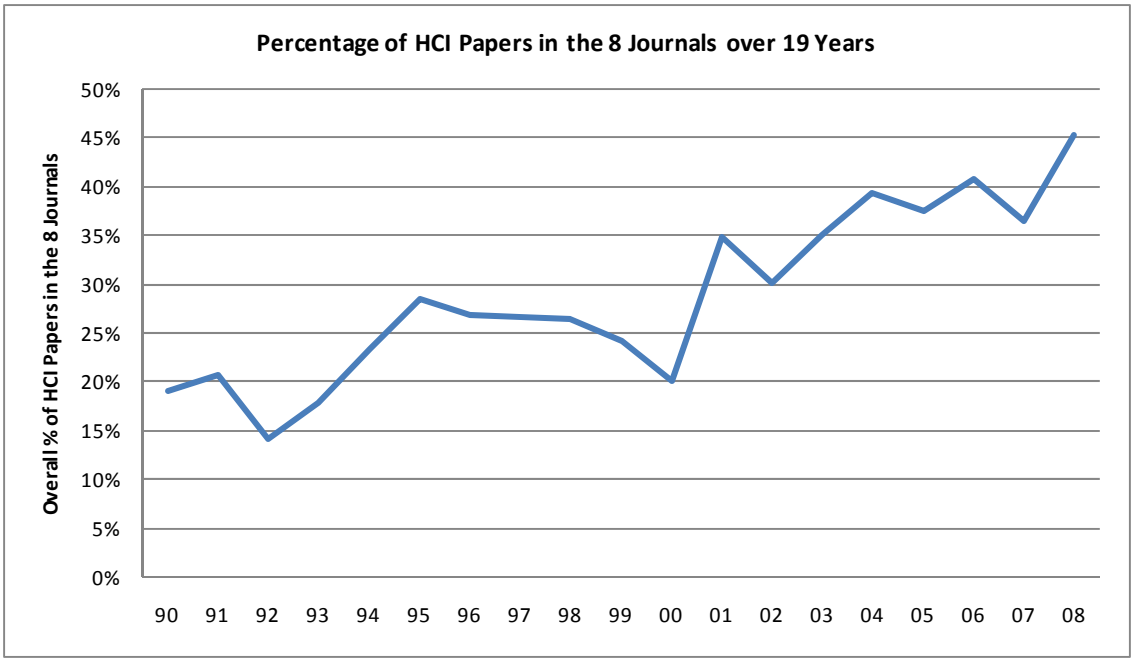
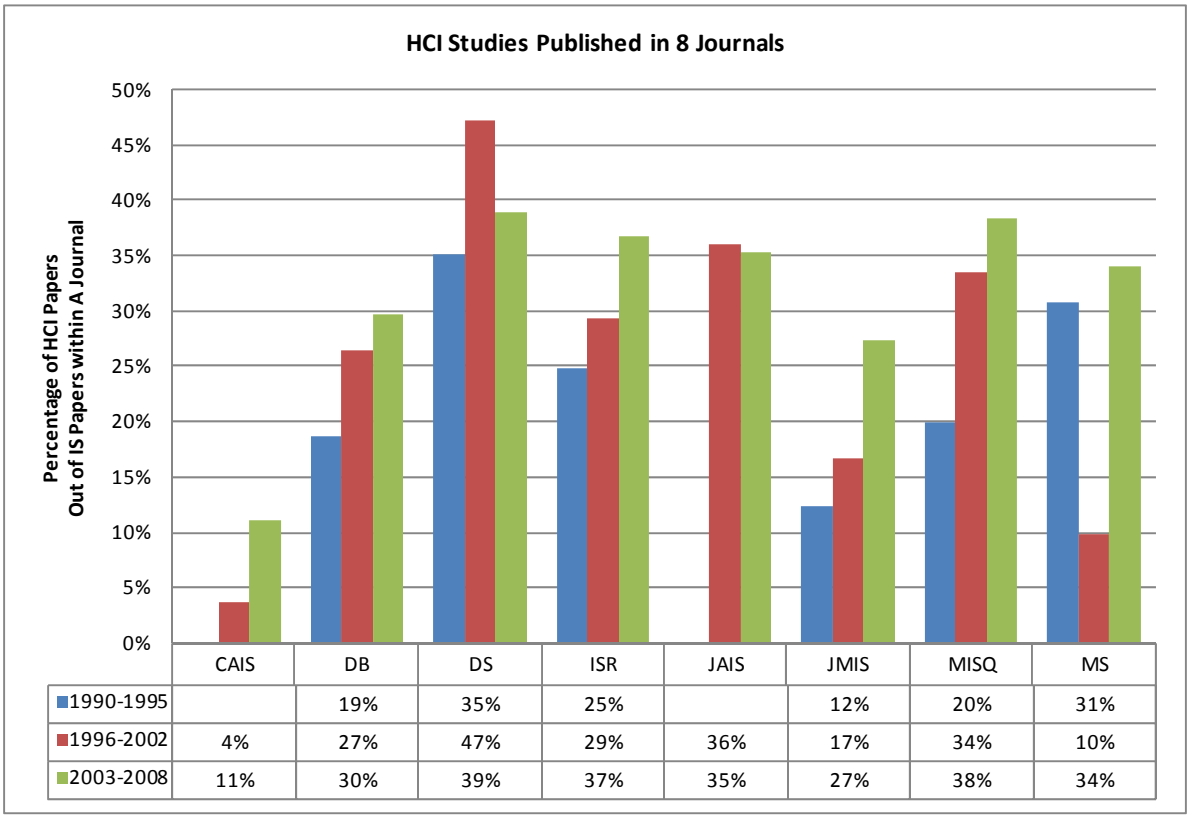


Figure 16: Total Percentage of HCI Articles in 8 Journals Over 19 Years

Figure 17 depicts the percentages of HCI articles published in each journal over the three periods (CAIS and JAIS, which were founded in 1999 and 2000, respectively, have only two periods). These percentages range from 4% to 47%. Within each journal, there seems to be an overall increasing trend in the percentage of HCI articles among the published IS studies, except for JAIS which started with a strong HCI focus and has maintained that, and MS, which publishes a small and irregular number of IS articles.



	CAIS	DB	DS	ISR	JAIS	JMIS	MISQ	MS
1990-1995		19%	35%	25%		12%	20%	31%
1996-2002	4%	27%	47%	29%	36%	17%	34%	10%
2003-2008	11%	30%	39%	37%	35%	27%	38%	34%

Figure 17: Percentage of the HCI Articles in Each Journal Over Three Periods of Time

RQ4.2: What topics are "preferred" by which sources?

By sources, we refer to the eight regular journals, six special issues in four other journals, and the two AMIS books. Table 22 shows the percentage of topics published within each of the sources (8 journals, AMS books, special issues outside the 8 journals). In each source, the percentages of IT Development (A), IT Use and Impact (B), and Research and Education (C) topical categories add up to 100%. Table 22 also demonstrates the total HCI topics and the average number of topics per HCI article in a source. We derive the following observations from the table:

- Cognitive belief and behavior (B01) was the predominant topic, with Attitude (B02), and Performance (B06) following as the second and third in all sources.
- Cognitive belief and behavior (B01), Attitude (B02), and Emotion (B05) were covered by all sources.
- Among the eight journals, Data Base has the highest ratio on IT Development (A topics) coverage, while JAIS has the highest ratio on IT Use and Impact (B topics) coverage.
- The AMIS books have the highest ratio on general research and education issues (C topics), which is consistent with the goals of the books.
- The average number of topics per paper varies greatly among the sources. The special issues and the AMIS books have fewer topics per paper, as compared to the papers in the eight regular journals. Among the eight journals, the newest ones, CAIS and JAIS, have the highest average number of topics per paper: 3.4 and 3.0, respectively. JMIS has an average of 2.8 topics per paper, which is higher than the average number of 2.4.

Table 22: Percentage of Topics within Sources

Topic		AMIS	BIT	IJHCI	IJHCS	ISJ	CAIS	DB	DS	ISR	JAIS	JMIS	MISQ	MS	Total
A01	Deve. methods & tools	1%					1%	1%		1%	1%	1%			0.7%
A02	User analyst involvement	3%					1%	4%	2%	2%	1%	1%	3%	5%	2.1%
A03	SW/HW development						0%	4%	1%	3%		3%	2%	8%	2.2%
A04	SW/HW evaluation				12%		1%	2%							0.4%
A05	User interface design & dev.	1%		5%		11%	5%	2%	3%	3%	2%	2%	4%	2%	3.0%
A06	User interface evaluation	3%		15%	6%		3%	5%	10%	2%	1%	2%	2%		2.8%
A07	User training						3%				1%	1%	1%		0.8%
	Subtotal of A	*8%*	*0%*	*20%*	*18%*	*11%*	*15%*	*19%*	*16%*	*12%*	*6%*	*10%*	*12%*	*15%*	*12%*
B01	Cognitive beliefs and behavior	24%	43%	40%	35%	33%	16%	31%	28%	31%	21%	23%	29%	34%	26.1%
B02	Attitude	1%	14%	10%	12%	22%	16%	14%	16%	12%	18%	20%	13%	18%	15.2%
B03	Learning	1%					1%	6%	5%	6%	3%	3%	4%		3.5%
B04	Motivation	3%		10%	6%		16%	1%	1%	4%	14%	13%	7%		8.2%
B05	Emotion	7%	14%	10%	18%	11%	2%	4%	1%	5%	5%	2%	5%	6%	3.9%
B06	Performance	14%	29%	5%		11%	17%	9%	17%	15%	17%	17%	12%	15%	14.8%
B07	Trust	7%		5%	6%	11%	7%	6%	1%	5%	6%	7%	7%	3%	6.1%
B08	Ethics	1%									2%		2%		0.6%
B09	Interpersonal relationship						1%	7%	3%	7%	4%	2%	5%	10%	4.1%
B10	User support						0%	1%	3%			1%	1%		0.7%
B11	Others												0%		0.1%
	Subtotal of B	*58%*	*100%*	*80%*	*76%*	*89%*	*78%*	*79%*	*77%*	*85%*	*90%*	*89%*	*85%*	*85%*	*83%*
C01	Research	32%					5%	3%	7%	3%	4%	1%	3%		4.2%
C02	Education	1%			6%		1%					1%			0.4%
	Subtotal of C	*33%*	*0%*	*0%*	*6%*	*0%*	*7%*	*3%*	*7%*	*3%*	*4%*	*1%*	*3%*	*0%*	*5%*
	Total % of Topics	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
	Total # of Topics	72	7	20	17	9	207	140	134	260	187	354	325	62	1794
	Total # of HCI papers	37	3	12	8	5	61	73	76	117	63	128	142	33	758
	Average # of topics per paper	1.9	2.3	1.7	2.1	1.8	3.4	1.9	1.8	2.2	3.0	2.8	2.3	1.9	2.4

RQ4.3: What methods are "preferred" by which sources?

