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Assessing Scholarly Influence: Using the Hirsch Indices to Reframe the Discourse

Duane Truex
Georgia State University, dtruex@gsu.edu

Michael Cuellar
North Carolina Central University, mcullar@nccu.edu

Hirotoshi Takeda
Paris Dauphine University, htakeda@cis.gsu.edu

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Assessing Scholarly Influence: Using the Hirsch Indices to Reframe the Discourse

Duane Truex
Georgia State University
Computer Information Systems
dtruex@gsu.edu

Hirotoshi Takeda
Georgia State University
Computer Information Systems
htakeda@cis.gsu.edu

Michael Cuellar
North Carolina Central University
Computer Information Systems
mcullar@nccu.edu

Abstract

This study is part of a program aimed at creating measures enabling a fairer and more complete assessment of a scholar's contribution to a field, thus bringing greater rationality and transparency to the promotion and tenure process. It finds current approaches toward the evaluation of research productivity to be simplistic, atheoretic, and biased toward reinforcing existing reputation and power structures. This study examines the use of the Hirsch family of indices, a robust and theoretically informed metric, as an addition to prior approaches to assessing 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. Other ranking studies, by narrowly bounding the venues included in those studies, distort the discourse and effectively privilege certain venues by declaring them to be more highly influential than warranted. The study identifies three different categories of scholars: those who publish primarily in North American journals, those who publish primarily in European journals, and a transnational set of authors who publish in both geographies. Excluding the transnational scholars, for the scholars who published in these journal sets during the period of this analysis, we find that North American scholars tend to be more influential than European scholars, on average. We attribute this difference to a difference in the publication culture of the different geographies. This study also suggests that the influence of authors who publish in the European journal set is concentrated at a moderate level of influence, while the influence of those who publish in the North American journal set is dispersed between those with high influence and those with relatively low influence. Therefore, to be a part of the top European scholar list requires a higher level of influence than to be a part of the top North American scholar list.

Keywords: *Scholarly Influence Ranking, Citation Analysis, Hirsch Index, h-index, Contemporary Hirsch Index, hc-index, g-index, Critical Perspective, Scientometrics, Information Systems (IS), Reification by Repetition. Information Sciences (InfSci).*

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Assessing Scholarly Influence: Using the Hirsch Indices to Reframe the Discourse

1. Introduction

The purpose of this paper is to demonstrate the utility of the Hirsch family of indices in the evaluation of scholarly influence. We argue that existing methods are subjective and methodologically suspect. Therefore, we suggest the IS field take advantage of the 80 years of work by scholars in the Information Sciences[1] discipline (Lotka, 1926, Molinari and Molinari, 2008) on the topic of how a field might best assess scholarly influence. We argue the IS field should assess scholarly influence based on the Information Science-based Hirsch family of indices and supported by the Google Scholar™ search engine. By adopting this methodology, we believe the IS field can overcome many of the issues related to bias (Walstrom et al., 1995) and politics (Gallivan and Benbunan-Fich, 2007).

Incorporation of the Hirsch indices is needed because current approaches to evaluating scholarly productivity can be seen as *atheoretical*, methodologically flawed, and biased, serving to simply reify and reinforce extant power structures and relationships. Historically, the evaluation of scholarly output has been based on publication in "premier" journals, but journal ranking methodology has come under scrutiny by different studies and editorial pieces in both US and European journals[2] (Alexander et al., 2007, Baskerville, 2008, Clark and Wright, 2007, Peffers and Tang, 2003, Rainer and Miller, 2005). Some argue that journal rankings force researchers to focus on safe or even trivial topics (Powell and Woerndl, 2008). European researchers have argued that journal rankings tend to exaggerate the importance of North American journals and institutions to the detriment of those in Europe, Austral-Asia, and Africa (Baskerville, 2008, Harzing, 2008b, Kateratanakul and Han, 2003, Mingers and Harzing, 2007, Powell and Woerndl, 2008, Willcocks et al., 2008). This point has also been made in the fields of accounting (Lee and Williams, 1999) and management (Collin et al., 1996a). Other authors challenge the efficacy of any reasonable single measure for judging the worth of a scholar and espouse a need to bring the whole process under control. Some advocate that practitioner and non-research publications that conflate consideration of a scholar's research contributions should be removed from consideration (Gallivan and Benbunan-Fich, 2007). We would argue, however, that journal rankings are an incomplete measure of the breadth of scholarly output and influence. For instance, in Computer Science and other rapidly changing fields, conference submissions and some web-shared documents are considered more important means of knowledge dissemination than journals, simply because the time lag in journal article production cannot keep up with the pace of knowledge discovery. By excluding books, conference papers, and other venues, some of which are of considerable importance to the scholarly tradition of other disciplines, we ignore important areas of scholarly influence and overstate the importance of journals.

