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ASSESSING THE IMPACT OF PREMIER INFORMATION SYSTEMS RESEARCH OVER TIME

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ABSTRACT

In this study we examine the influence of premier information systems research over time to assess the maturity of the Information Systems (IS) field and its impact on subsequent IS and non-IS research. 19,357 citations from the Social Science Citation Index (SSCI) (1982-2004) are attributed to 879 articles published in *MIS Quarterly* (MISQ), *Information Systems Research* (ISR), and the IS articles from *Management Science* (MS) between 1982 and 2004, and this number continues to increase over time. The results suggest that research in premier IS journals has an influence on other disciplines as 7,137 citations come from outside the IS discipline and this number continues to increase over time. Of particular note is the consistent increase over time in citations of premier IS research articles from the management, engineering and physical sciences, organizational behavior, and computer science disciplines. Given recent debates regarding the IT artifact, we also directly test the impact of articles that address the IT artifact and those that do not. We find that articles that directly address the IT artifact are cited significantly more often than those that do not, consistent with arguments made by Benbasat et al. [2003].

Keywords: Citation analysis, IT artifact, scientometrics, bibliometrics, IS field

I. INTRODUCTION

A substantial body of literature claims that an intellectual identity crisis exists in Information Systems (IS) research [Benbasat and Zmud 2003; Hirschheim and Klein 2003]. This literature has covered topics such as the identity and cumulative tradition of the IS field [Keen 1980], whether the IS field is truly global in its academic perspective [Avgerou et al. 1999; Katerattanakul and Han 2003], whether there is too much diversity in IS research [Benbasat and Weber 1996; Robey 1998], whether IS research is too rigorous and not relevant enough [Benbasat and Zmud 1999], whether the IS field has mature theories [Backhouse et al. 1991] or is mature in general [Cheon et al. 1993], what the core properties of the field are [Agarwal and Lucas 2005; Benbasat

and Zmud 2003], etc. A recurring series of questions from these debates center on whether the IS field is "legitimate" and whether its impact has grown over time.

One possible way to judge the legitimacy and impact of a discipline is by its contributions to knowledge [Agarwal and Lucas 2005]. In the IS discipline, several studies have used citations analysis of IS research as a measure of contribution to knowledge to address some of these debates and to better understand the structure of the field of IS. We categorize these citation-based studies as follows:

1. Developing journal inventories with citation counts [Hamilton and Ives 1980; Hamilton and Ives 1982];
2. Listing leading journals and research institutions [Lending and Wetherbe 1992; Vogel and Wetherbe 1984];
3. Finding the most cited authors with a co-citation analysis [Culnan 1986; Culnan 1987];
4. Comparing individual and institutional research productivity [Bradbard and Niebuhr 1987; Chua et al. 2003; Grover et al. 1992; Im et al. 1998];
5. Examining the distribution of types of articles from various journals [Cheon et al. 1992; Culnan and Swanson 1986], including the categorization of the various methodologies and topics that are used [Alavi and Carlson 1992; Cheon et al. 1993];
6. Determining the most cited articles [Walstrom and Leonard 2000];
7. Extrapolating the influence of certain journals on the field [Cooper et al. 1993; Holsapple et al. 1993; Katerattanakul and Han 2003].

Building on this body of citations research, the key debate we address is the question of the depth of maturity and impact of IS field research. We define the maturity of a field as the extent to which it has built a cumulative knowledge base; impact is how much a field affects other fields and science in general. A field with low impact will find fewer of its articles cited outside of its field. We assert that maturity and impact are needed for a field to have stature: "A discipline's scientific status is enhanced if its knowledge base is widely dispersed and used by other disciplines and researchers [Anderson 1983]" [Cote et al. 1991, p. 402]. We address the question of maturity and impact from the perspective of citation analysis, because it can shed light on both cumulative tradition and article use. Citation analysis provides a critical perspective in which journal influence can be analyzed [Cote et al. 1991] and is the established procedure for assessing scientific knowledge exchange [Cote et al. 1991; Garfield 1979]. Particularly, citation analysis "reflect(s) the usefulness of research to other scientists doing related work" [Garfield 1983, p. 9].

Scientific research, in general, has been widely criticized for its lack of relevance and utility; a key fact in the critics' arsenal is that "only 19 percent of all articles appearing in top journals are cited more than once within five years of publication" [Cote et al. 1991, p. 402]. In examining a wider range of scientific journals, only three percent of all published articles ever have an impact on science [Cote et al. 1991]. Consequently, some critics of academic research are so emboldened as to say that academic scientists are "welfare queens in white coats" [Cote et al. 1991, p. 402].