Table 23 summarizes the percentage of the various methods used within each source, with the percentages of all methods used in HCI papers adding up to 100%. The table also demonstrates the total number of methods and the average number of methods per HCI article in the source.

Table 23 shows that among this collection, the various sources demonstrated slightly different emphases on research methods. The AMIS books and the special issues show some distinctive preferences on methods. For example, AMIS book chapters utilized a great deal of non-empirical methods, in particular, frameworks, opinions, and models. Such emphasis reflects the nature of these books to be collections of work that synthesize existing work and provide directions for future research. Due to small numbers of HCI articles in the other four special issue sources, the distribution of methods used is even more condensed than that of the eight journals.

Table 23: Percentage of Methods within Sources

Method	AMIS	BIT	IJHCI	IJHCS	ISJ	CAIS	DB	DS	ISR	JAIS	JMIS	MISQ	MS	Total
1.1.1 Framework	18%					23%					1%	1%		3%
1.1.2 Conceptual model	10%			13%		12%	2%		2%	16%	3%	8%		5%
1.1.3 Conceptual overview	5%					2%				1%	1%	1%	2%	1%
1.1.4 Theory										7%				1%
1.2.1 Opinion (pure)	15%			13%		3%	1%	3%	1%	1%		4%		3%
1.2.2 Opinion (personal exp)	10%													0.5%
1.2.3 Desc. a tool, technique	8%		8%			6%			1%			1%		1%
1.3.1 Frameworks & appl.	8%				20%		1%	2%	4%		2%	3%		2%
Conceptual Methods Subtotal	*74%*		*8%*	*25%*	*20%*	*46%*	*5%*	*6%*	*8%*	*27%*	*8%*	*16%*	*2%*	*16%*
2.1.2 Desc. of a specific appl.							4%				3%	1%	2%	1%
2.2.1 Lab experiment	13%	100%	46%	38%	20%	6%	16%	38%	35%	19%	41%	14%	24%	26%
2.2.2 Field experiment			8%		20%	2%	6%	7%	2%	3%	3%	10%	2%	5%
2.2.3 Field study	3%			13%		3%	17%	6%	13%	1%	14%	7%	19%	9%
2.2.4 Positivist case study				13%		3%	5%	1%		3%	1%	6%	2%	3%
2.2.5 Interpretive case study						3%	5%		1%	1%	1%	5%		2%
2.2.6 Action research						2%	1%							0.2%
2.2.7 Survey	8%		31%	13%	20%	26%	29%	28%	22%	33%	23%	34%	21%	26%
2.2.8 Instrument develop.					20%		6%	10%	9%	1%	1%	2%	5%	4%
2.2.10 Secondary data							5%	2%	5%	1%	1%	1%	14%	3%
2.2.11 Interview	3%		8%			5%		2%	4%	6%	4%	3%	5%	3%
2.2.12 Delphi							1%				1%	1%		0.4%
2.2.13 Focus group						5%				3%			2%	1%
2.2.14 Other									1%			1%		0.4%
Empirical Methods Subtotal	*26%*	*100%*	*92%*	*75%*	*80%*	*54%*	*95%*	*94%*	*92%*	*73%*	*92%*	*84%*	*98%*	*84%*
Total %	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Total # of methods used	39	3	13	8	5	65	82	88	136	67	138	152	42	838
Total # of HCI papers	37	3	12	8	5	61	73	76	117	63	128	142	33	758
Average # of methods per paper	1.1	1.0	1.1	1.0	1.0	1.1	1.1	1.2	1.2	1.1	1.1	1.1	1.3	1.1

There are some differences among the eight journals as well. For example, CAIS is different from all other journals in that almost half of the methods used are non-empirical. The other journal that has a slightly higher use of non-empirical methods is JAIS, as about 27% of the methods used are non-empirical. HCI papers in DS, ISR, and JMIS used more Lab experiments (2.2.1) than Surveys (2.2.6); while the HCI papers in DB, JAIS, and MISQ employed more Surveys than Lab experiments. In general, four empirical methods, Lab experiment (2.2.1), Survey (2.2.6), Field study (2.2.3), and Field experiment (2.2.2) were popular in HCI studies in all eight journals. Instrument development-

related studies have found homes in all journals but CAIS, as have Secondary data-based studies.

Readers are cautioned against over-generalizing these results due to the limited number of studies within some journals and the journal policy changes from time to time.

RQ4.4: Which contributing disciplines are cited more frequently in which sources?

Table 24 shows the distribution of contributing disciplines cited within each source. For example, among all 403 citations to contributing disciplines by the 142 papers in MISQ, 33% of citations were within Information Systems (D2801). This table is consistent with the analysis for RQ2.1, where we consider only the 14 core contributing disciplines that have been cited by more than 10 of the 758 papers in the collection. Therefore, the total percentage of each source may not be 100%. A very small portion is constituted by other less-cited disciplines in each source. Table 24 indicates the following:

- During 1990-2008, Information Systems (2801) was the most cited discipline (35%), followed by Psychology (3801, 29%) and Business and Management (3502, 15%).
- Other disciplines that were cited by HCI studies in all eight journals include Computer Software (D2803) and Sociology (D3701).
- Finally, articles in all eight journals were built on at least two disciplines on average, with articles in MS, MISQ, and ISR slightly more multi-disciplinary than those in the other four journals.

Table 24: Distribution of Top Cited Contributing Disciplines within Each Source

Discipline	AMIS	BIT	IJHCI	IJHCS	ISJ	CAIS	DB	DS	ISR	JAIS	JMIS	MISQ	MS	Total	1990-1995	1996-2002	2003-2008
D2302 Statistics							1%	3%	1%						2%		
D2801 Information Systems	39%	75%	35%	47%	42%	37%	42%	37%	33%	34%	36%	33%	30%	35%	39%	35%	35%
D2802 AI and Signal and Image Processing							1%	3%	1%		1%	2%	1%	1%	3%	1%	1%
D2803 Computer Software						5%	2%	3%	2%	1%	5%	1%	2%	2%	3%	4%	1%
D3301 Education Studies	3%					4%	1%	2%	2%	1%	1%	2%		2%	2%	2%	2%
D3402 Applied Economics						1%	20%		2%			1%	3%	1%		1%	1%
D3502 Business and Mgt.	24%		26%	18%	33%	1%		21%	20%	5%	6%	17%	25%	15%	17%	18%	13%
D3599 Other Commerce, Mgt, Tour, & Service										1%		2%		1%			1%
D3701 Sociology	1%			6%		4%	2%	1%	5%	9%	5%	4%	5%	4%	2%	3%	5%
D3801 Psychology	21%	25%	29%	18%	25%	35%	28%	26%	26%	37%	30%	30%	24%	29%	25%	26%	31%
D3803 Cognitive Science	2%					8%	1%	1%	3%	5%	9%	2%		4%	3%	1%	5%
D4001 Journalism, Com, and Media	4%		6%			1%	1%	2%	3%		3%	1%	5%	2%	2%	4%	1%
D4203 Cultural Studies						2%	1%			1%	1%	1%		1%		1%	1%
D4401 Philosophy	1%								1%	3%		1%	1%	1%		1%	1%
Total %	95%	100%	97%	88%	100%	98%	98%	96%	98%	97%	96%	98%	98%	97%	98%	96%	97%
Total cites	96	4	31	17	12	163	166	199	332	150	344	403	91	2008	328	568	1112
Total # of papers	37	3	12	8	5	61	73	76	117	63	128	142	33	758	131	213	414
Avg # of disciplines per paper	2.6	1.3	2.6	2.1	2.4	2.7	2.3	2.6	2.8	2.4	2.7	2.8	2.8	2.6	2.5	2.7	2.7

Table 25 shows within each source, the percentage of papers that cited each particular contributing discipline. For example, in the 142 HCI papers published in MISQ, 94% cited Information Systems (D2801) as a contributing discipline. Since a large number of papers have cited a non-core discipline as a contributing discipline (that is, outside the 14 core disciplines), we decided to show all 38 supporting disciplines in this table so that it can depict an accurate picture. This table shows information that is not evident in Table 24.