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 the Information Systems research discipline. We take this task on for several reasons. First, just as financial analysts require vocabularies and tools to 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. Second, as a field, we need measures that enable us to assess our own scholarly influence relative to other fields and also to compare scholars within sub-disciplines of IS research. Third, within the IS research field, the competitive hiring, 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 important for us, we feel strongly that the breadth, depth, and persistence of a scholar's work should be considered as part of a person's intellectual legacy, rather than a single number

[1] By *Information Science* we refer to the interdisciplinary field incorporating computer science, mathematics, library science, cognitive science, social science and information systems, sometimes called: Library Information Science, and Information Sciences and Technology.

[2] In general, the distinction between US and European journals has three elements 1) country of origin or foundation, 2) the location of publication offices and/or chief editors, and 3) national affiliations, if any. For instance The *Scandinavian Journal of Information Systems (SJIS)* and *The European Journal of Information Systems (EJIS)* (domiciled at the London School of Economics) are considered European. The *MISQ, JMIS*, and *ISR,* all founded and domiciled in the US, are counted as American.

representing a ranking or a "hit rate." To that end, we are looking to understand and apply a set of measures to help quantify a scholar's legacy. This paper is but one stage in that larger program of inquiry. As that inquiry is more fully developed, 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 latter 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. In other words, we examine how the Hirsch family of citation statistics may provide a fairer and more transparent measure of scholarly influence than that presented by current approaches.

The paper proceeds as follows: In the next section, we briefly examine the literature exploring measures of individual scholars' influence. We then point out weaknesses in these measures and propose a method using the Hirsch family of statistics to strengthen the process. We then demonstrate the utility of the Hirsch indices by using the set of scholars listed by Lowry, Karuga and Richardson (2007) to show how the Hirsch statistics perform compared to the methodology selected by Lowry et al. (2007). Next, we develop a list of scholars drawn from European journals in order to demonstrate the ability of the Hirsch statistics to generate comparisons. Finally we discuss the findings and examine the limitations of the study as well as its implications for our continuing work on developing a set of better means to measure scholarly value.

2. Critique and Review of Current IS Scholarly Assessment Methods: a Literature Review

As Gallivan and Benbunan-Fich (2007) point out, the IS field has a long tradition of publishing research about research, with more than 40 works addressing the issue of journal rankings and scholarly output. Interest in this topic is not limited to our own field. Many social science scholars question the measuring of research output by publication counts (Bar-Ilan, 2008, Collin et al., 1996a, Lee and Williams, 1999). This recognition of the importance of such metrics is also accompanied by disaffection with extant methods for evaluating scholarly influence, 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 three broad categories: 1) journal ranking studies, 2) individual productivity measures, and 3) metrics and methods improvements. We discuss the first two streams in this section and focus on the third later in the paper. The first stream considers the relative importance of specific publication venues. These are the so-called journal ranking studies (Alexander et al., 2007, Baskerville, 2008, Clark and Wright, 2007, Ferratt et al., 2007, Geary et al., 2004, Hardgrave and Walstrom, 1997, Harzing, 2008b, Kodrzycki and Yu, 2005, Korobkin, 1999, Kozar et al., 2006, Lowry et al., 2004, Martin, 2007, Mingers and Harzing, 2007, Mylonopoulos and Theoharakis, 2001, Nelson, 2006, Nerur and Sikora, 2005, Peffers and Tang, 2003, Podsakoff et al., 2005, Rainer and Miller, 2005, Walstrom and Hardgrave, 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 (Athey and Plotnicki, 2000, Chua et al., 2002, Clark et al., 2007, Gallivan and Benbunan-Fich, 2007, Huang and Hsu, 2005, Liang, 2006, Lowry et al., 2007, Lyytinen et al., 2007). The journal ranking and individual contribution streams are interrelated, because the one approach used to assess scholarly worth has been citation counts in top-tier journals. The third stream focuses primarily on the metrics and methods used in the first two streams, and proposes improvements to or replacements for those extant methods (Abt, 2000, Banks, 2006, Bar-Ilan, 2008, Batista et al., 2006, Bornmann and Daniel, 2005, Bornmann and Daniel, 2006, Bourke and Butler, 1996, Braun et al., 2006, Egghe, 2005, Egghe, 2006, Egghe, 2007, Egghe and Rousseau, 2006, Glanzel, 2006, Liang, 2006, Molinari and Molinari, 2008, Saad, 2006, Schubert, 2007, van Raan, 2006, Zanotto, 2006).