Cooper et al. [1993] used citation analysis to measure journal influence in IS—primarily to determine which journals are the key journals in IS. Although this study is illuminating, it is now over twelve years old and was based on just nine years of journal data. A study by Holsapple et al. [1993] shares similar limitations. Finally, Katerattanakul et al. [2003] made strong arguments for a more global perspective in IS research.

Although determining the maturity of IS research through citation analysis has been previously addressed [Cooper et al. 1993; Holsapple et al. 1993; Katerattanakul and Han 2003], several relevant questions remain unanswered, especially in the context of current publication trends.

The questions we are primarily concerned with center around the influence of premier IS research over time, as a surrogate for knowledge in the IS field. In addressing the influence of premier IS research over time, we specifically address the following scientometric research questions:

1. What is the impact of premier IS research as compared to other business disciplines and other scientific research?

2. What is the relative maturity of the IS field as reflected in the references of premier IS research journals? What disciplines are referenced in premier IS research journal articles, and has the focus shifted more toward IS research over time?

3. Conversely, what disciplines cite premier IS research journals, and have these outside citations increased over time? What proportion of the citations of premier IS research articles are from within the IS field? What IS and non-IS journals most cite premier IS research articles, and how has this changed over time?

4. Do articles that address the IT artifact have greater impact (e.g. more citations) than those that do not?

We chose *MIS Quarterly* (MISQ), *Information Systems Research* (ISR), and the IS articles from *Management Science* (MS) for several reasons: We wanted to focus on citations from journals that are universally and historically considered the leaders of IS research internationally, and these three journals have been consistently ranked as the top, most influential general IS journals in the field by the last seven IS journal-ranking studies, from 1994 to 2005 [Gillenson and Stutz 1991; Hardgrave and Walstrom 1997; Holsapple et al. 1993; Lowry et al. 2004; Mylonopolous and Theoharakis 2001; Peffers and Ya 2003; Rainer Jr. and Miller 2005; Whitman et al. 1999]. In all these studies, only two journals are ever ranked in the top two positions: *MISQ* and *ISR. Journal of Management Information Systems* (JMIS), *European Journal of Information Systems* (EJIS), *Journal of the AIS* (JAIS), and *Information & Management* (I&M) are never ranked in the top two and are not consistently ranked in these seven studies, although they are clearly high-quality journals. We consider IS articles published in MS because it was generally ranked as the second-highest rated journal before ISR was published, it is still highly esteemed, and it has a deep citations history. MISQ was first published in 1977; MS was first published in 1954; ISR was first published in 1990. Moreover, the Social Sciences Citation Index (SSCI), accessed through the Web of Science,[1] provides data for ISR from 1994 to present. In contrast, SSCI started indexing MISQ in 1984 and IS articles in MS in 1982.

II. METHOD

Through the Web of Science, we traced citations data from the Science Citations Index Expanded (SCI-EXPANDED), the SSCI, and the Art and Humanities Citations Index (A&HCI), for papers published in *MISQ*, *ISR*, and *MS* (only for IS articles). These databases index the references cited in papers from target journals. Collectively, the three databases of the Web of Science draw their data from 8600 scholarly journals. There were 879 articles published in *MISQ*, *ISR*, and *MS* (only for IS articles) that are included in the data set for this study. By the year 2004, these papers had accumulated 19,357 citations. These papers contain 43,786 references. The citations data has been grouped on the basis of the research discipline journals where the cited work was published.[2]

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[1] Web of Science is a product of the Thomson Corporation that provides access to three citations index databases. See their link at http://portal01.isiknowledge.com/ (subscription required).

[2] The following 17 groups were used to categorize the disciplines of citing journals: accounting, agriculture and food sciences, computer science, economics, education, engineering and physical sciences, finance, health and biological sciences, information sciences, information

III. ADDRESSING THE RESEARCH QUESTIONS

WHAT IS THE IMPACT OF PREMIER IS RESEARCH AS COMPARED TO OTHER PREMIER SCIENTIFIC AND BUSINESS JOURNALS?

We argue that IS research is influential if it contributes to knowledge. Agarwal and Lucas recently suggested that "the impact of IS research has arguably been relatively small, especially compared with research in fields like finance . . . " [2005, p. 382]. To test whether the impact of premier IS research is in fact, "relatively small," we compare the impact of top IS research to those other premier business journals. Each year Thomson produces an ISI impact factor as part of their Journal Citation Reports [Thomson 2005] for all journals covered in its SSCI. This impact factor is the average number of times articles from the journal published in the past two years have been cited in the target year.