Table 25: Percentage of Papers within Each Source Citing a Contributing Discipline

		AMIS	BIT	IJHCI	IJHCS	ISJ	CAIS	DB	DS	ISR	JAIS	JMIS	MISQ	MS	Total	1990-1995	1996-2002	2003-2008
D2302	Statistics							1%	7%	3%			1%		1%	5%	1%	
D2801	Info Systems	100%	100%	92%	100%	100%	100%	96%	97%	92%	81%	96%	94%	82%	94%	98%	93%	93%
D2802	AI & Signal and Image Processing							1%	7%	2%		4%	7%	3%	3%	7%	4%	2%
D2803	Computer Software						13%	4%	7%	7%	2%	13%	2%	6%	6%	8%	10%	3%
D2804	Computation Theory & Math									1%								
D2805	Data Format											2%					1%	
D2899	Other Info, Comp, & Com Sciences				25%						3%				1%			1%
D2900	Engineering and Technology													3%		1%		
D2903	Manufacturing Engineering	3%																
D2912	Maritime Engineering								1%									
D3201	Medicine - General								1%			2%					1%	
D3212	Public Health & Health Services											1%						
D3301	Education Studies	8%					10%	3%	5%	5%	2%	4%	5%		4%	5%	5%	4%
D3401	Economic Theory							1%	1%	1%	2%	2%	1%		1%		1%	1%
D3402	Applied Economics						3%	45%		6%			2%	9%	2%		2%	2%
D3501	Accounting, Auditing								1%			1%				1%		
D3502	Business and Mgt.	62%		67%	38%	80%	3%		54%	56%	11%	16%	48%	70%	39%	44%	47%	34%
D3503	Banking, Finance, and Investment								1%									
D3504	Transportation								1%				1%					
D3505	Tourism												1%					
D3599	Other Commerce, Mgt, Tour, & Serv										3%	1%	7%		2%			3%
D3601	Political Science									1%								
D3602	Policy and Administration						2%				3%							1%
D3701	Sociology	3%			13%		11%	4%	3%	15%	22%	13%	11%	15%	11%	5%	7%	15%
D3703	Anthropology						2%											
D3704	Human Geography	3%																
D3799	Other Studies in Human Society							1%										
D3801	Psychology	54%	33%	75%	38%	60%	93%	63%	67%	74%	89%	80%	85%	67%	76%	63%	69%	84%
D3802	Linguistics	3%						1%		2%		2%	1%		1%		2%	
D3803	Cognitive Science	5%					21%	1%	1%	8%	11%	23%	7%		10%	7%	3%	14%
D3899	Other Behavioral & Cognitive Sci	3%																
D3901	Law											1%	3%		1%	1%	1%	
D4001	Journalism, Comm, and Media	11%		17%			2%	1%	5%	9%		8%	2%	15%	5%	5%	10%	3%
D4102	Visual Arts & Crafts	3%					2%					1%						1%
D4104	Design Studies			8%														
D4203	Cultural Studies						5%	3%			2%	2%	4%		2%		2%	2%
D4401	Philosophy	3%								3%	8%		3%	3%	2%	1%	3%	2%

Summary for RQ4

It is obvious that publication numbers and percentages of HCI studies among IS studies have been steadily increasing over the years. This is a sure sign that HCI studies are attracting more interest from MIS scholars and becoming more important to MIS over the years. The eight journals are all encouraging multi-disciplinary work, although they exhibit some differences in topics, methods, and contributing disciplines.

RQ5: Who are the Contributing Members?

RQ5.1: Who are the most prolific authors?

Three methods have been used to identify prolific authors and institutions in the literature: normal rank, adjusted rank,

and straight rank (Chua et al. 2003; Romano and Fjermestad 2001). Normal rank is based on the assumption that all authors perform equal-value work, thus every co-author of an article receives one point. Adjusted rank assumes that the marginal contribution of an author is greater for works with fewer authors, thus each co-author of an article receives only a fraction of a point determined by the number of co-authors. For example, each of the two co-authors of a paper receives half a point, and each of the three co-authors of a paper receives one third point. Finally, straight rank is based on the belief that the first author is solely responsible for idea creation, thus being the only person receiving credit. We consider the straight rank method to be limited in recognizing the contributions of all other authors, and in representing the fact that many co-authors agree to be listed alphabetically in their publications. In addition, it discourages recognitions in collaborations, which is not healthy for the advancement of the sub-discipline. Thus, in this paper, we only use the first two methods.

Figure 18 shows the total numbers of different authors and institutes during the three periods of time. Over the 19-year period, a total of 1,107 different authors contributed to the 758 articles. These authors came from 406 different institutions. Since not all authors can be displayed within the limited space in this paper, we only present the most prolific authors. Table 26, Table 27, and Table 28 list the two ranks for the most prolific authors during the three periods of times, respectively. Table 29 lists the most prolific authors during the entire 19 years. Of note, rankings denoted with a star (*) indicate a tie, in which case authors are listed alphabetically.

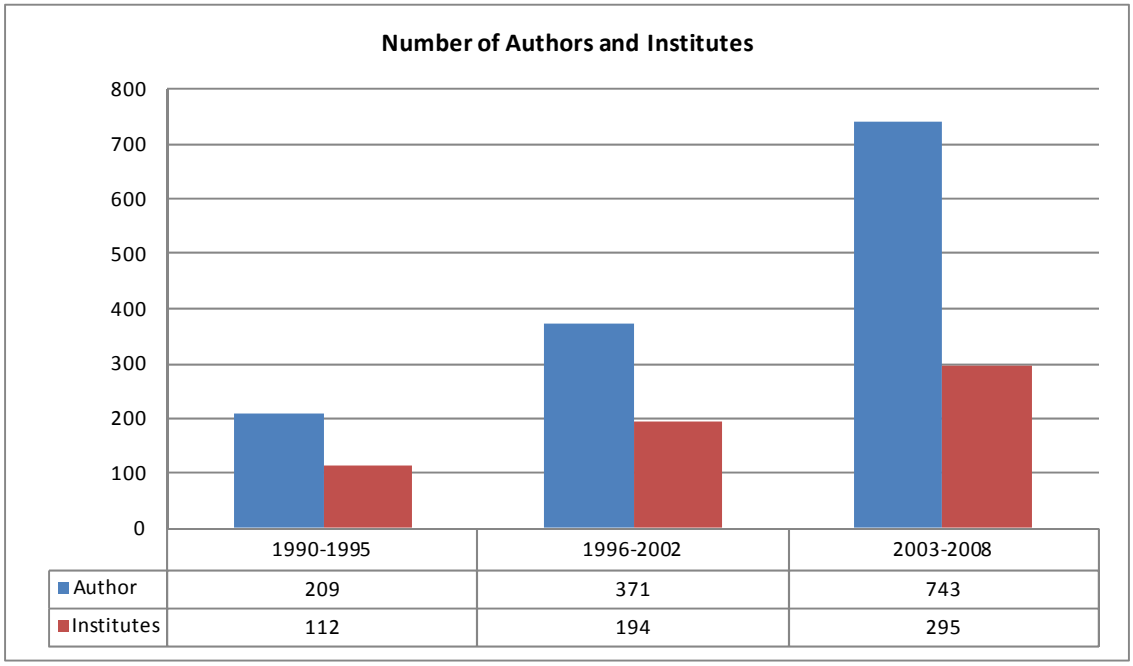


Figure 18: Numbers of Authors and Institutes during Different Periods of Time

Table 26: The Most Prolific Authors during 1990-1995

Top Normal Ranks

Rank	Author	Score
1	Todd, Peter	6
2*	Benbasat, Izak	5
2*	Guimaraes, Tor	5
3*	Chin, Wynne	4
3*	Doll, William	4
3*	Higgins, Christopher	4
3*	Vessey, Iris	4
4*	Barki, Henri	3
4*	Cronan, Timothy	3
4*	Galletta, Dennis	3
4*	Hartwick, Jon	3
4*	King, William	3
4*	Straub, Detmar	3
4*	Thompson, Ronald	3
4*	Torkzadeh, Gholamreza	3

Top Adjusted Ranks

Rank	Author	Score
1	Todd, Peter	2.83
2*	Benbasat, Izak	2.50
2*	Vessey, Iris	2.50
3*	Alavi, Maryam	2.00
3*	Chin, Wynne	2.00
4*	Higgins, Christopher	1.83
4*	Guimaraes, Tor	1.83
5*	Doll, William	1.58
5*	Straub, Detmar	1.58
6*	Barki, Henri	1.50
6*	Goodhue, Dale	1.50
6*	Hartwick, Jon	1.50
6*	Mathieson, Kieran	1.50
6*	Shaft, Teresa	1.50
6*	Szajna, Bernadette	1.50

Table 27: The Most Prolific Authors during 1996-2002

Top Normal Ranks

Rank	Author	Score
1*	Agarwal, Ritu	8
1*	Benbasat, Izak	8
1*	Venkatesh, Viswanath	8
2*	Dennis, Alan	5
2*	Gefen, David	5
3*	Bhattacherjee, Anol	4
3*	Chau, Patrick	4
3*	Davis, Fred	4
3*	Igbaria, Magid	4
3*	Lerch, Javier	4
3*	Satzinger, John	4
3*	Speier, Cheri	4
3*	Watson, Richard	4
3*	Wei, Kwok-Kee	4
4*	Alavi, Maryam	3
4*	Cronan, Timothy	3
4*	Galletta, Dennis	3
4*	Hu, Paul	3
4*	Huff, Sid	3
4*	Hunton, James	3
4*	Kappelman, Leon	3
4*	Kettinger, William	3
4*	Lim, Kai	3
4*	Marakas, George	3
4*	Morris, Michael	3
4*	Prasad, Jayesh	3
4*	Prybutok, Victor	3
4*	Straub, Detmar	3

Top Adjusted Ranks

Rank	Author	Score
1	Venkatesh, Viswanath	4.83
2*	Agarwal, Ritu	3.50
2*	Gefen, David	3.50
3	Benbasat, Izak	3.17
4	Bhattacherjee, Anol	3.00
5	Chau, Patrick	2.25
6	Dennis, Alan	2.08
7*	Hunton, James	2.00
7*	Lerch, Javier	2.00
8	Davis, Fred	1.67
9*	Kasper, George	1.50
9*	Kettinger, William	1.50
9*	Panko, Raymond	1.50
9*	Prasad, Jayesh	1.50
9*	Te'eni, Dov	1.50
9*	Webster, Jane	1.50
9*	Speier, Cheri	1.50
10*	Igbaria, Magid	1.42
10*	Satzinger, John	1.42
10*	Watson, Richard	1.42
10*	Wei, Kwok-Kee	1.42
11*	Alavi, Maryam	1.33
11*	Cronan, Timothy	1.33
11*	Goodhue, Dale	1.33
11*	Straub, Detmar	1.33
12*	Hu, Paul	1.25
12*	Simon, Steven	1.25
13	Tegarden, David	1.20

Table 28: The Most Prolific Authors during 2003-2008

Top Normal Ranks

Rank	Author	Score
1	Benbasat, Izak	24
2	Galletta, Dennis	14
3	Zhang, Ping	12
4*	Gefen, David	9
4*	Tam, Kar-Yan	9
5*	Pavlou, Paul	8
5*	Venkatesh, Viswanath	8
6	McCoy, Scott	7
7*	Agarwal, Ritu	6
7*	Dennis, Alan	6
7*	Kim, Sung	6
7*	Straub, Detmar	6
7*	Valacich, Joseph	6
8*	Burton-Jones, Andrew	5
8*	Davis, Fred	5
8*	Fuller, Mark	5
8*	Te'eni, Dov	5
9*	Browne, Glenn	4
9*	Butler, Brian	4
9*	Cenfetelli, Ronald	4
9*	Chin, Wynne	4
9*	Henry, Raymond	4
9*	Ho, Shuk Ying	4
9*	Karahanna, Elena	4
9*	Kim, Jinwoo	4
9*	Malhotra, Naresh	4
9*	Nah, Fui-Hoon	4
9*	Polak, Peter	4
9*	Sun, Heshan	4
9*	Thong, James	4
9*	Vessey, Iris	4