2.1. Survey Methods

To illustrate the first stream we point to three successive Walstrom and Hardgrave articles (Hardgrave and Walstrom, 1997, Walstrom and Hardgrave, 2001, Walstrom et al., 1995). They created a survey instrument asking respondents to rate a list of journals. Respondents were also invited to add to that list journals they believed should be included in the survey. Additional journals could be selected from an auxiliary list or from the respondents' own 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.

The survey methodology has been under scrutiny for its subjective nature and a perceived North American bias (Gallivan and Benbunan-Fich, 2007, Lyytinen et al., 2007, Willcocks et al., 2008). Recent studies have begun 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: European IS scholars who represent 25 percent of all IS scholars only represent 8-9 percent of those published in the field's top-tier journals (Lyytinen et al., 2007). Gallivan and Benbunan-Fich (2007) set out to examine why there were no Europeans and only two women in Huang and Hsu's (2005) highly cited article naming the top 30 IS scholars . 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 flaw is the problem of "Path Dependency" (Galliers et al., 2007, Gallivan and Benbunan-Fich, 2007, P. 38, Whitley and Galliers, 2007). The idea is that studies about journal rankings necessarily draw on previous studies of rankings, which in turn, draw on earlier studies of 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. 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. This notion is likened to the phenomenon called "replicative fading" in the SciFi lore on cloning. Replicative fading refers to the degeneration of viable DNA arising from the practice of reiterative cloning; with each successive generation of cloned offspring, genetic flaws become more pronounced over time; the clone is a less virile version of the original (Klotzko, 2001). Alpha (2008) suggests, "The only solution to replicative fading is to introduce DNA from non-cloned individuals, thus reducing the number of harmful mutations." This suggests that studies should be repopulated with updated and fresh selections of respondent choices regularly.[3] Second, and related to the first problem, are a number of factors that tend to make certain publications more recognizable and familiar to survey respondents. The number of years in print, the relative use in PhD programs, and the reification by repetition suggest that for respondents, sometimes familiarity is confused with quality. Third, several studies have demonstrated the older and generalist journals have an edge in the recognition game. But newer and more specialized journals are ignored because they are little known or are thought to have inconsequential scholarly markets (Gallivan and Benbunan-Fich, 2007). And finally, the recognition game leads to the fourth problem of self-reinforcing political influence. An often unstated, but generally recognized, point is that any study ranking of journals and scholars is a political process. In the IS literature, Gallivan and Benbunan-Fich address the political 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 and Benbunan-Fich, 2007, p.37). An example of that influence is in the process conducted at many universities to create an established journal list used to make tenure and promotion decisions (Adams and Johnson, 2008, Willcocks et al., 2008).

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[3] A colleague asked if inserting new journals will solve the problem of path dependency. For instance, if we consider the cases of the *CACM* and *I&M*, two journals that were among the initial top journals in IS back in the 1980s, would we expect that they will drop off the "Top 10" journal lists resulting from ranking surveys, just because a researcher has included newer journals such as the *JAIS* or *CAIS* in their surveys and asked subjects to rank them? We think that if one defines path dependency as the blind repetition of a closed list set and the refusal to allow new venues to be admitted, then opening the set would reduce path dependency. But it raises the issue of the subjectivity associated with the list's creation.