Meanwhile, the *Financial Times* compiles a list of what is generally considered to be the most prestigious and respected journals in each business discipline. They use this list as way of assessing the research element in their annual MBA rankings.[3] We use this list of top business journals, along with their ISI impact factors, to compare top business journals to the ISI impact factors of the top IS journals. Appendix 1 provides a comparison between the two premier IS journals and other *Financial Times*-listed business journals from 1993 to 2004. We excluded MS from the IS list because these data do not allow the unbundling of the IS articles in the overall impact rating and most MS articles are management articles.

From this analysis we find that ISR and MISQ and their impact factors are generally increasing over time, suggesting that IS research is becoming more influential. If we compare MISQ and ISR to the other *Financial Times*-listed business journals, we find that in more recent years MISQ and ISR compare exceptionally well to other top business journals' impact ratings [Thomson 2005]. The rise in prominence of ISR has been particularly dramatic. In the most recent 2004 ranking, we find the impact factor of MISQ and ISR to be significantly higher than the impact factor of all other journals listed in the Financial Times list ($t=1.88$, $p=0.068$, two-tailed).

A second method of assessing the impact of IS research is to compare it to the impact of other top journals. Recall that "only 19 percent of all articles appearing in top journals are cited more than once within five years of publication" [Cote et al. 1991, p. 402]. In contrast, we found that 94 percent of premier IS research (MISQ, ISR, and IS articles from MS published between 1984 and 2000) are cited more than once within five years of publication, which is well above the 19 percent hurdle. This suggests that premier IS articles are considered highly relevant and useful inside and outside the IS research community.

WHAT IS THE RELATIVE MATURITY OF THE IS FIELD AS REFLECTED IN THE REFERENCES OF PREMIER IS RESEARCH JOURNALS?

This question involves the assessment of the relative maturity of the IS field by determining the disciplines that are referenced in premier IS research articles. Specifically, we want to know which disciplines are sourced in premier IS research articles, and if the focus has shifted more toward IS research over time. We categorized each journal referenced in premier IS research articles over its history and report the results in Table 1.

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systems, law, management, marketing, organizational behavior and human resources, psychology, sociology, and other. The 17 discipline groups were obtained by clustering the 54 SSCI subject categories. We maintained the subject categories as the SSCI for the business disciplines, and clustered related non-business subject disciplines.

[3] See a list of the *Financial Times* Journals at http://www.bm.ust.hk/research/insights/.

Table 1. References Used in ISR, MISQ, and MS Articles

Field Area	1982-1984	1985-1988	1989-1992	1993-1996	1997-2000	2001-2004	Total
Accounting	13	68	66	67	147	120	481
Agriculture and Food Sciences				1		1	2
Computer Science	67	351	522	675	1001	581	3197
Economics		6	81	200	511	502	1300
Education	30	178	143	323	396	318	1388
Engineering, Computer Science and Physical Sciences	58	351	321	885	1487	1283	4385
Finance		16	42	77	174	107	416
Health and Biological Sciences	9	46	44	171	358	481	1109
Humanities and Social Sciences	15	164	186	669	857	681	2572
Information Sciences	1	4	4	6	9	12	36
Information Systems	222	1255	1335	2295	3532	3651	12290
Law		1	33	16	15	13	78
Management	176	1033	1021	1970	3102	3045	10347
Marketing	4	35	64	183	369	648	1303
Organizational Behavior and Human Resources	14	69	72	137	295	180	767
Other	8	51	33	52	102	95	341
Psychology	37	263	365	755	1271	875	3566
Sociology	6	10	11	43	53	85	208
Total	**660**	**3901**	**4343**	**8525**	**13679**	**12678**	**43786**
Information Systems Research				3164	7228	4729	15121
Management Science	231	480	583	1137	1749	1891	6071
MIS Quarterly	429	3421	3760	4224	4702	6058	22594
Number of Papers							
Information Systems Research				61	87	84	232
Management Science	5	10	11	23	42	45	136
MIS Quarterly	20	120	111	92	90	78	511
Total	25	130	122	176	219	207	879
Average References per Paper	**26.4**	**30.0**	**35.6**	**48.4**	**62.5**	**61.2**	**49.8**
Average IS References per Paper	**8.88**	**9.65**	**10.94**	**13.04**	**16.13**	**17.64**	**13.98**

