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Assessing Scholarly Influence: Proposing New Metrics

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ASSESSING SCHOLARLY INFLUENCE: PROPOSING NEW METRICS

Evaluer l'influence académique : proposition de nouvelles métriques

Completed Research Paper

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Abstract

This study examines the use of the Hirsch family of indices to assess the scholarly influence of IS researchers. It finds that while the top tier journals are important indications of a scholar's impact, they are neither the only nor indeed the most important sources of scholarly influence. In effect other ranking studies, by narrowly bounding the venues included in those studies, effectively privilege certain venues by declaring them as more highly influential than they are when one includes broader measures of scholarly impact. Such studies distort the discourse. For instance, contrary to the common view that to be influential one must publish in a very limited set of US journals, our results of the impact of scholars published in top tier European IS journals are of similar influence to authors publishing in the MIS Quarterly, ISR and Management Science even though they do not publish in those venues.

Keywords: Researcher Ranking, Citation Analysis, Hirsch Index, h-index, Contemporary Hirsch Index, hc index, g-index

Résumé

Cette étude examine l'utilisation des indices de la famille de Hirsh pour l'évaluation de l'influence académique des chercheurs en systèmes d'information (SI) en fonction de leurs publications. Nos résultats montrent que, bien que publier dans des journaux de première catégorie est une indication pertinente de l'influence académique, cela n'est ni la seule, ni la plus importante des sources d'influence académique. Ils montrent également que le champ des SI devrait adopter les indices de la famille de Hirsch. En effet, en restreignant fortement le nombre de revues inclues dans leurs analyses, de nombreuses études de classements privilégient certaines revues et postulent que ces dernières sont plus influentes qu'elles ne le sont en réalité, lorsque l'on inclut de plus larges mesures d'influence académique. Ainsi, de telles études biaisent le débat. Par exemple, notre étude remet en question la croyance répandue qu'il est absolument nécessaire de publier dans les meilleures revues américaines pour développer une influence académique. Elle montre notamment que l'impact des chercheurs qui publient dans les meilleures revues européennes en SI *représente une influence académique comparable à celle de chercheurs publiant dans MIS Quarterly, ISR et Management Science, quand bien même ils ne publient pas dans ces revues.*

Short Abstract in Native Language

This paper argues that existing methods of assessing the scholarly influence are biased; and, that the IS field should adopt the Hirsch family of indices as better measures of scholarly influence. It demonstrates these measures using a set of scholars publishing in the European Journal of IS (EJIS) and the Information Systems Journal (ISJ) and who were identified in Lowry et al (2007).

Résumé

Cette étude montre que les méthodes permettant d'évaluer l'influence académique des chercheurs en systèmes d'information (SI) sont biaisées ; de fait, les chercheurs en SI devraient probablement adopter les indices de la famille de Hirsch qui constituent de meilleures mesures de l'influence académique. L'étude démontre la pertinence de ces mesures en utilisant un ensemble d'articles parus dans l'European Journal of Information Systems (EJIS) et Information Systems Journal (ISJ) précédemment identifiées par Lowry et al. (2007).

Introduction

The object of this paper is to propose a new method for the assessment of scholarly influence. We argue that existing methods are subjective and methodologically suspect. We therefore suggest that the IS field take advantage of the 80 years of work done by Information Sciences discipline in assessing scholarly influence. In that line, we argue that the IS field should assess scholarly influence using the Information Science based Hirsch family of indices rooted in the Google Scholar™ search engine. We believe that by adopting this methodology, the IS field can overcome many of the issues related to bias (Walstrom et al. 1995), and politics (Gallivan et al. 2007).

Ranking methodology has come under scrutiny by different studies and editorial pieces in both US and European journals. (Alexander et al. 2007; Baskerville 2008; Clark et al. 2007b; Molinari et al. 2008; Peffers et al. 2003; Rainer et al. 2005) There have been arguments that journal rankings use an unfair method dependent on where you conduct your research or that the process of ranking itself forces researchers to focus on 'safe' or even 'trivial' topics. (Powell et al. 2008) European researchers have argued that journal rankings tend to exaggerate the importance of North American journals and institutions (Baskerville 2008; Harzing 2008b; Kateratanakul et al. 2003; Mingers et al. 2007; Powell et al. 2008; Willcocks et al. 2008). This point has also been made in the fields of accounting (Lee et al. 1999) and in Management (Collin et al. 1996). Other authors challenge the efficacy of any reasonable single measure for adjudging the worth of a scholar and espousing a need to bring the whole process "under control". Other studies advocate for the removal from consideration practitioner and non-research publications that 'conflate' consideration of a scholar's research contributions (Gallivan et al. 2007).

The research described in this paper arises from a stream of inquiry that takes all these issues and challenges to be serious and essential questions for our discipline. We take this task on for several reasons. Firstly, just as financial analysts require vocabularies and tools by which they can compare the performance and worth of firms in the same industry, and indices to compare firms in different and at times disparate industries (e.g., IBM and General Motors Corp.) university administrators require vocabularies and metrics to compare scholars across disparate disciplines. Secondly, as a field we need measures that enable us to assess our own scholarly influence relative to other fields. Thirdly, within our field, the competitive hiring and tenure and promotion processes suggest that there needs to be something besides purely subjective or political processes to make career-altering decisions. Finally, and maybe more influentially for us, we feel strongly that it is the breadth, depth, and persistence of a scholar's work that should be considered as part of a person's intellectual legacy and not just a single number representing a ranking or a 'hit rate'. To that end we are looking to understand and apply a set of measures to help consider a scholar's legacy. This paper is but one stage in that larger program of inquiry. We think that such a collection of measures would likely include various analyses of a scholar's publications, including where when and with whom the scholar has published and other measures of the network of influence the scholar has had. The later element would require various types of citations and co-citation analyses. But for this present work we are developing a single component of the larger proposed technique set. That is, we examine how the Hirsch family of citation statistics may provide a 'fairer' measure of scholarly influence than presented by current approaches.