2.2. Scientometric Methods

A second example in the journal assessment stream typifying the use of the citation analysis approach is provided by Lowry, Karuga, and Richardson (2007). They counted citations for articles published in *Management Information Systems Quarterly (MISQ), Information Systems Research (ISR),* and the IS articles published in *Management Science (MS)* as retrieved from Thomson's *Web of Science.* Lowry et al. 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, and articles, with each reported segment broken out by three five-year eras: 1990-1994, 1995-1999, and 2000-2004. Scientometric (i.e., citation-based) studies, while typically conducted to identify top scholars in a field, can also be used to identify top journals.

But scientometric analysis has its flaws. The technique tends to be time consuming because of the tediousness and difficulty in acquiring and teasing out a clean dataset for analysis as, until recently, there have been no central repositories of bibliographic information. The first problem is somewhat ameliorated with the advent of the many search engines, indexing protocols, and online databases such as ISI's "Web of Science" and the "Social Science Citation Index." The time consuming nature of scientometric analysis can still be daunting and problematic: an author's name may appear in various forms, author listing conventions and publication venues may change, and some journals have not passed the "qualification process" to be admitted into the bibliographic database. The efficacy of citation sets derived from these databases may be called into question because the citation databases index journals differently; inconsistently index conferences, books, and foreign language venues; and may not include new publication outlets. Another criticism of citation analysis approaches is the fact that citation practices 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" the ranking or impact factor by artificially inflating the citation count. Authors may also skew the process by adding unnecessary self-citations and tangentially related references to colleagues' work. Thus, decisions by authors about what and whom to include and exclude in bibliographies can also skew findings. Journals and articles that are older will, of course, have more citations, resulting in a skewing toward them (Lowry et al., 2007).

2.3. Other Methods

Other methods have been suggested for ranking journals. One approach that has been suggested is to rank journals based on universities' journal lists of universities. Alexander, Scherer and Lecoutre (2007) investigated the differences among international journal rankings to test for equivalency. They found a low degree of agreement among the six journal ranking systems they examined. Rainer and Miller (2005) present a method to average journal rankings across various lists. The method of averaging journal ranking across lists addresses the variability across journal ranking studies found by Alexander et al. (2007). Templeton, Lewis and Luo (2007) suggest ranking by institutional journal lists, which assumes an implicit weighting of research outlets made by each academic department. Another approach has been to rank journals based on the university affiliation of the various article co-authors. 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 divided by the total number of authors in the journal. The issue here is how to rank the institutions by quality. This leads to a circular logic in many cases (MacDonald and Kam, 2007) and reflects a subjectivity bias, wherein the better known or "name" institutions or politically powerful institutions are privileged over smaller research units and less well known institutions. The circular logic once again, illustrates the bias of reification by repetition.

Regional Biases

Another potential source of bias in the evaluation of influence comes from regional publication patterns. The literature shows patterns in publication that differ by region. For example, Lowry, et al. (2007) created a list of top IS researchers drawn from scholars that published in *MISQ, ISR,* and *MS.* This list was disproportionately filled with North American scholars. Few European or Asia-Pacific scholars were found on the list. This phenomenon has been observed in other reference disciplines as well (Collin et al., 1996b, Lee and Williams, 1999). In the IS literature, several recent articles have searched for evidence explaining why this is the case or have posited possible reasons for the differences. Lyytinen et al. examined the "status of European publishing in high-impact IS journals" and found the record disappointing, as they documented detailed evidence of a lack of proportional participation by Europeans in such journals (2007). Finding "popular explanations to this state of affairs neither credible nor useful," they offered recommendations addressing the training, values, and traditions in European IS research. In exploring the notion that European IS research draws on a relatively richer stock of social theories, Galliers and Whitley (2007) tried to identify characteristics of European IS research that distinguish it from IS research undertaken elsewhere. Gallivan and Benbunan-Fich (2007) explored the relative representation of Europeans in US' and European-based journals and found both Europeans and women underrepresented in high-impact US-centric journals. Similarly, Lyytinen et al. (2007), found significant differences in the relative representation of US and European scholars in European-based journals. Recently, a number of opinion pieces in the *European Journal of Information Systems (EJIS, v. 17, #2, 2007)* proffered explanations as to why European scholars are or are not represented in various publication venues. All of these articles examined the relative degree and proportion of representation by region, nationality, and to a lesser extent, gender and language in a narrowly defined set of so-called "high-impact" venues. None of these articles, however, examined the question of scholarly impact apart from an author's representation in those journals. In this paper, we intend to explicitly examine the question of an author's influence based on publication venue.