This analysis shows that the total number of references has increased over time from 26.4 in articles published in 1984 to over 61.2 in articles published most recently. Likewise, the number of IS references has increased from 8.88 in articles published in 1984 to17.64 in articles published between 2001 and 2004. Thus, IS references have increased from a low of 26.9 percent (13 IS references/48 total references) of the overall references in the 1993-1996 time period to 28.8 percent (17.64 IS references/61.2 total references) in the most recent time period from 2001-2004. We do not find any significant statistical chance in the number of IS references as a percent of all references over time—suggesting no change regarding the propensity of IS researchers to cite IS or non-IS work. This finding suggests there is not any overt inward-looking in premier IS literature or outward-looking to reference disciplines. In contrast, we find, on average, a relatively stable mix of IS and reference disciplines, which may be an indication of

maturity of the IS field. Finally, the dramatic increase in overall citations may also be an indicator of maturity, in that the field is building a cumulative research tradition.

Table 2. Citation of ISR, MIS, and MS Articles by Citing Discipline

Field Area	1982-1984	1985-1988	1989-1992	1993-1996	1997-2000	2001-2004
Accounting		2	2	6	16	25
Agriculture and Food		1	1	3	18	23
Computer		23	49	141	209	280
Economics		2	8	10	45	99
Education		6	20	54	60	107
Engineering and Physical		5	45	83	204	307
Finance			5		2	7
Health and Biological			13	16	93	94
Information		10	41	50	83	116
Information	6	358	981	2155	3559	4951
Law			1	1	6	7
Management	5	88	435	605	1008	1361
Marketing		2	13	15	61	217
Org. Behavior and Human		15	44	138	206	237
Other	1	6	4	10	20	56
Psychology		2	17	35	29	40
Sociology		5	21	66	89	97
Total	12	525	1700	3388	5708	8024
Information Systems				45	660	1530
Management	9	145	407	821	1245	1913
MIS Quarterly	3	380	1293	2522	3803	4581
Total	12	525	1700	3388	5708	8024
Total IS	6	358	981	2155	3559	4951
Total Non-IS Citations	6	167	719	1233	2149	3073
Number of						
Information Systems				61	87	84
Management	5	10	11	23	42	45
MIS Quarterly	20	120	111	92	90	78
Total	25	130	122	176	219	207

WHICH DISCIPLINES CITE MISQ, ISR, AND MS ARTICLES?

Another means of assessing the relative maturity of the IS field is to consider the citation of premier IS research articles in journals of outside disciplines. Specifically, we ask which disciplines cite premier IS research articles, and if these outside citations increase over time. To help answer this question, we categorized all premier IS research citations by the journals that cite them. Table 2 shows a total of 19,357 citations of premier IS research articles from the SSCI (1982-2004) were made to 879 articles published in premier IS research journals between 1982 and 2004. The vast majority of these citations (12,220) are from the IS field—rising from an average of 2.23 between 1985 and 1988 to an average of 5.74 between 2001 and 2004. Results of statistical tests tabulated in Table 3 suggest this is a significant increase in the number of total citations (t=7.42; p=0.000) and the number of IS citations (t=7.45; p=0.000) between the 1985-1988 and 2001-2004 time periods.

The results also suggest that research in these journals influences other disciplines: 7,137 citations of ISR, MISQ, MS articles came from outside the IS discipline, and this number continues to increase over time. Table 3 shows the citing discipline and suggests that the average citations coming from outside the IS discipline have significantly increased, growing from 1.61 in the 1985-1988 time period to 3.39 in the 2001-2004 time period (t=6.61; p=0.000). Of particular note is the consistent increase over time in citations from the management, engineering and physical sciences, organizational behavior, and computer science disciplines, as detailed in Table 2.

Table 3. Summary of Trends of Citations of ISR, MISQ, and MS Papers

Type of Citation	Number of Citations by Year Groups							Diff. of mean citations across years		Diff. of mean citations 1985-88 vs. 2001-04
		1982-1984	1985-1988	1989-1992	1993-1996	1997-2000	2001-2004	F-stat	Sig.	*t*-test
All Citations	Average	0.48	3.39	6.14	7.48	8.49	9.13	6.817	0	7.42
	Stdev	1.08	6.34	10.88	13.28	13.73	17.27			
IS Citations	Average	0.24	2.31	3.54	4.76	5.3	5.63	7.1	0	6.93
	Stdev	0.46	4.05	6.12	8.03	8.42	10.44			
Non-IS Citations	Average	0.24	1.08	2.6	2.72	3.2	3.5	5.33	0	7.3
	Stdev	0.83	2.6	5.44	6.05	5.89	7.62			

As the citation of premier IS research articles in other disciplines continues to increase, this increase indicates that the IS field is continuing to mature [Cote et al. 1991]. Table 4 also tabulates the IS and non-IS publications most frequently citing ISR, MISQ, and MS articles. I&M and MISQ head the list of IS journals citing ISR, MISQ, and MS articles with 2,018 and 1,826 cites, respectively.