A caveat: we are not addressing the issue of scholarly quality directly. We certainly recognize that any field may maintain certain measures for assessing quality, but we see that issue as important work-in-process which we do not tackle at this time. We are of the opinion that the two notions of influence and quality are, however, often confounded in the literature. The argument goes as follows: journal x is ranked as among the best. Author y publishes in this journal and author z does not. Author y is therefore better. This scenario is flawed for two reasons. First, there is little objective evidence that publications in top-tier journals are necessarily consistently of higher quality than articles published in other venues (Singh et al. 2007). In fact there is suggestion in this present study that influence, often used as a surrogate measure for quality, may be venue agnostic. And, secondly, the question of the rankings of 'best' and top-tier journals is a political process and one with inherent biases. Walstrom, Hardgrave, and Wilson (1995) tested some of these biases. Using consumer behavior theory, they developed a theory of bias in journal ranking in survey analysis by academics. They surveyed IS researchers to test six hypotheses about biases that affect ranking decisions derived from their theory and found bias arising from underlying discipline, familiarity, and research interest. Other examples of systematic bias are leveled at survey approaches to journal rankings. For instance, given a list of journals, respondents are inclined to select from the list provided even if that list is incomplete, called an 'anchoring effect" (Chua et al. 2002). Another example of bias in ranking studies was that respondents might take a variety of different considerations into account instead of simply assessing journal influence. They may consider differential weights given to rigor vs. relevance, methodological approaches, as well as personal preferences and whether they have been published in the journal etc. (Podsakoff et al. 2005). Thus research supports the notion that current methods of journal ranking are systematically biased.

Indeed, the entire concept of "quality" is problematic. It is not possible to provide a definition of quality that will be universally adopted. Quality is, in fact, a social construction. As Introna (2004) suggests publication in a journal, even a top tier journal, is not a designation of quality, but rather as a sign of successful conformance to a "regime of truth" or a paradigm of methodology (Kuhn 1996). We therefore argue that citation based statistics measure only how well a publication source (e.g. an author, a journal or an institution) is successful in negotiating the publication process in various venues. Historically, some venues have been harder to negotiate. This difficulty has been taken as a measure of the quality of the article. However, in this paper we eschew discussion of quality and rather refer to the idea of influence, which we view as the uptake of the ideas in the article as measure by its citations.[1]

In this present work we also explore another bias, namely, the question of regional, linguistic and cultural difference in publication and scholarly influence. That is we explicitly examine the question of whether publication in adjudged top tier US versus top-tier European journals signals a difference in scholarly influence.

The paper proceeds as follows: In the next section we briefly examine the literature exploring measures of scholarly influence of individual scholars. We then point out weaknesses in these measures and propose the Hirsch family of statistics as an improvement on the metrics used to assess influence. We discuss the findings, examine the limitations of the study and show how it provides pointers to our continued project seeking a set of better means to influence scholarly value.

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[1] We were motivated to undertake this research program by the way the larger discourse on academic 'importance' and 'quality' has begun to turn in our field, particularly in the United States. Relative hierarchies and importance rankings of academic researchers, departments and journals are being reinforced and reified with positions given and accepted unproblematically. One position in particular rankles: that there is (in our reading and hearing) an unwillingness to accept into the discourse that other sources of knowledge generation, dissemination and quality assessment exist other than those of the established paradigm. To the extent that the discourse is being closed versus opened on these points we believe we must respond by testing and challenging prevailing assumptions.

Members of this authorial team are critical social theoretic researchers, and they shape part of the research agenda. Our position is that quality is not an objective measure; 'quality' is a community sanctioned measure and statements about quality are, in part at least, political statements. Other papers in this research stream explicitly will address the question of quality and the ways power elites in the journal ranking discourse are reified by repetition.

Literature Review

As Gallivan and Benbunan-Fich (2007) point out our field has a rich tradition of research about research with more than 40 published works addressing the issue of journal rankings and scholarly output. Interest in this topic is not limited to our own field. The question of measuring research output by publication counts is prevalent in many of the social sciences (Bar-Ilan 2008; Collin et al. 1996; Lee et al. 1999). This recognition of the importance of such metrics is also accompanied by disaffection with extant methods each of which is seen to privilege one class of researcher or one class of journals. Thus our own work joins a chorus of work seeking a 'holy grail' of scholarly achievement assessment. Those papers typically fall into one of two broad categories. The first stream considers the relative importance of specific publication venues. These are the so-called journal ranking studies. Examples of these articles are well reviewed in Gallivan and Benbunan-Fich (2007) and include (among others): (Alexander et al. 2007; Baskerville 2008; Clark et al. 2007b; Ferratt et al. 2007; Geary et al. 2004; Hardgrave et al. 1997; Harzing 2008b; Kodrzycki et al. 2005; Korobkin 1999; Kozar et al. 2006; Lowry et al. 2004; Martin 2007; Mingers et al. 2007; Mylonopoulos et al. 2001; Nelson 2006; Nerur et al. 2005; Peffers et al. 2003; Podsakoff et al. 2005; Rainer et al. 2005; Walstrom et al. 2001; Walstrom et al. 1995; Whitman et al. 1999; Willcocks et al. 2008). The second, and more sparsely populated stream, examines the productivity of individual, and on occasion, collections of researchers. Examples from this stream include: (Athey et al. 2000; Chua et al. 2002; Clark et al. 2007a; Gallivan et al. 2007; Huang et al. 2005; Lowry et al. 2007b; Lyytinen et al. 2007). The two streams are interrelated because on the one approach used to assess scholarly worth has been citation counts in top-tier journals. A third stream of work papers focuses primarily on the metrics and methods used in the first two streams, or propose improvements or replacements to those extant methods. Examples include: (Abt 2000; Banks 2006; Bar-Ilan 2008; Batista et al. 2006; Bornmann et al. 2005; Bornmann et al. 2006; Bourke et al. 1996; Braun et al. 2006; Egghe 2005; Egghe 2006; Egghe 2007b; Egghe et al. 2006; Glanzel 2006; Liang 2006; Molinari et al. 2008; Raan 2006; Saad 2006; Schubert 2007; van Raan 2006; Zanotto 2006).

To illustrate the first stream we point to three successive Walstrom and Hardgrave articles (Hardgrave et al. 1997; Walstrom et al. 2001; Walstrom et al. 1995). They created a survey instrument asking respondents to rate a list of journals and to add journals missing entries from an auxiliary list or from experience. Their instruments, administered to a sampling of IS academics selected from sources such as the ISWorld Directory of MIS Faculty, were then averaged to create the mean scores for each journal. These scores were then arranged in a ranking table.

A second example in the scholar and institution assessment stream typifying the using citation analysis approach is provided by Lowry, Karuga and Richardson (2007b). They counted citations for articles published in *MIS Quarterly, Information Systems Research* and the IS articles published in *Management Science* as retrieved from Thomson's *Web of Science*. They counted authors and institutions using unweighted, weighted, and geometric methods of assessing the authors' contributions (Chua et al. 2002). They then reported the most frequently cited authors, institutions, institutions by journal, articles, with each reported segment broken out by three 5-year eras: 1990-1994, 1995-1999, and 2000-2004.