Top Adjusted Ranks

Rank	Author	Score
1	Benbasat, Izak	11.58
2	Zhang, Ping	5.58
3	Galletta, Dennis	5.00
4	Gefen, David	4.17
5	Venkatesh, Viswanath	3.83
6	Tam, Kar-Yan	3.50
7	Pavlou, Paul	3.17
8*	Burton-Jones, Andrew	2.50
8*	Kim, Sung	2.50
9*	Te'eni, Dov	2.42
9*	Davis, Fred	2.42
10	Agarwal, Ritu	2.37
11	Nah, Fui-Hoon	2.33
12	Dennis, Alan	2.25
13*	Browne, Glenn	2.17
13*	McCoy, Scott	2.17
14	Straub, Detmar	2.08
15	Vessey, Iris	2.03
16*	Sen, Ravi	2.00
16*	Cenfetelli, Ronald	2.00
17*	Gallivan, Michael	1.83
17*	Ho, Shuk Ying	1.83
17*	Limayem, Moez	1.83
17*	Valacich, Joseph	1.83
18*	Fuller, Mark	1.67
18*	Karahanna, Elena	1.67
18*	Malhotra, Naresh	1.67
18*	Stewart, Katherine	1.67
18*	Sun, Heshan	1.67
19*	Carroll, John	1.50
19*	Jiang, Zhenhui	1.50

Table 29: The Most Prolific Authors during 1990-2008

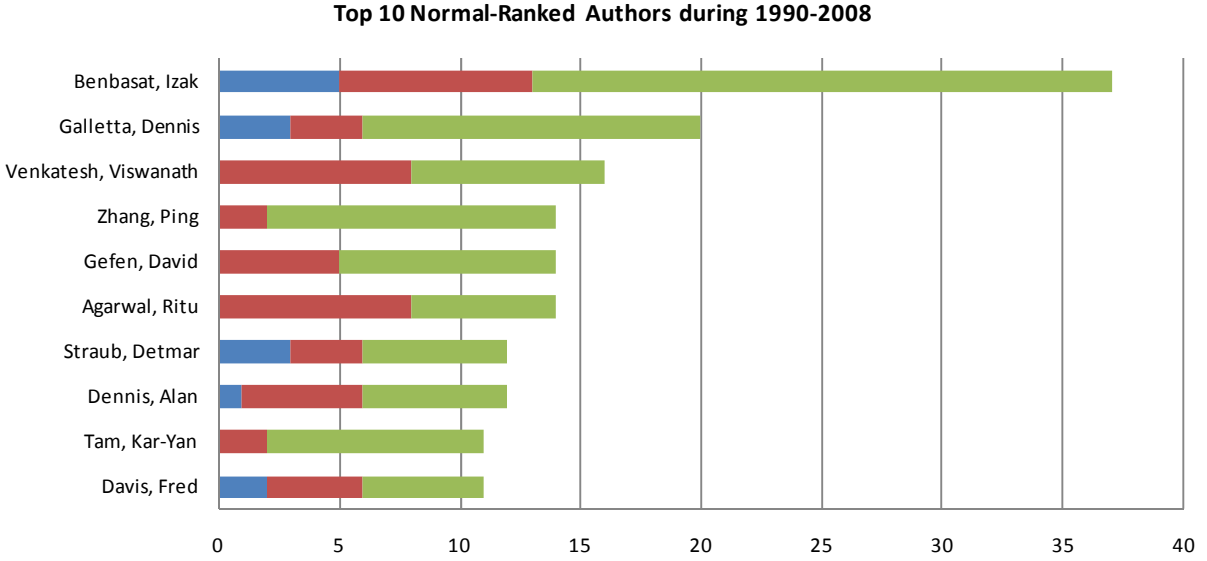
Top Normal Ranks

Rank	Author	Score
1	Benbasat, Izak	37
2	Galletta, Dennis	20
3	Venkatesh, Viswanath	16
4*	Agarwal, Ritu	14
4*	Gefen, David	14
4*	Zhang, Ping	14
5*	Dennis, Alan	12
5*	Straub, Detmar	12
6*	Davis, Fred	11
6*	Tam, Kar-Yan	11
7*	Todd, Peter	10
7*	Vessey, Iris	10
8*	Chin, Wynne	9
8*	Pavlou, Paul	9
8*	Valacich, Joseph	9
9	Te'eni, Dov	8
10*	Guimaraes, Tor	7
10*	Higgins, Christopher	7
10*	Karahanna, Elena	7
10*	McCoy, Scott	7
10*	Olfman, Lorne	7
10*	Wei, Kwok-Kee	7
11*	Alavi, Maryam	6
11*	Barki, Henri	6
11*	Bhattacherjee, Anol	6
11*	Chau, Patrick	6
11*	Compeau, Deborah	6
11*	Cronan, Timothy	6
11*	Doll, William	6
11*	Igbaria, Magid	6
11*	Kim, Jinwoo	6
11*	Kim, Sung	6
11*	King, William	6
11*	Morris, Michael	6
11*	Speier, Cheri	6
11*	Watson, Richard	6
11*	Webster, Jane	6
12*	Burton-Jones, Andrew	5
12*	Butler, Brian	5
12*	Cheney, Paul	5
12*	Fuller, Mark	5
12*	Goodhue, Dale	5
12*	Grover, Varun	5
12*	Johnson, Richard	5
12*	Limayem, Moez	5
12*	Massey, Anne	5
12*	Santhanam, Radhika	5
12*	Satzinger, John	5
12*	Thong, James	5
12*	Yi, Mun	5

Top Adjusted Ranks

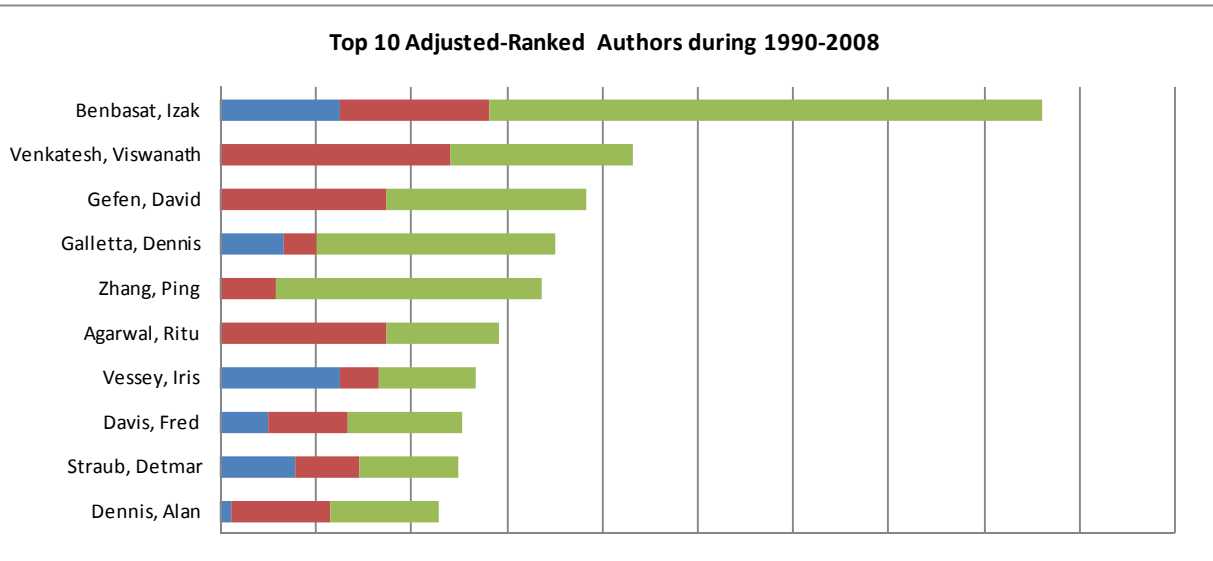
Rank	Author	Score
1	Benbasat, Izak	17.25
2	Venkatesh, Viswanath	8.67
3	Gefen, David	7.67
4	Galletta, Dennis	7.03
5	Zhang, Ping	6.75
6	Agarwal, Ritu	5.87
7	Vessey, Iris	5.37
8	Davis, Fred	5.08
9	Straub, Detmar	5.00
10	Dennis, Alan	4.58
11*	Te'eni, Dov	4.42
11*	Todd, Peter	4.42
12*	Bhattacherjee, Anol	4.00
12*	Tam, Kar-Yan	4.00
13*	Goodhue, Dale	3.83
13*	Alavi, Maryam	3.83
14	Chin, Wynne	3.75
15	Pavlou, Paul	3.67
16	Webster, Jane	3.33
17*	Higgins, Christopher	3.00
17*	Valacich, Joseph	3.00
18*	Chau, Patrick	2.92
18*	Olfman, Lorne	2.92
19*	Guimaraes, Tor	2.83
19*	Karahanna, Elena	2.83
19*	Barki, Henri	2.83
20	Limayem, Moez	2.67
21*	Burton-Jones, Andrew	2.50
21*	Cronan, Timothy	2.50
21*	Kim, Sung	2.50
21*	King, William	2.50
21*	Shaft, Teresa	2.50
21*	Szajna, Bernadette	2.50
22	Wei, Kwok-Kee	2.42
23*	Nah, Fui-Hoon	2.33
23*	George, Joey	2.33
23*	Kasper, George	2.33
23*	Speier, Cheri	2.33
24	Butler, Brian	2.27
25*	Browne, Glenn	2.17
25*	Compeau, Deborah	2.17
25*	Koufaris, Marios	2.17
25*	McCoy, Scott	2.17
25*	Morris, Michael	2.17
25*	Santhanam, Radhika	2.17
25*	Stewart, Katherine	2.17
26	Doll, William	2.12
27	Igbaria, Magid	2.08

Figure 19 and Figure 20 show the top 10 most prolific authors' ranking scores over the entire 19 years, with the three periods' data stacked to the whole.