Group Decision and Negotiation and *Organization Science* lead the list of non-IS journals citing ISR, MISQ, and MS articles, with 263 and 208 cites, respectively. This suggests a strong impact of IS research outside of the IS discipline.

WHAT IS THE CITATIONS IMPACT OF PAPERS THAT ADDRESS OR DO NOT ADDRESS THE IT ARTIFACT?

Benbasat et al. [2003] sounded a warning that the IS field is threatened by an identity crisis because so much IS research is primarily based in other disciplines. They suggest that IS papers that directly address the IT artifact are more useful in advancing IS research and making IS a field with a unique and meaningful identity. In contrast, Agarwal and Lucas [2005] suggest that focusing exclusively on the IT artifact makes IS research too narrow, and thus they advocate macro studies that link IS research directly with its reference disciplines. Robey [2003] concurs, suggesting that "IS needs to strengthen its ties with contributing disciplines," as cited in [Agarwal and Lucas 2005, p. 383]. Benbasat and Zmud [2003] would suggest that since research outside the IT nomological net is more appropriately done by researchers outside the IT discipline [Benbasat and Zmud 2003], it is likely such research would have less impact on subsequent IS research. Agarwal and Lucas [2005] would suggest that a more macro view, with work clearly linked to IS reference disciplines, would have more impact.

To test these claims, we argue that the more useful these articles are in advancing IS research, the more likely they are to be cited by subsequent IS studies. Therefore, we directly empirically tested whether research that directly addresses the IT artifact has significantly more or fewer citations than research that does not address the IT artifact.

Table 4a. Publications Most Frequently Citing ISR, MISQ, and MS Articles Published from 1982–2004

Rank	IS Journals Citing ISR, MISQ, and MS	Citations
1	*Information & Management*	2018
2	*MIS Quarterly*	1826
3	*Information Systems Research*	860
4	*Journal of Management Information Systems*	840
5	*Journal of Computer Information Systems*	653
6	*Decision Support Systems*	524
7	*European Journal of Information Systems*	477
8	*Journal of Information Technology*	435
9	*Journal of Strategic Information Systems*	361
10	*International Journal of Information Management*	318
11	*Information Systems Journal*	316
12	*Communications of the ACM*	283
13	*Behavior & Information Technology*	249
14	*International Journal of Human-Computer Studies*	224
15	*Journal of Organizational Computing & Electronic Commerce*	182
16	*Computers In Human Behavior*	178
17	*International Journal of Electronic Commerce*	169
18	*Data Base*	160
19	*Industrial Management & Data Systems*	143
20	*DATABASE for Advances in Information Systems*	137

Table 4b. Publications Most Frequently Citing ISR, MISQ, and MS Articles Published from 1982–2004 (continued)

Rank	Non-IS Journals Citing ISR, MISQ, And MS	Citations
1	*Decision Sciences*	850
2	*Omega-International Journal of Management Science*	478
3	*Management Science*	462
4	*IEEE Transactions on Engineering Management*	348
5	*Group Decision and Negotiation*	263
6	*Organization Science*	208
7	*European Journal of Operational Research*	193
8	*Journal of Systems and Software*	137
9	*IFIP Transactions A-Computer Science & Technology*	137
10	*Expert Systems with Applications*	122
11	*Small Group Research*	120
12	*Lecture Notes In Computer Science*	81
13	*Journal of the Operational Research Society*	74
14	*International Journal of Operations & Production Management*	73
15	*Organizational Behavior & Human Decision Processes*	71
16	*Journal of Management*	61
17	*Journal of Engineering & Technology Management*	60
18	*Computers & Education*	56
19	*Sloan Management Review*	54
20	*Industrial Marketing Management*	53

To illustrate the citations impact with our premier IS research articles dataset, we first needed a means of separating these articles into those that address the IT artifact and those that do not. As a measure of the IT artifact, we use Barki's [1993] scheme to categorize each MISQ, ISR, and IS MS article into nine overall research categories.[4] This scheme classifies keywords that are used in IS research into broad categories. Typically, keywords from the same article may fall in different classes of the scheme, making article classification challenging. One approach to overcome this challenge is to use only the first keyword in each paper (considered the most important keyword). A second approach groups an article into the category of most of the keywords. We classified the articles using both approaches and, by sample article inspection, found that both methods resulted in similar classification of the articles. For the results presented, we placed each article into the category of the first keyword in the article. We consider six of these categories (information systems, information technology, IS development and operations, IS Education and Research, IS management, IS usage) to be part of the IT artifact and/or its immediate nomological net, based on [Benbasat and Zmud 2003].