As seen in the examples provided above, current methods used to derive various rank orders of scholarly influence typically fall into one of two categories. The first deals with the use of survey analysis methods and the second with scientometric methods. Survey analysis takes perspective data from researchers in the field. Scientometric methods use data analysis of scholarly output taking data from databases. Typically scientometric analysis involves citation analysis using some library database.

The survey methodology has been under scrutiny for its subjective nature and a perceived North American bias. (Gallivan et al. 2007; Lyytinen et al. 2007; Willcocks et al. 2008). Recent studies have begin to explore the notion of the North American centricity of IS research outlets. Lyytinen et al. (2007) noted the relative paucity of participation by non-North American authors in leading journals where European IS scholars representing 25% of all IS scholars only represent 8-9% of those published in the field's 'top-tier' journals (Lyytinen et al. 2007). Gallivan and Benbunan-Fich (2007) noted that in Huang and Hsu's (2005) highly cited article of the "top 30 IS scholars" there were no Europeans and only two women on the list set out to examine why. Thus IS scholars have begun to examine the ways in which we assemble ranking IS journal impact and scholar influence to see if there exists systematic bias in the method.

Survey methods are generally thought to have four other flaws. The first has been termed the problem of the "Path Dependency" (Galliers et al. 2007). The idea is that studies about journal rankings necessarily draw on previous studies on rankings, which, in turn draw on earlier studies on ranking. With each survey certain journals reappear and are imprinted or reified in the study methodology. Thus we have a kind of reification by repetition in the way studies are conducted making it relatively more difficult for newer or 'niche' journals to break into the rankings. Another way to look at this is that the conduct of ranking studies whereby the researcher must replicate and extend previous work provides consistency from study to study but also breeds a kind of conformity. Secondly, and related to the first problem, is that a number of factors lend to make certain publication more recognizable and familiar to respondents. The number of years in print, the relative use in PhD programs, and the reification by repetition suggest that sometimes for respondents, familiarity is confused with quality. Thirdly, several studies have demonstrated that the older and 'generalist' journals have an edge in the recognition game. But newer and 'specialist journals' are ignored because they are little known or are thought to have inconsequential scholarly markets. And finely, this leads to the fourth problem of self-reinforcing political influence. An often unstated, but generally recognized point is that any study ranking of journals of scholars is a political process. In the IS literature, Gallivan and Benbunan-Fich address this issue directly. Referring to both Harvey Sachs and Lucy Suchman's notions of the politics of categories and labeling, they say: "How we classify persons, objects and events–including what is and is not counted– rests on a series of political decisions that both reflect and, in turn, influence the allocation of power" (Gallivan et al. 2007,p.37).

Scientometric analysis has its flaws as well. It tends to be time consuming as there have been no central repository of bibliographic information until recently and because of the tediousness and difficulty required to acquire and tease out a clean dataset for analysis. The first problem somewhat ameliorated with the advent of the many search engines, indexing protocols and online databases, however, the problem can still be daunting and problematic because many potential representations of an author's name and changing author listing conventions in publication venues. Moreover with the many citation databases indexing different journals and inconsistently indexing conferences, books and foreign language venues and new venues being added frequently the efficacy of citation set serving as the data for analysis that is derived from the databases is called into question. Other criticisms of citation analysis approaches include the facts that citation methods can vary by discipline and country resulting in variation in the number of citations. Editors asking for citations of articles from their journals during the review process can rig citations. Decisions by the researcher as to what to include and exclude in the research can skew findings. Journals and articles that are older will of course have more citations resulting in a skewing toward them (Lowry et al. 2007a).

The Journal Impact Factor has become a very important scientometric indicator for describing journal influence evaluation. It represents the average number of times articles from the journal published in the past two years have been cited in *Journal Citation Reports* (JCR) year and calculated by dividing the number of citations in the JCR year by the total number of articles published in the two previous years (Thomson 2008)l. It therefore focuses on only results over the latest two years and takes citations for only one year. Thus it only considers one year and thus does not consider the "lifetime" achievement of a journal or how influential it might have been over its lifetime.

Other methods have been suggested for ranking journals. One approach that has been suggested is to rank journals based on journal lists of universities. Alexander, Scherer, Lecoutre (2007) investigated the difference in international journal rankings to test for equivalency. They found a low degree of agreement among the six journal ranking systems examined. Rainer and Miller (2005) present a method to average journal rankings across lists. This addresses the variability across journal ranking studies found by Alexander et al. Templeton, Lewis and Luo (2007) propose to rank by institutional journal lists. Based on the idea that this is how the department values research outlets. Another approach as been to rank journals based on the affiliation of the authors of the articles in the journal. Ferratt, Gorman, Kanet and Salisbury (2007) proposed the Author Affiliation Index as a measure of journal quality which is calculated as percentage of authors in a journal associated with high quality academic institutions. The issue here is how to rank the institutions by quality. This leads to a circular logic in many cases (MacDonald et al. 2007).

Other ways of using citation data have been suggested. Recently, the PageRank algorithm used by Google to index their pages has received some attention. Lim, Ma, Wen, Xu, Cheang (2008) describe a novel method using this algorithm for ranking "pure" MIS journals based on citations received from "pure" MIS journals and weighted by citation importance. They hold that citation quantity alone is insufficient because citation quantity does not represent citation quality. A citation from a prestigious MIS journal should count more than from a non-prestigious journal or a non-MIS journal. This assertion is atheoretically established. That is, that there is no discussion of the entities and causal mechanisms that make these assertions meaningful.

Theory Light and Theory Driven Approaches

An unaddressed issue in all of these studies is that they all lack a theoretical basis. As Straub (2006) has observed, these studies "rarely go beyond the simplest research question to explore why journals are highly or lightly regarded. … [T]hey seldom investigate the serious issues that relate to methodological choices for determining the rankings." There has been no attempt to generate a theoretical understanding of the development of literature streams that would account for the use of citations and give a theoretical basis of choice of methods or metrics in studying metrics.

To answer this lack of theoretical background, we recognize that the information science discipline has been working for over 80 years to develop a method to assess scholarly influence. Building on a stream of empirical studies beginning with Lotka (1926), the information sciences discipline has developed a series of metrics and methods for performing a variety of studies of scholarly influence. For example, in this field methods have been developed to perform analyses of the structure of fields (White et al. 1981; Zhao 2006), and influence of authors on others (White 2003). Relatively few of these techniques have been used within the IS field. The studies cited above in the IS literature have failed to take advantage of this previous work. We argue that future work in influence studies should be based on the information science knowledge base. We argue that using the theory base built up in the information sciences field can resolve the problem of atheoretical generation of the metrics and methodologies in the IS studies and answer Straub's concern with this area of the metrics.