2.3. Theory-Light vs. Theory-Driven Approaches

An unaddressed issue in all of these studies is that they all lack a theoretical basis. As Straub has observed, these studies "rarely go beyond the simplest research question to explore why journals are highly or lightly regarded…they seldom investigate the serious issues that relate to methodological choices for determining the rankings" (2006). No attempt has been made to generate a theoretical understanding of how literature streams develop that would, in turn, provide a theoretical basis for the choice of methods or metrics in studying scholarly influence.

Other reference disciplines have been considering the question of measuring scholarly contribution for some time. In fact, the Information Science (infoSci) discipline has been working for more that 80 years to develop methods to assess scholarly influence. The information sciences discipline has developed a series of metrics and methods for performing a variety of studies of scholarly influence. The theoretical basis of these methods is a set of empirical studies beginning with Lotka (1926), from which various authors have deduced a set of mathematical formulae that have described the nature of citation frequency (c.f., Egghe (2005) for complete basis of Lotkaian Informetrics). The Hirsch indices, described below, were developed within that tradition. For example, in the Information Sciences, methods have been developed to perform analyses of the structure of fields (White and Griffith, 1981, Zhao, 2006) and influence of authors on others (White, 2003). Although Culnan and Swanson provided early examples of citation analysis in our own field (Culnan, 1986, Culnan, 1987), relatively few of the techniques developed in the information sciences have appeared in the information systems literature. We argue that future work in influence studies should be based on the information sciences knowledge base.

A set of indices, which we collectively call the Hirsch-family Indices, has been developed and is garnering attention in a variety of disciplines. In our study, we will be using the *h*-index first suggested by Hirsch (2005), the Contemporary Hirsch Index (commonly called the *hc*-index) (Sidiropoulos et al., 2006), and the *g*-index suggested by Egghe (2006). All of these indices assign a number to an author/researcher that suggests the impact the researcher has had. A higher index means a researcher has more publications that are highly cited than a researcher with a lower *h*-index. Therefore, the index is a surrogate number registering influence and has been rapidly adopted and used in natural science fields (Glanzel, 2006). [4]

[4] A reviewer has helpfully suggested that we consider the use of "hit counts" for online or open access journals as another metric. This is an intriguing suggestion that should be further investigated. A bibliography related to open

The *h*-index is calculated as the number of papers *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). We illustrate the calculation of the *h*-index with an example we created for a hypothetical "Dr. C" (*c.f.,* Table 1). We first list all the publications that Dr. C. has and rank them in descending order by the number of citations to each publication. 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 same number of citations shown in parenthesis:

Table 1: Ranked articles for Dr. C

Rank by citation count	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
13…23	…Other articles…	…<9 cites

After rank position 12, Dr. C. has 10 additional cited articles, but none of these other articles has any more than 9 citations each (Table 1). Where the rank number of articles on the list and the citation counts cross (currently at article rank 12 with 9 citations), we determine the *h*-index. That is, we rank order articles by their citation count and look for the first article whose rank position number becomes higher than its own citation count. The rank position where the citation count remains higher than the rank is the *h*-index. Or, expressed in another way, in the current example, until the 11th article, all citations counts were higher than the article's rank. But on the 12th article we find that, for the first time, the ranking (12) becomes higher than the citation count (9) for that article. Thus, our hypothetical Dr. C. has an *h*-index of 11 because the 11th article in the list has 13 citations and the 12th article has nine citations. The *h*-index tells us that the author has at least *h*-index number of articles with at least *h*-index citations each.

The *h*-index improves on simple citation counting or simple productivity by combining the twin notions of productivity *and* impact to produce ***a measure of influence***. ***Productivity*** is considered in the raw number of papers published. A single highly cited work will not garner a researcher a high *h*-index. No matter how many times that a single high-impact paper is cited, an author publishing only one single paper can only garner an *h*-index of one. ***Impact*** is measured as the number of citations by others to a given work. This means that a person producing many papers, each of which is cited only once has an *h*-index of one. Thus, only by both publishing regularly *and* having publications cited frequently by others can an author's *h*-index increase. Productivity and impact, as measured by other authors' references to a work, are then balanced against each other in the *h*-index to produce a measure of influence. Thus, to achieve high influence, a researcher must produce a sustained number of papers with impact on the field.