We considered the remaining three categories (external environment, organizational environment, reference disciplines) to not be part of the IT artifact nor its immediate nomological net. Table 5 represents the division of these articles and the total citations accruing to each of these two groups over time. Table 5 shows the average IS and non-IS citations for IT Artifact and

[4] We used the eight top-levels groups of the keyword classification scheme that was prepared by Barki et al. [1993], as follows: reference discipline, external environment, information technology, organization environment, IS management, IS development and operations, IS usage, information systems, and IS education, and research.

non-IT Artifact groups over time. Table 5 also shows the results of statistical tests comparing the citations of premier IS research articles that address the IT Artifact versus those that do not.

Table 5. Total Citations by IT Artifact over Time (ISR, MISQ, and MS)[5]

Barki Scheme IS Research Categories	IT Artifact	1982-1984	1985-1988	1989-1992	1993-1996	1997-2000	2001-2004	Total
IT Artifact Papers								
Information Systems	Yes		77	404	969	1434	1821	4705
Information Technology	Yes		1	53	113	339	750	1256
IS Development and Operations	Yes	10	265	377	574	768	872	2866
IS Education and Research	Yes		23	91	219	338	357	1028
IS Management	Yes		66	284	446	657	834	2287
IS Usage	Yes		21	144	336	475	582	1558
Total Citations		10	453	1353	2657	4011	5216	13700
IS Citations		5	305	783	1720	2525	3273	8611
Non-IS Citations		5	148	570	937	1486	1943	5089
Cumulative # of Papers		21	109	199	292	409	533	533
Average Citations Per Paper		0.48	4.16	6.80	9.10	9.81	9.79	25.70
Reference and Environment Papers Non-IT Artifact Papers								
External Environment	No		0	0	18	149	271	438
Organizational Environment	No	2	46	215	384	669	839	2155
Reference Disciplines	No	0	26	132	329	879	1698	3064
Total Citations		2	72	347	731	1697	2808	5657
IS Citations		1	53	198	435	1034	1678	3399
Non-IS Citations		1	19	149	296	663	1130	2258
Cumulative # of Papers		4	46	78	161	263	346	346
Average Citations Per Paper		0.50	1.57	4.45	4.54	6.45	8.12	16.35
Overall Test								
t-test Average total citations: IT Artifact = Reference Papers		-0.04	3.25	2.029	4.11	3.49	1.4	4.6
t-test Average IS citations: IT Artifact = Reference Papers		-0.05	3.09	2.114	4.25	3.83	1.79	5.36
t-test Average Non-IS citations: IT Artifact = Reference Papers		-0.04	3	1.314	2.65	2.64	0.71	3.04

We find that the average citations per "IT artifact" paper (Table 5, 25.75 citations) is higher than the average citations per non-"IT artifact" papers (Table 5, 16.3 citations) (t=3.79) over the whole time period. This suggests that ISR, MISQ, and MS papers that address the IT artifact are more likely to have impact than those papers that do not. In addition, IS citations (t=4.2) and non-IS

[5] Note: Articles are classified by their first keyword using the Barki Classification Scheme. The following categories are grouped together as IS artifact articles: Information Systems, Information Technology, IS. Development and Operations, IS Education and Research, IS Management, and IS Usage.

citations (t=2.88) are statistically higher for IT artifact papers than for non-IT artifact papers over the entire sample period. This seems to be consistent with Benbasat and Zmud's [2003] arguments that the most influential articles would be those that directly address the IT artifact. To reiterate, the citation impact seems to be greater both inside and outside the IS discipline as evidenced by the higher IS and non-IS citations for articles that directly address the IT artifact versus those that do not.