A recent development in the information science discipline has been the proposal of the Hirsch family of indices. The first index proposed is the *h*-index. Hirsch suggested that the influence of a scholar be calculated as h, if h of his/her N_p papers have at least h citations each, and the other (N_p -h) papers have no more than h citations each (Hirsch 2005).

The h-index for a particular researcher is calculated as follows. For this example, we use Dr. C (alias). We first list all the publications that Dr. C. has and rank them in the order of citations that each of the publications has, going from largest to smallest. The publications with the same number of citations (ties) can be listed in any order within the ties. For Dr. C. we have the articles with the citations in parenthesis:

Table 1: Ranked articles for Dr. C

Rank	Article	Citations
1	CACM article	233
2	Accounting article	104
3	IFIP article	86
4	EJIS article	40
5	ISJ article	23
6	SIGMIS article	19
7	SJIS article	17
8	SAIS article	15
9	JAIS article	15
10	Semiosis article	14
11	AMCIS article	13
12	CAIS article	9

Dr. C. has 10 more articles but they do not have any more than 9 citations each. When the number of articles on the list (currently 12) and the citation counts cross (currently 9) we have enough to get the *h*-index. We are essentially listing in order of number of citations and looking for the article where the number of the article in the list become higher than the citation number for that article. Until the 11th article, all citations were higher than the rank. But on the 12th article we find for the first time the ranking (12) becoming higher than the citation (9). For Dr. C. his *h*-index is 11. The 11th article in the list has 13 citations and the 12th article has 9 citations. The *h*-index tells us that the author has at least *h*-index (in this example 11) number of articles with at least *h*-index (11) citations each.

Via citation counts the *h*-index assigns a number to a journal/researcher that suggests the impact the journal/researcher has had up until the date of the computed h-statistic. The higher the *h*-index, the more highly cited papers the journal/researcher has garnered. The *h*-index is therefore a surrogate number registering influence, and has been rapidly adopted and used in natural science fields (Glanzel 2006).

The *h*-index improves on simple citation counting or simple productivity by combining the notions of productivity and impact to produce a measure of influence. Productivity is measured by the amount of articles the author produces. Impact is measured by the number of citations that those articles receive. One must achieve a high number in both number of papers published and citations to those papers to get a high *h*-index. To illustrate the two extremes where two researchers might have the same low *h*-index of one we look at two examples. Consider the situation where a researcher A produces one seminal paper that is cited many (for example 1000) times. Researcher A has an *h*-index of one because they have one paper with 1000 citations but no second paper. Consider also research B who produces many papers (for example 100) but only one of those papers has been cited (only once). Researcher B also has an *h*-index of one since there is only one paper that is cited one time; the remaining 99 papers have no citations. Both researchers, A and B, have the same *h*-index. The h-index allows for productivity and impact to be balanced against each other to produce a measure of influence. To achieve high influence a source must produced a sustained number of papers with impact on the field.

Studies have used the *h*-index to examine how to qualify papers as being 'genius, basic, or ordinary' based on the *h*-index and the time elapsed since the publication of the paper (Egghe 2007b). Other studies have extended the use of the *h*-index into the domains of chemistry (Raan 2006) and business (Saad 2006). Ashkanasy (2007) recently compared the Thomson/ISI impact factors (IF) with the Harzing h-statistic in the ranking of eight management oriented journals. While the rankings were different, he concluded that in terms of ranking these eight journals, the selection of the IF or h-statistic of little significance. Since the IF focuses on very recent performance of the journal, this would indicate that the journals are not varying from their historical levels of influence. This study also shows evidence of the external validity of the h-index since it correlates with other measures.

After the publication of the *h*-index, several potential drawbacks have been noted. For example, a scholar that has only recently entered the field or an article that has relatively recently been published will not have as many publications as an older scholar or article that has had more time to accumulate citations. The obvious inability of new journals or researchers to have long standing articles leads to a skewing of the index toward older authors and articles.

One attempted correction for the h-statistic age bias is the introduction of the contemporary *h*-index also called the *hc*-index (Sidiropoulos et al. 2006). By using the *hc*-index, we can compensate for the effects of time and create comparability between journals with papers of different ages. The *hc*-index does not rank the papers with simple citation counts. Rather it takes each paper and assigns a citation score $S^c(i)$ calculated as follows:

$$S^C(i) = \frac{\gamma * C(i)}{(Age(i)+1)^{\delta}}$$

where $C(i)$ is the number of citations that paper i receives. $C(i)$ is the *h*-index ranking mechanism. $Age(i)$ is the age of paper i in years. A paper published in the current year has an $Age(i) = 0$. The symbols γ is a constant chosen to increase the effect of more recent papers, and δ is a constant chosen to lessen the effect of older papers. In the original paper Sidiropoulos et al. (2006) used $\gamma = 4$, and $\delta = 1$. The *hc*-index takes the $S^c(i)$ score for each paper by a researcher/journal and then ranks the papers according to the $S^c(i)$ score. The *hc*-index is then found similar to the *h*-index, where the *hc*-index is the rank, where the rank overtakes the corresponding $S^c(i)$ score. Thus we find that in contrast to the *h*-index, the *hc*-index will decline over time if the articles published by a scholar cease to be cited or cited at a lesser rate than previously cited.

Another issue is that of the gross number of citations received by a scholar. This considers the question of the so-called "one hit wonder." If an author publishes a paper that is cited thousands of time but other articles are not highly cited. The *h*-index for such a scholar would be low potentially as low as one. Is this a correct measure of that scholar's influence? Some scholars have answered this question in the negative and have proposed the *g*-index which is designed to improve the *h*-index by giving more weight to highly cited articles. It is defined as the largest number such that the top g articles received (together) at least g^2 citations (Egghe 2006). The *g*-index is calculated using the formula:

$$g = \left(\frac{\alpha - 1}{\alpha - 2}\right)^{\frac{\alpha-1}{\alpha}} T^{\frac{1}{\alpha}}$$

Where T is the total number of sources and α>2 is the Lotkaian exponent. Explanation of how to derive this formula is outside the scope of this paper, but using this formula allows for highly cited papers to have more impact on the *g*-index. The *g*-index addresses the flaw in the *h*-index where highly cited papers are counted the same as less cited papers once the citation counts are above the *h*-index threshold.

In keeping with our own recommendations that we draw from the literature, we will apply the information science based Hirsch indices within our study.