	Davis, Fred	Tam, Kar-Yan	Dennis, Alan	Straub, Detmar	Agarwal, Ritu	Gefen, David	Zhang, Ping	Venkatesh, Viswanath	Galletta, Dennis	Benbasat, Izak
1990-1995	2	0	1	3	0	0	0	0	3	5
1996-2002	4	2	5	3	8	5	2	8	3	8
2003-2008	5	9	6	6	6	9	12	8	14	24

Figure 19: Top 10 Normal-Ranked Authors during 1990-2008



	Dennis, Alan	Straub, Detmar	Davis, Fred	Vessey, Iris	Agarwal, Ritu	Zhang, Ping	Galletta, Dennis	Gefen, David	Venkatesh, Viswanath	Benbasat, Izak
1990-1995	0.25	1.58	1.00	2.50	0.00	0.00	1.33	0.00	0.00	2.50
1996-2002	2.08	1.33	1.67	0.83	3.50	1.17	0.70	3.50	4.83	3.17
2003-2008	2.25	2.08	2.42	2.03	2.37	5.58	5.00	4.17	3.83	11.58

Figure 20: Top 10 Adjusted-Ranked Authors during 1990-2008

RQ5.2: What are the most prolific institutions housing HCI researchers?

We applied the same formulas used for authors to institutions. Table 30 presents the normal and adjusted ranks among the most prolific institutions during the entire 19 years. As per above in the author rankings, ties are starred (*).

Table 30: The Most Prolific Institutions during 19 Years (1990-2008)

Top Normal Ranks

Rank	Institute	Score
1	University of British Columbia	65
2	University of Pittsburgh	43
3*	Indiana University	42
3*	University of Maryland	42
4	Georgia State University	38
5	City University of Hong Kong	37
6	University of Arkansas	35
7	Syracuse University	32
8	National Univ. of Singapore	29
9	Carnegie Mellon University	28
10	University of Georgia	27
11	Queen's University	24
12	Hong Kong UST	23
13*	University of Houston	22
13*	University of Minnesota	22
13*	Washington State University	22
14*	Florida State University	21
14*	University of Arizona	21
14*	University of South Carolina	21
14*	University of Toledo	21
15*	Drexel University	20
16*	Michigan State University	19
16*	Yonsei University	19
17*	University of South Florida	18
17*	University of Western Ontario	18
18*	Pennsylvania State University	17
18*	University of Michigan	17
19	NJIT	16
20*	Case Western Reserve Univ.	15
20*	Claremont Graduate University	15
20*	University of Calgary	15
21	University of Central Florida	14
22*	Tel Aviv University	13
22*	University of North Texas	13
22*	University of Notre Dame	13
23*	Oklahoma State University	12
23*	Texas Tech University	12
23*	University of Melbourne	12
23*	University of Memphis	12
23*	University of Virginia	12
24*	Florida Atlantic University	11
24*	UIUC	11
24*	Worcester Polytechnic Institute	11

Top Adjusted Ranks

Rank	Institute	Score
1	University of British Columbia	29.92
2	University of Maryland	20.90
3	Indiana University	16.80
4	University of Pittsburgh	16.30
5	Georgia State University	15.34
6	University of Arkansas	15.25
7	Syracuse University	14.25
8	City Univ. of Hong Kong	13.83
9	National Univ. of Singapore	11.50
10	University of Georgia	11.42
11	Carnegie Mellon University	10.75
12	Queen's University	10.17
13	Drexel University	10.00
14	University of Houston	9.58
15	Hong Kong UST	8.53
16*	University of South Florida	8.42
16*	Florida State University	8.42
17	University of Minnesota	8.23
18	University of South Carolina	8.08
19	Michigan State University	7.92
20	Washington State University	7.42
21	University of Michigan	7.19
22	Pennsylvania State Univ.	7.11
23	University of Western Ontario	7.08
24	University of Toledo	6.82
25	Yonsei University	6.58
26	University of Calgary	6.25
27*	Tel Aviv University	6.08
27*	University of Arizona	6.08
28	Texas Tech University	6.00
29*	Claremont Graduate Univ.	5.58
29*	NJIT	5.58
30	UIUC	5.08
31	University of North Texas	5.00
32	University of Nebraska-Lincoln	4.83
33	McGill University	4.75
34	University of Notre Dame	4.67
35	Florida Atlantic University	4.67
36	Case Western Reserve Univ.	4.63
37	University of Melbourne	4.55
38	University of Texas at Austin	4.45
39*	University of Virginia	4.33
39*	Boston University	4.33
39*	Texas Christian University	4.33

Summary for RQ5

Over the past 19 years, HCI research has attracted a great number of researchers from a great number of institutions. The total number of authors has increased steadily over the years. This indicates the broad interests IS scholars have had in HCI research, and good opportunities for collaboration and employment.

DISCUSSION

The five mega-research questions and their corresponding detailed questions have been addressed with quantitative descriptions from the 19-year literature review. It is important to point out the limitations of this study before we further discuss the potential directions for the HCI sub-discipline as a whole, and the significance and implications of this study.

Limitations

This paper is among the few to draw a multifaceted overview of HCI studies in the IS discipline based on the evidence of published articles. It is limited due to the time-consuming nature of such studies. First, it has the limitation of using a journal "basket" (Chua et al. 2003; Lowry et al. 2004) that is constrained by the selected journals and other sources, as well as the time period. We considered the recent 19 years of the eight prime MIS journals and several other highly relevant sources in this study. While this is very reasonable, and much broader in coverage than other studies of a similar nature (Romano and Fjermestad 2001; Vessey et al. 2002), the 19-year time period and various sources may have had a strong influence on the assessment results. This includes the potential biases of the sources' emphases on publishable works, and the characteristics of the research that may be salient only for this period of time.

Second, we continue to realize that some classifications are not detailed enough, as previously noted (Zhang and Li 2005). For example, the RFCD classification scheme for disciplines does not distinguish different types of Information Systems in the 2801 discipline, and treats several areas normally regarded as different disciplines as several subjects within 2801. Psychology (3801) represents a similar example. It would be interesting to see what type of psychology, such as cognitive psychology, organizational psychology, social psychology, or consumer psychology, is most influential for some of the studies. Despite this limitation, we still consider RFCD to be superior to some other classifications for disciplines due to its comprehensive coverage.

Potential Future Directions for the HCI sub-discipline

Research Topics and the Evolution of ICT Artifacts and Use Contexts

The literature reviewed here supports the suggestion that the MIS/HCI discipline must be closely linked to practice and consulting (Banville and Landry 1989), and hence, research on cutting-edge technology. For example, studies focusing on the Web have increased tremendously (see Figure 10), while the contexts of studies have gradually shifted from organizational and work place (see Figure 2) to broader contexts. With more focus on social and interpersonal issues, research efforts on topics such as trust, emotion, and interpersonal relationship have increased over the years (Figure 4); as have studies at the group level of analysis (Figure 9). On the other hand, researchers in the HCI sub-discipline might also focus on long-term theoretical works that examine more fundamental issues as HCI research is inherently inclined toward human characteristics and human cognitive, affective, motivational, and behavioral factors that do not change as frequently or quickly as technology or contexts. This gives HCI researchers the advantage of emphasizing the fundamental theoretical understandings of humans and their interaction with IT, and the advantage of applying or testing such understandings in new IT development and IT use contexts to further enhance or enrich such understandings.

For example, we have seen more research that examines the fundamental issues of humans that are beyond performance, such as cognitive beliefs and behavior, attitude, emotion, and motivation (Figure 4). We have also seen that more studies examine multiple topics (Figure 3) because inherently many HCI issues intertwine with each other. All of these are exciting and promising. Such interests prompt for additional investigations that will reveal the true phenomenon of HCI in various contexts.

Theoretical Frameworks and Models

Related to the need for long-term work is the development of conceptual frameworks (and empirical validations) to understand the HCI sub-discipline as a whole, including both IT design/development and IT use/impact issues. With the increased importance of HCI in IT development and use, and increased understanding required to guide practice, comes the need for more informative and parsimonious frameworks and models. Compared to relatively low efforts during the first two periods, which was reported previously (Zhang and Li 2005), there have been more studies focusing on providing frameworks and high-level overviews in recent years (see Table 12 and Figure 8). This is very promising because good frameworks and models enhance our understanding at a higher level, and thus, can substantially advance the sub-discipline. In particular, we hope to see additional theoretical perspectives that are beyond some of the dominating ones in the IS discipline that are either for individual IT use, or omit other important factors such as emotions (Benbasat and Barki 2007).

More Focus on IT Design/Development

The majority of the efforts so far have been on IT use and impact (see Table 9). Research should also emphasize IT design/development because it is part of the HCI research area. Designing new and better technologies with informed practice should be one of the ultimate goals of HCI research. Theoretical understandings that do not feed design can eventually lose their relevance. There have been strong calls to focus more on the IT artifacts (Benbasat and Zmud 2003; Orlikowski and Iacono 2001), and to inform IT design by focusing on the specific antecedents of cognitive beliefs so that IT design can be guided (Benbasat and Barki 2007). We echo our colleagues on such calls. In particular, IT design or design research (Hevner et al., 2004) can be significantly enhanced by a consciousness of studying HCI issues with the IT design in mind, by linking our understanding of human reactions to IT back to guiding IT design/development, and by focusing on IT design and development for its own sake. This should be done both within the IS discipline and between IS and other design-oriented disciplines such as Computer Science, Engineering, and General Design Studies. While IS researchers have begun to rejuvenate interest in this important area, additional effort needs to be put into more design-oriented research, and into making HCI research in IS known to other design disciplines. Likewise, the work of other disciplines needs to be known to IS researchers, as each side has a great deal to ultimately contribute to IT products and services. Only a strong collaborative spirit and environment can enable informed IT designs that consider human, organizational, and societal needs. AIS SIGHCI has engaged in a number of activities to make this happen. We call for more efforts toward design-oriented research and making IT Use and Impact research more design relevant.