One of the key features about the *h*-index is that as publications get cited, the *h*-index grows over time. The indices are an influence measure at a given point in time. Therefore, analyses from data

access journals is located at http://opcit.eprints.org/oacitation-biblio.html. A study on the relationship between hit counts and citations is related here: http://www.bmj.com/cgi/content/full/329/7465/546.

drawn at different times might give different results. Since the process of publication is dynamic, and citations to publications are a moving target, over time, one would expect that the index for a productive scholar would increase. A chart of this progression is shown in Figure 1.

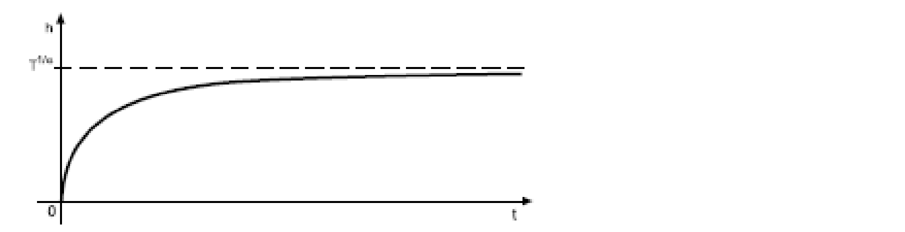

Figure 1: Chart of the growth of an *h*-index (from Egghe (2007))

As the figure shows, the *h*-index grows in a logarithmic pattern until it is asymptotic to a level described by $T^{1/\alpha}$, where T is the number of the papers produced by an author and alpha is a proportionality constant of a Lotkaian system representing an empirically derived decay rate of scholarly productivity (Egghe, 2005). In this figure, T is the same as N_p (the set of papers) in the previous definition (Egghe and Rousseau, 2006).

2.4. Limitations to the "native" *h*-index

This pattern implies certain key considerations and initial short-comings for the use of what may be termed the initial or native *h*-index as a measure for scholarly influence. We will describe those shortcomings and then discuss the enhancements to the native h-index developed to address these limitations. The first limitation addresses the scholar who has had more time to produce cited articles. The longer an article is in print, the more opportunity it has to be cited. So, in general, all other things being equal, an author who has had N articles in print for a longer period than another author with N articles in print, will likely have a higher h index. Accordingly, we cannot say simply on the basis of the *h*-index that one author is more influential than another without ensuring that we have a comparable number of articles and article age. Without adjusting for productivity over time, one can only say that one author is more influential than another at present.

A second limitation deals with the instance wherein one article receives significantly more citations than other articles by the same author. The native h-index is insensitive to the total number of citations an article receives. It uses the citation count to rank the articles, but once ranked, the citation count is not considered in the calculation of the index value. For example, once ranked, it does not matter if the most-cited article has 50 or 5,000 citations, the index value is the same. But if one believes that papers cited more frequently than others are inherently more influential than less cited articles by an author, it can be argued that these relative differences should be recognized and factored into the calculation of the index.

Third, there are different citation patterns arising from different publication norms and traditions in different fields. For instance, the number of co-authors typically appearing on a work, and what venues and contribution kinds (web contributions, professional papers, and white papers *vs.* research journals) are typically cited may result in differences in the *h*-index for an entire field. For example, biologists are cited more often than physicists, who are, in turn, cited more often than engineers (Molinari and Molinari, 2008). Certain fields such as medicine and computer science often publish works with long lists of co-authors. Given that citation practices vary from field to field, we must take care, when we are comparing authors' influence, to adjust for sub-disciplinary or field-specific norms.[5]

[5] This has proven a problem in the medical field. It has been reported that, upon finding that authors in published studies in *The Journal of the American Medical Association* had little to do with the research reported in those articles, editorial policy was changed to require disclosure of an author's degree of participation in the research leading to the article (Business Week, 2008).

2.5. Responses to Limitations in the native h-index

Time-in-print Limitation Response.