Methodology

In this study, we compared the ranking produced by the Hirsch family of indices against that produced by Lowry, Karuga and Richardson(2007b). By doing so, we sought to identify if the rankings produced by the Hirsch family were different from that produced by the Lowry et al study and if so, what might be the causes. We also explored the influence of scholars publishing in European journals to determine if the same level of influence was found among those scholars.

We utilized the Publish or Perish (PoP) tool (Harzing 2008c) to compute the various Hirsch family statistics. PoP is a software tool that retrieves data from Google Scholar™ (GS) and analyzes the data computing various indices and reporting the results (Harzing 2008a). GS is considered to be superior to the *ISI Web of Science* (WoS) or *Elsevier Scopus* sources for five reasons. First, GS expands data sources beyond ISI-listed journals to include additional scholarly sources including books, dissertations, conference papers, and non-ISI journals (Harzing 2008a). Second, in GS's search and retrieval GS considers all authors instead of only the first listed author (Harzing 2008a). Third, GS includes Languages Other than English (LOTE) sources that are generally not included in the WoS (Harzing 2008a). And fourth, GS also has superior coverage of social science and computer science compared to WoS. On the other hand, GS includes non-scholarly citations, has uneven coverage, and under represents older publications compared to WoS. Also, GS's automated search process occasionally returns nonsensical results and is not updated as frequently as WoS (Harzing 2008a). Despite these shortcomings, given Google Scholar's superior coverage in the business, computer science, and social science areas, we argue that the GS based PoP tool will be an improvement on using the WoS for our discipline.

To directly compare our results with those of Lowry, et al (2007b), we compiled a composite list of all the authors mentioned in their three lists as found in their Appendix 5. This yielded a total of 133 researchers. This list appears to be disproportionately North American in representation.

As a comparison to the largely North American scholars selected by Lowry et al (2007), we mimicked their sampling approach to select a set of non-North American scholars. The object of this exercise is to identify authors who publish in European journals and to assess their influence compared to the North American authors who published in MISQ/ISR/MS. We therefore, acquired the list of authors that had published in two representative European IS journals–the *European Journal of Information Systems* and the *Information Systems Journal*. These two journals appear in the Rainer and Miller (2005) and Cuellar, Takeda, and Truex (2008) journal rankings as the highest ranked European IS journals and are consistently ranked among the highest of the European IS journals in other studies. They are not, of course, the only European journals. Our sample omits the *Scandinavian Journal of IS* (*SJIS*), *Le journal Systèms d'Information et Management (SIM), the Journal of Information Technology (JIT), the European Journal of Operational Research (EJOR)* and *the Journal of Strategic Information Systems (JSIS)* and the *European Conference of IS (ECIS).* We only claim to provide a representative sample of scholars to illustrate the limitation of perspective introduced by selecting a limited number of journals and to illustrate the relative influence of scholars that publish in venues other than MISQ, ISR, and MS. Data was taken from EJIS and ISJ from the years 2000-2004 inclusive. This time stripe was the same as one of the timeframes taken by the Lowry et al. study. This process resulted in a list of 363 authors. There were seven authors that overlapped between the European list and the Lowry North American list; otherwise the lists were mutually exclusive.

These lists where then entered into PoP using the following process. We recognized early on that PoP would yield different results depending upon the input into the program. For example, entering "John Mingers" would retrieve all the items listed by his full name, but would miss those where he was listed as "J Mingers". So both forms of entry would be necessary. Also, certain common names would result in a large number of extraneous listings. This would not be an issue with relatively unique names such as Mingers' however it became a huge issue with names like "M Smith". Therefore, exclusion of extraneous articles would be necessary. Finally, we identified some peculiarities in the results returned by PoP. For example, PoP allows the user to include certain categories of articles by subject area such as biological and medical, physics and astronomy etc. Early on, we noticed that when pulling data from all subject areas, PoP would return Mingers and Brocklesby (1997). However, when any one of categories was turned off, this article would not be displayed. We therefore resolved to leave all the categories on. The final process is listed as follows:

1. We needed to identify the first names of the authors. We entered the name as listed in Lowry et al (2007b). This name was usually listed as "Taylor, S" or "Myers, MD." If we had the full name we entered the full name as listed in the journal into PoP.
2. Select an article from the Lowry et al. basket of journals (MISQ, ISR, or Management Science) and surf to the entry in GS to identify the first name of the author in question.
3. Re-enter the complete name in PoP along with additional search parameters if two initials were given, for example: "Michael Myers" or "MD Myers".
4. Review each article in the list starting from the most cited articles. PoP can automatically sort the papers in the order of citation ranking. During steps 1-3 we caught more papers than expected. We were suffering from error of inclusion. Articles that were not authored by the scholar being examined are "deselected" so as to eliminate them from the calculation of the indices. We soon found that the h and g-index did not change when you remove papers that have less than the h-index number of citations. The hc index changes minimally when you remove papers that have less than the h-index number of citations. So we only needed to go as far as the paper with the h-index number of citations. We didn't filter any papers that had less than the h-index number of citations.
5. The values for the h, hc and g indices were captured in a spreadsheet.

Two of the authors each entered all of the names into PoP and then compared the results. Where the results were different, the authors compared their respective results and then adjusted the data entry returned for a scholar. This data collection was accomplished between 4/1/2008 and 5/6/2008.

Results

Appendix 1 shows a comparison between Lowry et al's ranking based on total citation count compared with the results of a ranking based on the h, hc, and g indices. The table is ordered in alphabetical order by scholar's last name. The total citations and citations rank from the Lowry survey are presented next to the author's name. the next series of two columns present the value and rank order position of the *h*-index, *g*-index, and the *hc*-index.

The Lowry rankings only correlate 8.93% with the *h*-index, 12.65% with the *hc*-index, and 32.47% with the *g*-index. This small amount of correlation is attributable to two factors. First, the wider range of data available in PoP compared with that the ISI Web of Science utilized by Lowry et al. Lowry et al. (2007). Lowry, et. al. collected citations only for those papers reported in MISQ, ISR, and MS during the period studied while we had access to all the data available in GS; providing closer approximation to the scholar's total publication output. Second, as one would expect the method of calculation of the indices results in a significant difference in results from that achieved by Lowry.

Lowry et al. ranked the scholars based on a simple citation count of papers identified. The *h*-index requires a scholar to have a large number of papers that are highly cited to gain a high rating rather than simply just having one highly cited paper. Thus we see that Lowry et al. by their methodology privileged those scholars having papers with a high citation count but did not consider the overall contribution of those scholars. Thus we conclude that Lowry et al's rankings did not consider the overall contribution of the scholar in generating their rankings that being precluded by a limitation in the view of the scholar's work and by their ranking methodology.