Research Methods

RQ1.4 ("What are the research methods?") and RQ1.5 ("What methods are often used to study what topics?") show that many methods are accepted in the HCI sub-discipline and different methods can address the same research topics. Yet, the current literature shows a continued need to utilize more interpretive and qualitative research methods in HCI studies. The advantage of such an approach is obvious. Due to the dynamic nature of HCI for supporting tasks within contexts, and the need for technology to be more socially aware and more supportive of communication, research methods such as action research, case study, interview, etc., are better suited for addressing the complexity and dynamics of HCI phenomena in everyday settings.

Implications for Research, Education, and Practice

Besides some of the directions pointed out earlier, this study has several additional research implications. This study continues to outline the ingredients of a typical research study. In addition to being used to assess literature, the seven facets may be used by a scholar to design a research study, including dissertation research. Results from this literature assessment may trigger some interesting explorations. For instance, Table 13 shows the co-occurrence pattern of research topics and methods. This may give scholars suggestions on which methods have been proven to be effective (or ineffective) in examining a certain phenomenon, and which methods might lead to a fresh viewpoint and, thus, be worth exploring. Finally, this study strongly suggests that a number of very useful classification schemes can be used for similar future studies. For example, the classification of HCI research topics is very comprehensive and allows dialogues with other related disciplines such as design-oriented disciplines. Each of the topics in the scheme can be further examined in terms of its current status and future direction. An existing classification framework for methods (Alavi and Carlson 1992) is expanded to reflect the current research methods. The classification of contexts depicts the rich environments where MIS-oriented HCI studies are conducted.

This literature assessment has teaching and educational implications, especially in preparing doctoral students. Students might want to familiarize themselves with knowledge and issues from several other disciplines in addition to the IS discipline, especially psychology and business, and be able to conduct research with a variety of methods. The recent trend toward multiple topics within a study challenges our future scholars to prepare themselves for designing research studies. Frequently used methods may be taken into consideration when doctoral program directors or curricula committees decide which methodological courses should be offered. Ph.D. students may benefit from the concise collection of the major scholars and their work in the HCI field. Part of a good foundation for scholarly activity is to be able to recognize and cite major scholars and their contributions to the intellectual body of the field. In most Ph.D. programs, the building of this knowledge occurs in a rather random fashion as students take seminars and write papers. This paper provides a good base of scholarly knowledge. In addition, professors in Ph.D. programs may use this article to provide ideas for questions to be asked in preliminary and qualification exams.

This study has practical implications as well. While designing IT, practitioners are strongly encouraged to examine what happens after previous or similar products have been released and put into use in real contexts. Such an examination should provide abundant insight for the design of new products. As demonstrated by this study, the majority of HCI studies in the IS discipline are particularly interested in issues that occur in the use and impact stage, thus, such research results are worth referencing by practitioners. The topic classification scheme (Table 4) lists a variety of issues and concerns that can provide an HCI designer with broad perspectives pertinent to human interaction with technologies in various contexts. IT practitioners may be concerned with issues that occur at all

stages of the IT lifecycle. This article lists various issues involved in the IT lifecycle that may or may not have been studied (see Table 4).

CONCLUSION

The importance of HCI research is elevated by the continued expansion of IT capabilities, yet limited by the realization of IT values because of human users' cognitive qualities, information processing capabilities, and use of IT (Banker and Kauffman 2004). Although HCI research in MIS has a history as long as the MIS discipline, understanding its intellectual substances, its current state, evolutions, and possible future directions is of significant importance to the HCI sub-discipline, to MIS as a whole, and to other closely-related disciplines.

This study builds on earlier efforts (Zhang and Li 2005) to systematically assess the IS literature, and to depict the status of research considering humans and their interaction with technologies over a period of 19 years, which has involved a large number of scholars. Using a classification approach with seven facets, this study allows multiple categories of a particular facet to be assigned to a paper. This multiplicity captures a more accurate picture of the nature of HCI research and allows us to reveal more realistic and interesting patterns by conducting co-occurrence and cross-facet analyses. Overall, this study is informative in that it provides state-of-the-art research issues and concerns, research emphases and gaps, potential research directions, and publication and employment opportunities. Thus, it can play an important role in the identification and promotion of this sub-discipline, and suggest directions for guiding future efforts in research, collaboration, publication, practice, and education. It can also help guide doctoral students in identifying potential research topics for dissertation research, and even suggest academic institutions for future employment.

HCI research occupies a gratifying percentage of space in primary MIS journals, showing an increase in both number and percentage. This indicates that HCI studies have gained more importance over the years. HCI research is attractive to a great number of MIS scholars. Equally encouraging is the existence of a large number of institutions where such scholars are employed and appreciated, thus forming centers of excellence in HCI research.

The HCI sub-discipline has evolved over the last 19 years. Since 1990, there have been some very obvious changes. Evolving from its current state, there are a number of potential future directions for this sub-discipline. Understanding that a field cannot be created and cannot evolve according to precisely pre-defined plans (Banville and Landry 1989), we hope that our efforts will inspire additional discussions, initiatives, and actions within the community so that we can advance our understanding of humans interactions with technologies in various contexts for various purposes. Together with other MIS sub-disciplines and related disciplines, the community can make human experiences with technologies more pleasant, interesting, rewarding, and fulfilling, thus generating greater personal value for individuals, more profitable business value for organizations, and additional social value for large communities and societies.

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Zigurs, I. and B. K. Buckland (1998) "A Theory of Task/Technology Fit and Group Support Systems Effectiveness," *MIS Quarterly* (22) 3, pp. 313-334.

Appendix A: List of 758 Articles Assessed in This Study

AMIS Books Chapters

ID	Article
1.	Agarwal & Angst, 2006
2.	Benbasat, 2006
3.	Browne, 2006
4.	Carroll & Rosson, 2006
5.	Carroll, 2006
6.	Compeau, et al., 2006
7.	Crowston, et al., 2006
8.	Davis, 2006
9.	Dennis, et al., 2006
10.	DeSanctis, 2006
11.	Dhillon & May, 2006
12.	Dillon, 2006
13.	Friedman, et al., 2006
14.	Galletta & Zhang, 2006
15.	Galletta, et al., 2006
16.	Goodhue, 2006
17.	Grudin, 2006
18.	Hiltz, et al., 2006
19.	Hubona, et al., 2006
20.	Kasper & Andoh-Baidoo, 2006
21.	Kim, et al., 2006
22.	Kutzschan & Webster, 2006
23.	Nass, et al., 2006
24.	Olfman, et al., 2006
25.	Olson & Olson, 2006
26.	Randolph & Hubona, 2006
27.	Sasidharan & Santhanam, 2006
28.	Shayo & Olfman, 2006
29.	Silver, 2006
30.	Stanton, et al., 2006
31.	Sun & Zhang, 2006
32.	Te'eni, 2006
33.	Tractinsky, 2006
34.	Vessey, 2006
35.	Zhang & Galletta, 2006
36.	Zhang, 2006
37.	Zigurs & Munkvold, 2006

BIT Special Issue

ID	Article
38.	Chae & Kim, 2004
39.	Hall & Hanna, 2004
40.	Nah, 2004

Communications of AIS

ID	Article
41.	Seddon, et al., 1999
42.	Tegarden, 1999
43.	Berg & Spiegler, 2000
44.	Kock, 2001
45.	Urbaczewski & Wheeler, 2001
46.	Vogel, et al., 2001
47.	Zhang, et al., 2002
48.	Hitchman, 2003
49.	Lee, et al., 2003
50.	Nadkarni & Nah, 2003
51.	Shaw, 2003
52.	Whitworth & Zaic, 2003
53.	Zviran & Erlich, 2003
54.	Carey, et al., 2004
55.	Chen, et al., 2004
56.	Kavanagh, 2004
57.	Loiacono & McCoy, 2004
58.	Lyytinen, et al., 2004
59.	Te'eni & Schwarz, 2004
60.	Anandarajan & Simmers, 2005
61.	Finneran & Zhang, 2005
62.	Lankton & Louis, 2005
63.	Liang, et al., 2005
64.	Liao, et al., 2005
65.	Looi, 2005
66.	Lorenzo, et al., 2005
67.	McCoy, et al., 2005
68.	McKeen, etal., 2005
69.	Musa, et al., 2005
70.	Zhang, et al., 2005
71.	Avital, et al., 2006
72.	Balijepally, et al., 2006
73.	Beaudry & Carillo, 2006
74.	Faja & Trimi, 2006
75.	Gefen, et al., 2006
76.	Jawadi & Akremi, 2006
77.	Lafky, et al., 2006
78.	Pan & Pan, 2006
79.	Ridings, et al., 2006
80.	Sen, 2006
81.	Tulu, et al., 2006
82.	Bandyopadhyay & Fraccastoro, 2007
83.	Civan & Pratt, 2007
84.	Dong, et al., 2007
85.	Harrison & Datta, 2007
86.	Hennington & Janz, 2007
87.	Kim, et al., 2007
88.	Parameswaran & Whinston, 2007
89.	Sen, 2007
90.	Shroff, et al., 2007
91.	Treiblmaier, 2007
92.	Chatterjee & Datta, 2008
93.	Crazier, et al., 2008
94.	Djamasbi, et al., 2008
95.	Jones, et al., 2008
96.	Miaskiewicz & Monarchi, 2008
97.	Nguyen, et al., 2008
98.	Smith & McKeen, 2008
99.	Urbaczewski & Koivisto, 2008
100.	Wilson & Sheetz, 2008
101.	Zhang & Bhattacharyya, 2008

Data Base (Incl. Special Issue)

ID	Article
102.	Alavi, 1990
103.	Hwang & Wu, 1990
104.	Ein-Dor & Segev, 1991
105.	George, 1991
106.	Amoroso & Cheney, 1992
107.	Conrath & Sharma, 1992
108.	Napier, et al., 1992
109.	Galletta, et al., 1993
110.	Dekleva, 1994
111.	Mathieson & Ryan, 1994
112.	Shirani, et al., 1994
113.	Chin & Gopal, 1995
114.	Kappelman, 1995
115.	Shaft, 1995
116.	Jiang & Klein, 1996