Table 6. Citations for ISR, MISQ, and MS (IS) Articles with Low and High IS Content

IS References Use in Paper	1982-1984	1985-1988	1989-1992	1993-1996	1997-2000	2001–2004	Total
High Number of IS Refs. (>= 18 IS References)							
Average Citations Per Paper	3.00	4.92	8.55	11.18	11.54	13.60	25.67
IS Citations	1.00	3.25	4.89	7.38	7.31	9.04	16.96
Non-IS Citations	2.00	1.67	3.65	3.79	4.23	4.56	8.7
t-test Average Citations :							
IS Citations = Non-IS Citations	-0.5	0.93	0.95	2.63	2.91	3.62	5.38
Number of Papers	2	24	47	97	173	238	2
Low Number of IS Refs. (<=4 IS References)							
Average Citations Per Paper	0.14	2.38	4.53	5.14	5.13	5.02	4.76
IS Citations	0	1.54	2.54	3.03	3.14	2.44	2.66
Non-IS Citations	0.14	0.83	1.99	2.11	1.99	2.58	2.1
t-test Average Citations :							
IS Citations = Non-IS Citations	-1.0	1.31	0.72	1.40	2.20	-0.25	2.00
Number of Papers	7	48	85	128	168	212	212
Overall Tests							
t-test Average Citations :							
High IS Refs = Low IS Refs	4.69	1.46	1.08	3.11	3.58	4.53	7.39
t-test Average IS Citations:							
High IS Refs = Low IS Refs	10.2	1.28	1.09	3.73	3.72	5.6	8.48
t-test Average Non-IS Citations:							
High IS Refs = Low IS Refs	3.97	1.56	1.08	1.89	3.02	2.62	5.09

Note: This table summarizes total citations as well as citations from IS and non-IS sources based on if they have IS references that are higher (lower) than the median for all MISQ articles.

A second possible proxy for the IT artifact is the extent to which IS articles are referenced in an ISR, MISQ, or MS article. The premise of this measure is that the greater the number of references of IS articles to total number of references, the more likely the article contains the IT

artifact. Consistent with arguments by [Benbasat and Zmud 2003], we expect the impact of papers that contain the IT artifact would be greater than those that do not address the IT artifact. To test if there is a relationship between the extent that IS papers are referenced in a premier IS article and subsequent citations of that article, we determined the IS reference content in each paper. For our dataset, the median number of IS references cited in the articles is 11. The lower quartile of articles has four or fewer IS references, while the top quartile is made up of articles with 18 or more IS references. We then performed a t-test comparing the subsequent citations for those articles with the top quartile number of IS journal articles references versus those with the lower quartile number of IS journal article references (See Table 6). We find that there is an average of 28.9 citations per article for the 210 articles with IS content in the upper quartile. That number is significantly greater than the average per article citation of 14.54 of 212 articles with IS content in the lower quartile (t=3.21). We likewise find that those with high IS content are cited by other IS articles significantly more than those without (36.3 vs. 14.8 IS citations (t=4.00)). Similar to the results obtained by using the Barki scheme to classify articles having the IT artifact, we find a significant difference in the number of non-IS citations between these two groups (9.96 vs. 6.33 non-IS citations (t=1.87)).

Using these two different methods to represent the IT artifact construct, we find evidence that IT artifact research published in premier IS research journals has significantly more total citations and IS citations than the non-IT artifact research published in premier IS research journals. Again, this lends credence to the arguments put forward by Benbasat and Zmud [2003] that IT artifact research is critical in advancing IS research and making IS its own distinct discipline.

However, some would argue that the number of non-IS citations accruing to papers addressing the IT artifact or non-IT artifact may, in fact, be the most salient test of the IT artifact and its impact on research. In this direct test, we show that in fact there are significantly more non-IS citations for papers that address the IT artifact. Specifically, papers that address the IT artifact under the Barki scheme have more non-IS citations than papers in the environment and reference disciplines (Table 5: 9.4 vs. 6.2 non-IS citations per paper (t=2.88). We arrive at similar results by using the number of IS references used in a paper as a proxy for the IT Artifact (Table 6: 9.96 vs. 6.33 non-IS citations per paper (t=1.87). We believe this evidence provides support for the Benbasat and Zmud [2003] IT artifact arguments over the Agarwal and Lucas [2005] macro view of IS research.

IV. DISCUSSION

SUMMARY OF FINDINGS

Our first question assessed the impact of premier IS research as compared to other business disciplines. Despite claims by Agarwal and Lucas [2005] that suggest “the impact of IS research has arguably been relatively small,” we find that top IS research has very high impact, as compared to other top business research—especially in more recent years as measured by impact factors. This claim is strongly backed up by the finding that 94 percent of premier IS research (MISQ, ISR, and IS articles from MS published between 1984 and 2000) are cited more than once within five years of publication, which is well above the 19 percent hurdle. We therefore make the case that top IS research has high impact and compares well to other top business and scientific research.