This limitation of perspective can be further illustrated by the selection of scholars chosen from EJIS and ISJ (Table 2). The rankings in Table 2 were determined by sorting first on the h-index, within that on the hc-index and then on the g-index. There is an overlap of authorship of only 1.94% between the total list of 362 generated by our search of EJIS and ISJ with the list of 134 authors generated by Lowry from MISQ, ISR and MS. This indicates that these journals have substantially different authorship as has been seen in other studies. Lyytinen, Baskerville, Iivari and Te'eni (2007) found that European scholars provide only 3-6% of the author pool for MISQ and ISR. This finding indicates that these two groups of journals have a somewhat parochial perspective with only the local scholars by and large publishing in the local journals. In table 2, the common authors with table 1 are highlighted. As can be seen, it appears that only the most highly influential scholars publish in both venues.

Table 2: Rankings of EJIS/ ISJ authors

Rank	Author	*h*-index	*g*-index	*hc*-index	Rank	Author	*h*-index	*g*-index	*hc*-index
1	Whinston, A. B	42	76	24	53	Ackermann Fran	16	32	12
2	Grover, V.	40	69	25	54	Martinsons, Maris G.	16	28	11
3	Hirschheim, R.	36	69	21	55	Zhu, Kevin	15	26	15
4	Huber, G. P.	35	82	20	56	Magoulas, George	15	27	13
4	Kraemer, K.	35	62	19	57	Rose, Gregory M.	15	18	12
6	Willcocks, L.	33	57	19	58	Kock, Ned	15	22	11
7	Lyytinen, K.	30	57	19	59	Iivari, Juhani	15	32	10
8	Ciborra, C.	28	52	20	60	Hughes, J.	14	38	14
9	Love, P. E. D.	28	35	19	61	Byrd, Terry Anthony	14	27	11
10	Lederer, A. L.	28	49	16	62	Vidgen, Richard	14	26	11
11	Chen, C.	26	45	20	63	Sawyer, Steve	14	22	11
12	Galliers, R. D.	25	47	16	64	Massey, A. P.	14	27	10
13	Akkermans, H.	25	44	16	65	Robertson, Maxine	14	27	10
14	Zairi, M.	25	41	15	66	Dhillon, Gurpreet	14	25	10
15	Thompson, S. H. Teo	24	41	15	67	Valerie Belton	14	33	9
16	Jones, S.	23	45	16	68	Currie, Wendy	14	23	9
17	Dix, Alan	23	57	13	69	Huang, J. C.	14	14	9
18	Keil, Mark	22	46	18	70	Townsend, Anthony M.	14	33	8
19	Swan, Jacky	22	39	15	71	Doukidis, Georgios	14	20	8
20	Sarkis, Joseph	22	35	15	72	Tiwana, Amrit	13	33	12
21	Mathiassen, Lars	22	39	13	73	Hart, Paul	13	31	11
22	Paul, Ray	22	25	12	74	Davison, Robert	13	25	11
23	Heeks, Richard	21	39	17	75	Avgerou, Chrisanthi	13	24	11
24	Mingers, John	21	48	15	76	Smith, H. Jeff	13	27	10
25	Y. K. Chau, Patrick	21	43	15	77	Pan, Shan L.	13	25	10
26	Rouncefield, M.	21	34	15	78	Powell, Philip	13	25	9
27	Kettinger, Wm	21	46	14	79	Liu, Kecheng	13	25	9
28	Johnston, R. B.	21	23	14	80	Buxmann, Peter	13	20	8
29	Baskerville, R	20	47	15	81	Beynon-Davies, Paul	13	19	8
30	Irani, Zahir	20	30	15	82	Swatman, P. A.	13	23	7
31	Ramamurthy, K.	20	38	13	83	Seddon, Peter B.	12	31	10

32	O'Keefe, Robert	20	36	12	84	Peppard, Joe	12	30	10
33	Crabtree, Andy	19	33	16	85	Lee, Heejin	12	23	10
34	Chalmers, M	19	37	15	86	de Moor, Aldo	12	17	10
35	Newell, Sue	19	34	13	87	Ngwenyama, Ojelanki	12	28	8
36	Klein, Gary	19	30	13	88	Tudhope, Douglas	12	19	8
37	Sharrock, Wes	19	33	11	89	Edwards, John	12	15	8
38	Saunders, Carol	18	36	13	90	Brown, S. A.	12	14	7
39	Giaglis, George	18	26	13	91	King, M	11	27	18
40	Klein, Heinz K.	18	51	12	92	Kern, Thomas	11	24	10
41	Alter, Steven	18	41	12	93	Damsgaard, Jan	11	22	10
42	Jiang, J. J.	18	34	12	94	Smithson, Steve	11	23	9
43	Carroll, Jennie	18	21	12	95	Stenmark, Dick	11	22	9
44	Montoya-Weiss, M. M.	17	38	13	96	Howcroft, Debra	11	17	9
45	Klein, Stefan	17	35	13	97	Poon, S.	11	27	8
46	Wigand, Rolf	17	55	12	98	Randall, Dave	11	21	8
47	Rafaeli, Sheizaf	17	39	12	99	Pries-Heje, Jan	11	19	8
48	Rai, Arun	17	33	12	100	Montealegre, Ramiro	11	18	8
49	Sahay, Sundeep	17	32	12	101	Hendrickson, Anthony R	11	29	7
50	Strong, D	17	20	12	102	Fitzgerald, Guy	11	23	7
51	Land, Frank	17	30	9	103	Jain, H.	11	16	7
52	Sharma, Rajeev	17	18	9	104	He, Xin	11	14	7

Besides the distinct publication patterns, we see that the scholars publishing in EJIS/ISJ are only slightly less influential than those publishing in MISQ, ISR, and MS (Table 3). Table 3 was calculated by taking all the authors in the MISQ/ISR/MS list and all the authors in the EJIS/ISJ list. Authors that existed in both lists were thus calculated in both columns in table 3.

Table 3: Comparison of h, hc and g statistics for Lowry vs. European journals.

Statistic	MISQ/ISR/MS	EJIS/ISJ	Percent Difference
h-index mean	24.41	18.02	74%
hc-index mean	15.55	12.55	81%
g-index mean	54.68	33.46	61%

The range of the *h*-index for both sets of scholars was identical–from a low of 11 to a high of 42. This indicates that scholars of the same level of influence publish in US-based and European-based journals. In examining the average values, we see here that the indices for the EJIS/ISJ scholars are 74%, 81%, and 61% respectively of the MISQ/ISR scholars indicating that scholars publishing in the European journals have about 75% of the influence of those publishing in the North American journals (Table 3). If we consider the top 25 scholars in each group (ranked by *h*-index), the gap narrows with the top scholars being more similar in influence. We find a similar pattern, the top 25 scholars publishing in the European journals are 81, 83%, and 67% as influential as those publishing in the North American Journals (Table 4). Similar to table 3, table 4 includes authors that appear in both lists in the calculations.