117.	Atkinson & Kydd, 1997
118.	Ju & Wagner, 1997
119.	Kendall, 1997
120.	Perry & Ballou, 1997
121.	Rivard, et al., 1997
122.	Webster & Ho, 1997
123.	Yager, et al., 1997
124.	Chan, et al., 1998
125.	Curl, et al., 1998
126.	Gefen & Keil, 1998
127.	Khalifa, 1998
128.	Louadi, et al., 1998
129.	Zigurs, et al., 1999
130.	Higa & Wijayanayake, 2000
131.	Ryan, et al., 2000
132.	Chiasson & Lovato, 2001
133.	Cooper & Bhattacherjee, 2001
134.	Mathieson, et al., 2001
135.	Simon, 2001
136.	Antony & Batra, 2002
137.	Gefen, 2002
138.	Henfridsson & Holmstrom, 2002
139.	Hong & Lerch, 2002
140.	Kawalek & Wood-Harper, 2002
141.	Shaw, et al., 2002
142.	Gefen & Ridings, 2003
143.	Cash, et al., 2004
144.	Chen, et al., 2004
145.	Gallivan, 2004
146.	Kim & Prabhakar, 2004
147.	Powell, et al., 2004
148.	Slyke, et al., 2004
149.	Burton-Jones & Hubona, 2005
150.	Fox & Spence, 2005
151.	Gefen & Ridings, 2005
152.	Iivari, 2005
153.	Sauter & Free, 2005
154.	Serva, et al., 2005
155.	Fang & Neufeld, 2006
156.	Gao & Koufaris, 2006
157.	Glassberg, et al., 2006
158.	Lee, et al., 2006
159.	Li, et al., 2006
160.	Limayem, 2006
161.	Liu & Ma, 2006
162.	Mao & Palvia, 2006
163.	Moores, et al., 2006
164.	Strong, et al., 2006
165.	Leclercq, 2007
166.	Schultze & Carte, 2007
167.	Turetken & Sharda, 2007
168.	Cao, et al., 2008
169.	Ho, et al., 2008
170.	Ocker & Fjermestad, 2008
171.	Plummer, et al., 2008
172.	Slyke, et al., 2008
173.	Truemper, et al., 2008
174.	Wu & Kuo, 2008

Decision Sciences

ID	Article
175.	King, et al., 1990
176.	Umanath, et al., 1990
177.	Doll & Torkzadeh, 1991
178.	Hawk & Raju, 1991
179.	Howard & Mendelow, 1991
180.	Kottemann & Davis, 1991
181.	Loy, 1991
182.	Torkzadeh & Doll, 1991
183.	Vessey, 1991
184.	Fedorowicz, et al., 1992
185.	Gal & Steinbart, 1992
186.	Guimaraes, et al., 1992
187.	Mackay, et al., 1992
188.	Sulek & Marucheck, 1992
189.	Cook, 1993
190.	Tan & Benbasat, 1993
191.	Davis & Kottemann, 1994
192.	Hendrickson, et al., 1994
193.	Kettinger & Lee, 1994
194.	Mirani & King, 1994
195.	Moffitt, 1994
196.	Sambamurthy & Chin, 1994
197.	Snead & Harrell, 1994
198.	Subramanian, 1994
199.	Swink, 1995
200.	Valacich & Schwenk, 1995
201.	Hunton, 1996
202.	Teng & Calhoun, 1996
203.	Venkatesh & Davis, 1996
204.	Agarwal & Prasad, 1997
205.	Gonzalez & Kasper, 1997
206.	Guimaraes & Igbaria, 1997
207.	Jackson, et al., 1997
208.	Kettinger & Grover, 1997
209.	King & Xia, 1997
210.	Ramarapu, et al., 1997
211.	Smelcer & Carmel, 1997
212.	Warkentin, et al., 1997
213.	Bhattacherjee, 1998
214.	Doll, et al., 1998
215.	Goodhue, 1998
216.	McHaney & Cronan, 1998
217.	Agarwal & Prasad, 1999
218.	Kettinger & Lee, 1999
219.	Lucas & Spitler, 1999
220.	Morris, et al., 1999
221.	Speier, et al., 1999
222.	Swink & Speier, 1999
223.	Van Dyke, et al., 1999
224.	Chu & Spires, 2000
225.	Bolt, et al., 2001
226.	Chau & Hu, 2001
227.	Dunn & Grabski, 2001
228.	Grabowski & Sanborn, 2001
229.	Parikh, et al., 2001
230.	Reneau & Blanthorne, 2001
231.	Schmidt, et al., 2001
232.	Yi & Davis, 2001
233.	Carr, 2002
234.	Venkatesh, et al., 2002
235.	Somers, et al., 2003
236.	Speier, et al., 2003
237.	Piccoli, et al., 2004
238.	Stafford, et al., 2004
239.	Abdinnour-Helm, et al., 2005
240.	Boyer & Hult, 2005
241.	Kim & Malhotra, 2005
242.	Froehle, 2006
243.	Li, et al., 2006
244.	Looney, et al., 2006
245.	Venkatesh, 2006
246.	Yi, et al., 2006
247.	Fuller, et al., 2007
248.	Massey, et al., 2007
249.	Looney, et al., 2008
250.	Venkatesh & Bala, 2008

ISJ Special Issue

ID	Article
251.	Avital & Te'eni, 2008
252.	Dinev, et al., 2008
253.	Guo & Poole, 2008
254.	McCoy, et al., 2008
255.	Tomiuk & Pinsonneault, 2008

ISR

ID	Article
256.	Brancheau & Wetherbe, 1990
257.	Elam & Mead, 1990
258.	Galletta & Heckman, 1990
259.	Newman & Noble, 1990
260.	Tan & Benbasat, 1990
261.	Mathieson, 1991
262.	Moore & Benbasat, 1991
263.	Todd & Benbasat, 1991
264.	Vessey & Galletta, 1991
265.	Mackay & Elam, 1992
266.	Morris, et al., 1992
267.	Suh & Jenkins, 1992
268.	Ang, et al., 1993
269.	Barki & Hartwick, 1994
270.	Beath & Orlikowski, 1994
271.	Constant, et al., 1994
272.	Santhanam & Sein, 1994
273.	Straub, 1994
274.	Asahi, et al., 1995
275.	Chin & Newsted, 1995
276.	Compear & Higgins, 1995
277.	Doll, et al., 1995
278.	Shaft & Vessey, 1995
279.	Taylor & Todd, 1995
280.	Kasper, 1996
281.	Roy & Lerch, 1996
282.	Sharda & Steriger, 1996
283.	Simon, et al., 1996
284.	Vandenbosch & Higgins, 1996
285.	Weber, 1996
286.	Harrison, et al., 1997
287.	Kim & Lerch, 1997
288.	Lim, et al., 1997
289.	Agarwal & Prasad, 1998
290.	Dennis & Carte, 1998
291.	Dennis & Kinney, 1998
292.	Marakas, et al., 1998
293.	Parthasarathy & Bhattacherjee, 1998
294.	Gattiker & Kelley, 1999
295.	Gordon & Moore, 1999
296.	Kraut, et al., 1999
297.	Sein & Santhanam, 1999
298.	Sethi & King, 1999
299.	Sussman & Sproull, 1999
300.	Todd & Benbasat, 1999
301.	Agarwal, et al., 2000
302.	Johnson & Marakas, 2000
303.	Kim, et al., 2000
304.	Lim, et al., 2000
305.	Limayem & DeSanctis, 2000
306.	Marcolin, et al., 2000
307.	Venkatesh, 2000
308.	Alavi & Leidner, 2001
309.	Belanger, et al., 2001
310.	Butler, 2001
311.	Chwelos, et al., 2001
312.	Garfield, et al., 2001
313.	Lerch & Harter, 2001
314.	Orlikowski & Iacono, 2001
315.	Plouffe, et al., 2001
316.	Agarwal & Venkatesh, 2002
317.	Alavi, et al., 2002
318.	Chen & Hitt, 2002
319.	Devaraj, et al., 2002
320.	Koufaris, 2002
321.	McKinney, et al., 2002
322.	McKnight, et al., 2002
323.	Palmer, 2002
324.	Rai, et al., 2002
325.	Sia, et al., 2002
326.	Stewart & Segars, 2002
327.	Chin, et al., 2003
328.	Fisher, et al., 2003
329.	Miranda & Saunders, 2003
330.	Purao, et al., 2003
331.	Sussman & Siegal, 2003
332.	Yi & Davis, 2003
333.	Hong, et al., 2004
334.	Jarvenpaa, et al., 2004
335.	Jones, et al., 2004
336.	Karimi, et al., 2004
337.	Lilien, et al., 2004
338.	Malhotra, et al., 2004
339.	Pavlou & Gefen, 2004
340.	Schultze & Orlikowski, 2004
341.	Chidambaram & Tung, 2005
342.	Kim, et al., 2005
343.	Majchrzak, et al., 2005
344.	Pavlou & Gefen, 2005
345.	Tam & Ho, 2005
346.	Wixom & Todd, 2005
347.	Burton-Jones & Straub, 2006
348.	Dinev & Hart, 2006
349.	Galletta, et al., 2006
350.	Heninger, et al., 2006
351.	Hong & Tam, 2006
352.	Khatri, et al., 2006
353.	Kim & Benbasat, 2006
354.	Kumar & Benbasat, 2006
355.	Nicolaou & McKnight, 2006
356.	Pavlou & Dimoka, 2006
357.	Barki, et al., 2007
358.	Jiang & Benbasat, 2007
359.	Ma & Agarwal, 2007
360.	Cenfetelli, et al., 2008
361.	Dabbish & Kraut, 2008
362.	Dawande, et al., 2008
363.	Devaraj, et al., 2008
364.	Forman, et al., 2008
365.	Hahn, et al., 2008
366.	Kane & Alavi, 2008
367.	Kuruzovich, et al., 2008
368.	Moon & Sproull, 2008
369.	Ragu-Nathan, et al., 2008
370.	Robert, et al., 2008
371.	Santhanam, et al., 2008
372.	Wakefield, et al., 2008

IJHCI Special Issues

ID	Article
373.	Ho & Tam, 2005
374.	Jain & Kanungo, 2005
375.	Park, et al., 2005
376.	Qiu & Benbasat, 2005
377.	Rajeswari & Anantharaman, 2005

378.	Rao, et al., 2005
379.	Tarasewich, et al., 2005
380.	Cai & Xu, 2008
381.	McCoy, et al., 2008
382.	Shen & Khalifa, 2008
383.	Tan & Chou, 2008
384.	Zhang, et al., 2008