Our second question involved the assessment of the relative maturity of the IS field by determining the disciplines that are referenced in premier IS research articles. Specifically, we wanted to know what disciplines are sourced in premier IS research articles and if the focus shifted more toward IS research over time. Although premier IS journals have many more references nowadays than in the past, we do not find any significant statistical change in the percent of IS references as a percent of the overall references over time—suggesting no change regarding the propensity of IS researchers to cite IS or non-IS work. This finding also implies there are no trends toward any overt inward-looking in IS literature or outward-looking to

reference disciplines but rather a relatively stable mix of IS and reference disciplines. However, there are substantially more gross IS references over the same period of time—suggesting that maturity may be occurring by an increased cumulative tradition in IS research.

Our third research question conversely addressed the degree to which outside fields cited IS research, as reflected in MISQ, ISR, and MS references. We found very strong statistical evidence that points to the increase of outside fields citing IS research—more than doubling over time. Of particular note is the consistent increase over time in citations from the management, engineering and physical sciences, organizational behavior, and computer science disciplines. As the citation of articles published in MISQ, ISR, and MS in other disciplines continues to increase, the IS field is shown to be continuing to mature [Cote et al. 1991] and to have an impact on outside referent disciplines.

Our fourth research question addressed whether IS articles that focus on the IT artifact have greater impact than articles that do not focus on the IT artifact. We found that articles addressing the IT artifact had significantly more impact than articles not addressing the IT artifact, based on two levels of analysis: (1) categorizing IT artifact and non-artifact articles based on Barki coding; and (2) categorizing IT artifact and non-artifact articles based on the number of an article's IS citations. This is consistent with Benbasat and Zmud's [2003] argument that those articles that directly address the IT artifact are more influential on subsequent IS research than those articles that do not address the IT artifact.

CONTRIBUTION

One of the major contributions of this research is to provide empirical support for the argument that IS researchers should be focusing on research that focuses on the IT artifact. We found strong evidence that such research has greater impact, as measured by citations, over time. Further, we provide empirical evidence that articles of greatest impact focus on theoretical advances, whether they involve pure theory building, or theory building with empirical or qualitative support. None of the most influential articles focus on exploratory data analysis, commentary, speculation, or frameworks.

We have also shown evidence for the growing maturity and impact of IS field research. Most importantly, the IS field is increasingly being cited, and thus is being considered relevant, to the fields of management, engineering and physical sciences, organizational behavior, and computer science. This trend also highlights the importance of producing IS research that is theory based because effective theory generalizes to multiple contexts. In developing effective theory, we call on the IS field to continue to focus on building theory that tells a meaningful story and is approachable, succinct, and parsimonious. Such characteristics of good theory will aid the continued influence of the IS field on the advancement of IS research and its subsequent impact on other fields.

LIMITATIONS AND FUTURE RESEARCH

It is important to reemphasize that this research used MISQ, ISR, and MS as surrogates for premier IS research. We recognize that MISQ, ISR, and MS do not represent all IS topics and represent only a small sample of all IS research. An article can be excellent yet have little citation impact because it is an area where relatively few people are working [Lowry et al. 2004]. As time passes, it will make sense to continue to assess other premier IS research outlets to ensure that the results of this study are generalizable to the IT field.

Citation analyses have several other limitations [Lowry et al. 2004], including variations in self-citation policies of journals. To help control for self-citation, we eliminated all self-citations from the MISQ, ISR, and MS articles, yet found nearly identical results throughout. Also, some journals are published more frequently than others. There are also differences in the number of pages, the average number of articles, and editorial policies on how many citations are allowable.

A more potentially insidious limitation—that we did not observe in our top-25 article list but still has potential impact on citation analyses—is that articles may be negatively cited as poor examples of research or flawed paradigms. A classic example of such an atheoretical article is Ackoff's classic article [1967] on "Management misinformation systems," which was written intentionally to stir debate. A recent example, and maybe one of the greatest offenders, was the highly questionable and atheoretical article by Nicholas G. Carr claiming "IT doesn't matter" [2003]. However, some critics would say that such negative articles, even if created on a flawed and atheoretical foundation, are important contributions to the literature because they stir up debate and research conversation [Cote et al. 1991]. Thankfully, negative citations (where an article is used as a poor example of a finding) account for less than 10 percent of all citations [Moravcsik and Muragesan 1975].

V. CONCLUSION

Any discipline working for scientific maturity is justified in its concern about the utility and relevance of its research product both inside and outside the discipline [Cote et al. 1991]. The results of this paper suggest that premier IS research is maturing and becoming increasingly relevant to both IS and non-IS research and that there is a healthy sharing of knowledge between premier IS research and its related outside disciplines.

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