Table 4: Top 25 Scholars Comparison			
Statistic	MISQ/ISR/MS	EJIS/ISJ	Percent Difference
h-index mean	33.48	27.16	81%
hc-index mean	20.76	17.32	83%
g-index mean	71.76	49.68	69%

Discussion

Our findings indicate the incomplete nature of ranking methodologies such as that employed by Lowry et al (2007b). To simply extract a set of articles from journals held a priori to be "premier" and then count citations of articles published by the authors of them results in an estimate of influence that is biased by the parochial nature of journal publication, limited access to publication data and incorrect measures of influence.

To avoid the parochial bias, as complete and inclusive a publication record of a scholar should be obtained. We recommend that Google Scholar™ be used as a data source for this type of assessment. By not being bound to publication in any particular venue but rather measuring the uptake of a scholar's ideas by the research community, we arrive at a fairer and less biased metric of influence that will only increase in accuracy as Google Scholar ™ increases its reach.

From previous studies, Takeda and Cuellar (2008) and Cuellar, Takeda, and Truex (2008), it is clear that MISQ is the most influential IS journal and that ISR and JMIS are next in influence within the IS community. However, this study demonstrates that while MISQ, ISR, and the IS articles from *Management Science* are vehicles that convey a scholar's influence in the IS community, they are not the only or even the most important vehicles of influence. Indeed, the results of the analysis of the European scholars shows that equivalent levels of influence may be achieved without publication in the North American premier journals. Ranking studies that narrowly bound the venues from which articles, scholars or citations are extracted, privilege or weight certain venues as being more influential that the empirical data shows thus distorting the measurement of influence. This distortion results in the biasing of important decisions about promotion and tenure in favor of those scholars who publish in these journals while denigrating those who do not. In particular it militates against Europeans scholars who write books and publish in European journals.

In terms of indices, we suggest that the IS discipline move away from homegrown measures that are *atheoretically* developed in favor of metrics that have been undergoing development within the Information Sciences community. The use of the Hirsch indices is one step in this direction. These measures as demonstrated here provide a theoretically based approach to the assessment of influence that consider both quantity and uptake of publication as well as the obsolescence of papers.

Some suggestions have been made to exclude articles and citations to articles found in "non-scholarly IS journals" such as Harvard Business Review or Sloan Management review (Gallivan et al. 2007). We argue that this determination depends on the type of influence that is desired to be assessed. To arrive at a scholar's complete influence across all areas including research, practice, and the public perception, it is necessary to include all different venues. Only if it is desired to consider only the impact on other scholars should the number of venues from which articles and citations are derived be limited to "Scholarly IS journals."

One might infer from this discussion that even after opening the analysis to the 'flotsom and jetsom' of of articles and citations from venues other than the top-tier research journals, authors not consistently appearing in the top U.S. journals are not quite as influential as those who do publish in top tier journals. But we suspect that this would be in error for two reasons. First, the 'flotsom and jetsom' are important in order to obtain a scholar's complete publication record. As Straub (2006) suggests there is a problem of a "type II" error. Sometimes top journals are not omniscient. They do on occasion reject important and influential work. Secondly, there is the whole question of author who chose not to publish in journals but choose other venues such as conferences and books. The discourse in computer sciences and biological genome research is carried on largely through conference and electronic venues simply because the field is changing more rapidly than journal articles can accommodate. In rapidly changing fields, print venues simply record "old news."

This study is limited by the following considerations. As indicated above, the GS data source is not a complete source of bibliographic information. While it will improve over time, it is incomplete and may not properly represent the influence of a scholar. Second, we only assessed scholars who published in five different journals. The findings therefore should be considered as a listing of "the most influential IS scholars." These findings only compare the influence of the authors who publish in these venues. To generate a "most influential scholars" list, it would be required to compile a list of scholars from many different sources. Third, the use of the Hirsch indices should not be considered as a complete assessment of scholarly influence. To complete the analysis, other tools such as social network analysis and co-citation analysis should be used (see e.g. White 2003; White et al. 1981; Zhao 2006).

Conclusion

This paper suggests a new method for the assessment of scholarly influence. We argue for a new method in assessing scholarly influence analysis in the IS field because the existing methods of assessing scholarly influence exhibit several types of systematic bias and are methodologically incomplete. Because of these concerns we suggested that the IS discipline utilize the Hirsch family of indices and the Google Scholar™ search engine and demonstrated that by adopting this methodology, the IS field could overcome many of the issues related to bias (Walstrom et al. 1995) and politics (Gallivan et al. 2007).

This research arose from a continuing stream of inquiry exploring the question of how we might better determine scholarly influence and takes as a given that a single measure will not be sufficient to the task. In particular it does not accept that the measure of scholarly influence requires that one publish in a limited set of so called 'top tier journals'. Indeed this research illustrates how one may be rated as being influential even without publishing in those journals. By using the Hirsch family of the citation statistics applied to a wider set of publication venues we suggest provides a 'fairer' measure of scholarly influence than presented by current approaches.

While acknowledging that our field needs quality measures, we did not address the issue of scholarly quality directly. We cautioned that because there is little objective evidence that publications in top-tier journals are necessarily consistently of higher quality than articles published in other venues, that the rankings of 'best' and top-tier journals is a political process with inherent biases, much more work needs to be directed at the development of better 'quality' measures. We did however find evidence in the research that influence, often used as a surrogate measure for quality, may be venue agnostic. In fact, we also questioned the entire concept of quality. Following Introna (2004), we observed that publication is a sign of conformance to a particular paradigm of research and writing methodology as opposed to quality measure.

We explored the question raised by others dealing with bias of American centrism of journals (Gallivan et al. 2007; Lyytinen et al. 2007) and another bias, namely the question of regional, linguistic, and cultural difference in publication and scholarly influence, and found supporting evidence that this is so.

Future research in this topic would entail further application of Hirsch indices to the assessment of scholarly influence. For example, the *h*-index may be used to compare a scholar up for tenure with peers who have achieved tenure. This is possible by taking advantage of the time based nature of the *h*-index (Egghe 2007a). Research should investigate the values of this constant to provide improved assessment of the IS field. A third possible area for future research would be to create a set of techniques to fully assess scholarly influence. These techniques could include in addition to use of the Hirsch indices, co-citation analysis, co-author analysis, and social network analysis.