IJHCS Special Issues

ID	Article
385.	Chan, et al., 2003
386.	Featherman & Pavlou, 2003
387.	Finneran & Zhang, 2003
388.	Ryan, et al., 2003
389.	Yi & Hwang, 2003
390.	Chung, 2006
391.	Du & Wagner, 2006
392.	Thong, et al., 2006

JAIS (Incl. Special Issues)

ID	Article
393.	Gefen & Straub, 2000
394.	Tan & Teo, 2000
395.	Zhang, 2000
396.	Geissler, et al., 2001
397.	Leonard & Cronan, 2001
398.	Panko & Halverson, 2001
399.	Te'eni & Feldman, 2001
400.	Gefen, 2002
401.	Shim, et al., 2002
402.	Khalifa & Liu, 2003
403.	Lee, et al., 2003
404.	Li, et al., 2003
405.	Limayem & Hirt, 2003
406.	Rafaeli & Raban, 2003
407.	Sarker & Sahay, 2003
408.	Shin, 2003
409.	Brown, et al., 2004
410.	Carte & Chidambaram, 2004
411.	Cenfetelli, 2004
412.	Fichman, 2004
413.	Galletta, et al., 2004
414.	Kim, et al., 2004
415.	Markus & Mao, 2004
416.	Nah & Benbasat, 2004
417.	Wasko, et al., 2004
418.	Li, et al., 2005
419.	Sarker, et al., 2005
420.	Wang & Benbasat, 2005
421.	Zhang and Li, 2005
422.	Al-Natour, et al., 2006
423.	Bowen, et al., 2006
424.	Hargittai, 2006
425.	Rensel, et al., 2006
426.	Son, et al., 2006
427.	Sun & Zhang, 2006
428.	Van Slyke, et al., 2006
429.	Bagozzi, 2007
430.	Benbasat & Barki, 2007
431.	Choi, et al., 2007
432.	Compeau, et al., 2007
433.	Dickey, et al., 2007
434.	Dinev & Hu, 2007
435.	Germonprez, et al., 2007
436.	Marakas, et al., 2007
437.	Olphert & Damodaran, 2007
438.	Parameswaran & Whinston, 2007
439.	Porra & Hirschheim, 2007
440.	Schwarz & Chin, 2007
441.	Silva, 2007
442.	Stahl, 2007
443.	Straub & Burton-Jones, 2007
444.	Venkatesh, et al., 2007
445.	Wagner & Newell, 2007
446.	Briggs, et al., 2008
447.	Burton-Jones & Meso, 2008
448.	Gable, et al., 2008
449.	George, et al., 2008
450.	Goswami, et al., 2008
451.	Hardin, et al., 2008
452.	Komiak & Benbasat, 2008
453.	Kudaravalli & Faraj, 2008
454.	Sheng, et al., 2008
455.	Zhang & Watts, 2008

JMIS (Incl. Special Issue)

ID	Article
456.	Cronan & Douglas, 1990
457.	Davis & Davis, 1990
458.	Minch, 1990
459.	Smith & Vanecek, 1990
460.	Amoroso & Cheney, 1991
461.	Gogan, 1991
462.	Magal, 1991
463.	Harrison & Rainer, 1992
464.	Briggs, et al., 1993
465.	Burton, et al., 1993
466.	Levine & Rossmoore, 1993
467.	Vessey & Conger, 1993
468.	Zmud, et al., 1993
469.	Mirani & King, 1994
470.	Tan, 1994
471.	Thompson & Higgins, 1994
472.	Chen, 1995
473.	Igbaria, et al., 1995
474.	Lee, et al., 1995
475.	Massey & Clapper, 1995
476.	Satzinger & Olfman, 1995
477.	Steiger, 1995
478.	Yoon & Guimaraes, 1995
479.	Agarwal, et al., 1996
480.	Chau, 1996
481.	Choe, 1996
482.	Edberg & Bowman, 1996
483.	Igbaria, et al., 1996
484.	Leitheiser & March, 1996
485.	Money, 1996
486.	Montazemi, et al., 1996
487.	Reinig, et al., 1996
488.	Saleem, 1996
489.	Tillquist, 1996
490.	Wang & Strong, 1996
491.	Galletta, et al., 1997
492.	McKeen & Guimaraes, 1997
493.	Sheetz, et al., 1997
494.	Shibata, et al., 1997
495.	Ahituv, et al., 1998
496.	Essex, et al., 1998
497.	Jarvenpaa, et al., 1998
498.	Moody, et al., 1998
499.	Satzinger & Olfman, 1998
500.	Schenk, et al., 1998
501.	Shaft & Vessey, 1998
502.	Tan, et al., 1998
503.	Hu, et al., 1999

504.	Panko, 1999
505.	Satzinger, et al., 1999
506.	Zviran & Haga, 1999
507.	Burgoon, et al., 2000
508.	Grise & Gallupe, 2000
509.	Huang & Wei, 2000
510.	Mao & Benbasat, 2000
511.	Hillmer & Dennis, 2001
512.	Markus, 2001
513.	Sack, 2001
514.	Bargeron, et al., 2002
515.	Chau & Hu, 2002
516.	Coppola, et al., 2002
517.	Hong, et al., 2002
518.	Sniezek, et al., 2002
519.	DeLone & McLean, 2003
520.	Easley, et al., 2003
521.	Hardgrave, et al., 2003
522.	Hayne, et al., 2003
523.	Kahai & Cooper, 2003
524.	Kang & Santhanam, 2003
525.	Massey, et al., 2003
526.	Peace, et al., 2003
527.	Pennington, et al., 2003
528.	Reinig, 2003
529.	Brown, et al., 2004
530.	Doll, et al., 2004
531.	Gefen, 2004
532.	Kohli & Mahmood, 2004
533.	Pitts & Browne, 2004
534.	Santanen, et al., 2004
535.	Sharda, et al., 2004
536.	Gallivan, et al., 2005
537.	Hong, et al., 2005
538.	Jiang & Benbasat, 2005
539.	Leimeister, et al., 2005
540.	Malhotra & Galletta, 2005
541.	Nelson, et al., 2005
542.	Paul, et al., 2005
543.	Roberts, et al., 2005
544.	Tiwana & McLean, 2005
545.	Everard, et al., 2006
546.	Fang, et al., 2006
547.	Gemino, et al., 2006
548.	Hess, et al., 2006
549.	Lam & Lee, 2006
550.	Lim, et al., 2006
551.	Lopes & Galletta, 2006
552.	Stewart, 2006
553.	Wei, et al., 2006
554.	Zhou, et al., 2006
555.	Biocca, et al., 2007
556.	Espinosa, et al., 2007
557.	Fuller, et al., 2007
558.	Hann, et al., 2007
559.	He, et al., 2007
560.	Kankanhalli, et al., 2007
561.	Liang, et al., 2007
562.	Mithas, et al., 2007
563.	Santhanam, et al., 2007
564.	Tarafdar, et al., 2007
565.	Wang & Benbasat, 2007
566.	Zhang, D., et al., 2007
567.	Zhang, J., et al., 2007
568.	Awad & Ragowsky, 2008
569.	Bolton, et al., 2008
570.	Charki & Josserand, 2008
571.	Cyr, 2008
572.	Gefen, et al., 2008
573.	He & King, 2008
574.	Kim, 2008
575.	Lowry, et al., 2008
576.	Malhotra, et al., 2008
577.	Ren, et al., 2008
578.	Tang, et al., 2008
579.	Turel, et al., 2008
580.	Vance, et al., 2008
581.	Wang & Benbasat, 2008
582.	Zahedi & Song, 2008
583.	Zimmer, et al., 2008

Management Science

ID	Article
584.	Connolly, et al., 1990
585.	Hiltz & Johnson, 1990
586.	Melone, 1990
587.	Poole, et al., 1991
588.	Grabowski & Wallace, 1993
589.	Hartwick & Barki, 1994
590.	Anson, et al., 1995
591.	Bell & O'Keefe, 1995
592.	Goodhue, 1995
593.	Kekre, et al., 1995
594.	Srinivasan & Te'eni, 1995
595.	Straub, et al., 1995
596.	Hoch & Schkade, 1996
597.	Szajna, 1996
598.	Hunton & Price, 1997
599.	van Bruggen, et al., 1998
600.	Venkatesh & Davis, 2000
601.	Hitt & Frei, 2002
602.	Ahuja, et al., 2003
603.	Balasubramanian, et al., 2003
604.	Johnson, et al., 2004
605.	Ding, et al., 2005
606.	Kim & Malhotra, 2005
607.	Song & Zahedi, 2005
608.	Bagozzi & Dholakia, 2006
609.	Roberts, et al., 2006
610.	Sabherwal, et al., 2006
611.	Shah, 2006
612.	Venkatesh & Agarwal, 2006
613.	Boh, et al., 2007
614.	Ahearne, et al., 2008
615.	Porter & Donthu, 2008
616.	Tucker, 2008

MIS Quarterly

ID	Article
617.	Bergeron, et al., 1990
618.	Lamberti & Wallace, 1990
619.	Nelson, 1990
620.	Gerlach & Kuo, 1991
621.	Joshi, 1991
622.	Silver, 1991
623.	Thompson, et al., 1991
624.	Adams, et al., 1992
625.	Todd & Benbasat, 1992
626.	Trauth & Cole, 1992
627.	Webster & Martocchio, 1992
628.	Ahrens & Sankar, 1993
629.	Chan, et al., 1993
630.	Culnan, 1993
631.	Hendrickson, et al., 1993
632.	Kraemer, et al., 1993
633.	Lawrence & Low, 1993

634.	Segars & Grover, 1993
635.	Szajna & Scamell, 1993
636.	Alavi, 1994
637.	Barki & Hartwick, 1994
638.	Doll, et al., 1994
639.	McKeen, et al., 1994
640.	Olfman & Mandviwalla, 1994
641.	Szajna, 1994
642.	Chin & Todd, 1995
643.	Compeau & Higgins, 1995
644.	Goodhue & Thompson, 1995
645.	Pitt, et al., 1995
646.	Taylor & Todd, 1995
647.	Ye & Johnson, 1995
648.	Yoon, et al., 1995
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