Finally, we would caution against reification by repetition. Simply stated, there is a danger that by adhering to the received view holding that quality is only achieved by publication in a limited set of designated journals, we risk feeding a cycle of self referential and self reinforcing truths. In so doing, we create a consistency that breeds conformity rather than a fostering spirit of free and open discourse where the status quo may be challenged.

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Appendix 1: Comparison of Lowry et al Rankings vs. the Hirsch Family Indices

Comparison of Lowry et al Total Citation Rankings vs. the Hirsch Indices								
Citations Rank	Authors Name	Total Citations	*h*- index Rank	*h*-index	*g*-index Rank	*g*-index	*Hc*- index Rank	*Hc*-index
34	Adams,DA	214	85	9	76	33	79	8
33	Agarwal,R	221	31	24	35	53	12	20
17	Alavi,M	328	23	26	21	65	17	19
14	Bakos,J	352	72	13	29	57	67	10
48	Banker,RD	174	5	38	7	84	8	22
21	Barki,H	295	67	15	67	40	67	10
89	Barney,JB	112	9	35	4	101	3	26
47	Barua,A	180	44	21	62	41	38	15
80	Beath,CM	119	70	14	76	33	79	8
1	Benbasat,I	976	2	41	5	85	8	22
94	Bostrom,RP	109	31	24	58	44	43	14
18	Brancheau,JC	328	81	11	67	40	83	7
4	Brynjolfsson,E	551	3	40	1	103	1	30
75	Chidambaram,L	124	72	13	84	29	72	9
71	Choudhary,V	126	85	9	98	13	79	8
15	Compeau,D	340	93	7	82	31	87	6
85	Connolly,T	113	44	21	38	52	43	14
37	Cooper,RB	206	78	12	75	34	87	6
29	Davis,FD	242	31	24	1	103	30	16
69	Davis,GB	127	23	26	24	63	30	16
10	Delone,WH	481	82	10	82	31	72	9
23	Dennis,AR	267	15	32	16	68	17	19
46	Dexter,AS	181	62	17	62	41	72	9
86	Earl,MJ	113	53	19	40	51	43	14
91	Fuerst,WL	111	85	9	85	28	93	5
40	Gefen,D	195	27	25	29	57	8	22
95	George,JF	107	53	19	52	45	54	12
22	Goodhue,DL	290	53	19	52	45	49	13
31	Grover,V	233	3	40	13	69	5	25
97	Guha,S	105	96	6	100	7	93	5
92	Guimaraes,T	111	44	21	71	37	59	11
49	Gurbaxani,V	174	67	15	47	47	59	11
27	Hartwick,J	248	72	13	52	45	72	9

8	Higgins,CA	502	39	22	28	59	49	13
24	Hitt,L	266	27	25	13	69	12	20
72	Howell,JM	125	62	17	45	49	43	14
62	Huff,S	145	39	22	62	41	54	12
70	Iacovou,CL	127	97	4	88	26	97	3
53	Igbaria,M	164	15	32	27	60	12	20
38	Ives,B	203	18	30	23	64	38	15
81	Janz,BD	116	90	8	93	25	79	8
16	Jarvenpaa,SL	334	9	35	8	79	8	22
87	Kalathur,S	113	100	2	99	12	100	1
41	Karahanna,E	193	72	13	47	47	72	9
73	Kauffman,RJ	125	23	26	52	45	24	18
77	Kavan,CB	122	93	7	93	25	87	6
96	Keil,M	107	39	22	49	46	24	18
35	Kekre,S	213	49	20	62	41	67	10
50	Kemerer,CF	172	22	27	13	69	17	19
60	Kettinger,WJ	146	49	20	52	45	43	14
74	King,WR	125	15	32	40	51	30	16
88	Kirsch,LJ	113	72	13	86	27	72	9
55	Klein,HK	159	59	18	40	51	54	12
51	Kraemer,KL	170	9	35	25	62	17	19
78	Kriebel,CH	122	72	13	76	33	87	6
43	Lee,AS	185	59	18	43	50	38	15
32	Leidner,DE	224	53	19	18	67	30	16
82	Martocchio,JJ	114	53	19	71	37	59	11
93	Mata,FJ	111	98	3	95	22	97	3
30	Mathieson,K	241	93	7	79	32	93	5
7	Mclean,ER	510	62	17	32	55	59	11
65	Melone,NP	135	98	3	97	17	99	2
19	Moore,GC	312	85	9	73	36	93	5
58	Morris,MG	149	67	15	60	43	67	10
12	Mukhopadhyay,T	416	31	24	34	54	30	16
63	Myers,M	137	53	19	35	53	38	15
25	Nelson,RR	263	85	9	88	26	83	7
42	Newman,M	189	78	12	88	26	83	7
59	Niederman,F	149	82	10	88	26	83	7
66	Northcraft,GB	134	29	25	49	46	54	12
36	Nunamaker,J	208	6	37	25	62	17	19
3	Orlikowski,WJ	640	8	36	3	102	2	27
68	Pitt,LF	129	59	18	73	36	59	11

83	Poole,MS	114	21	28	16	68	24	18
56	Reich,BH	155	90	8	88	26	87	6
11	Robey,D	458	9	35	19	66	17	19
28	Sambamurthy,V	248	39	22	62	41	30	16
54	Segars,AH	162	62	17	96	18	49	13
57	Smith,MD	150	31	24	19	66	12	20
98	Srinivasan,K	103	29	25	52	45	17	19
79	Stoddard,DB	121	90	8	86	27	87	6
9	Straub,D	493	9	35	10	75	3	26
76	Swanson,EB	123	49	20	70	39	49	13
20	Taylor,S	302	82	10	58	44	72	9
26	Thompson,RL	252	78	12	61	42	67	10
2	Todd,P	695	70	14	32	55	59	11
67	Trauth,EM	131	66	16	79	32	59	11
52	Valacich,JS	165	19	29	21	65	29	17
6	Venkatesh,V	531	38	23	12	70	24	18
44	Venkatraman,N	183	6	37	5	85	7	23
84	Vogel,D	114	23	26	38	52	43	14
99	Walsham,G	102	31	24	31	56	30	16
61	Watson,HJ	146	31	24	67	40	49	13
39	Watson,R	203	19	29	35	53	24	18
64	Webster,J	137	39	22	49	46	38	15
100	Wei,KK	102	49	20	79	32	54	12
45	Weill,P	182	44	21	43	50	30	16
13	Wetherbe,JC	416	44	21	45	49	59	11
90	Whinston,A	112	1	42	9	76	6	24
5	Zmud,R	538	14	34	11	74	12	20