One proposed correction for the age bias in the h-statistic is 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 papers of different ages. The *hc*-index does not rank the papers with simple citation counts. Rather, it takes each paper and assigns an age-adjusted 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. *Age* (*i*) is the age of paper *i* in years. A paper published in the current year has an *Age* (*i*) = 0. The symbol γ is a constant chosen to increase the effect of more recent papers as γ increases, and δ is a constant chosen to lessen the effect of older papers as δ increases. 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 similarly to the *h*-index, where the *hc*-index is the rank, and where the rank overtakes the corresponding $S^c(i)$ score. Thus we find, in contrast to the *h*-index, the *hc*-index will decline over time if an article ceases to be cited after some time or is cited at a diminishing frequency over time.

Extending our hypothetical example given above for Dr. C, we can show how the *hc*-index is calculated.

Table 2: Ranked articles for Dr. C for the *hc*-index

Rank by citation count	Year published	Article	Citations	$S^c(i)$	$S^c(i)$ Rank
2	2003	Accounting article	104	69	1
1	1991	CACM article	233	52	2
3	2000	IFIP article	86	38	3
4	2001	EJIS article	40	20	4
12	2007	CAIS article	9	18	5
8	2005	SAIS article	15	15	6
7	2004	SJIS article	17	14	7
5	2002	ISJ article	23	13.14	8
6	2003	SIGMIS article	19	12.67	9
11	1997	AMCIS article	13	4.33	10
10	1995	Semiosis article	14	4	11
9	1993	JAIS article	15	3.75	12

We added the year of publication to the Table 1 data, calculated the $S^c(i)$ for each article by the formula described above, and present the results in Table 2, where the articles are sorted in $S^c(i)$ descending order. We see that the formula has given more weight to more recent articles over older articles with more citations. For example, the Accounting article with 104 citations is ranked above the CACM article with 233 citations, because the CACM article has had 12 more years to gain citations. Similarly, the CAIS article with only nine citations has moved up ahead of many articles with more citations because it has had only one year to gain those citations, suggesting that it will become a very influential article. Applying the same algorithm to Table 2 as that in the *h*-index in Table 1, but using the $S^c(i)$ ranking, we see that there are nine articles with nine or more citations, the rest being less than nine. Hence, Dr C has an *hc*-index of nine.

2.6. Relative Citation Frequency limitation Response.

The *g*-index is designed to improve the *h*-statistic by giving more weight to highly cited articles. This index is defined as the largest number, such that the top *g* articles received (together) at least g^2 citations (Egghe, 2006). Thus, this index weights the index toward papers that are more highly cited. Again extending our hypothetical example for Dr. C, we arrive at Table 3:

Table 3: Ranked articles for Dr. C for the g index

Rank by citation count (g)	Year published	Article	Citations	sum(citations)	g2
1	1991	CACM article	233	233	1
2	2003	Accounting article	104	337	4
3	2000	IFIP article	86	423	9
4	2001	EJIS article	40	463	16
5	2002	ISJ article	23	486	25
6	2003	SIGMIS article	19	505	36
7	2004	SJIS article	17	522	49
8	2005	SAIS article	15	537	64
9	1993	JAIS article	15	552	81
10	1995	Semiosis article	14	566	100
11	1997	AMCIS article	13	579	121
12	2007	CAIS article	9	588	144
13	2006	JAIS article	7	595	169
14	2005	eService Article	8	603	196
15	1993	MISQ article	3	606	225
16	2001	ISR article	1	607	256
17	2002	Article	0	607	289
18	2003	Article	0	607	324
19	2004	Article	0	607	361
20	2005	Article	0	607	400
21	2006	Article	1	608	441
22	2007	Article	0	608	484
23	2008	Article	0	608	529
24	1995	Article	0	608	576
25	1996	Article	0	608	625

Here, the articles are also ranked in terms of citations, descending from highest to lowest. The rank squared is calculated and termed g^2. For each article, we compute the sum of the citations for the articles above that article plus the citations for that article. The *g*-index level is the point where the sum of the articles is higher than or equal to g^2, and the sum of citations for each remaining article is less than g^2. In this example, that point occurs at the 24th article; so our hypothetical Dr. C would have a *g*-index of 24.

3. Methodology

To demonstrate the utility of the Hirsch family of indices, we performed two studies. In the first study, we replicated a study done by Lowry, Karuga, and Richardson (2007) that assessed the influence of scholars based on citation counts of articles published in MISQ, ISR, and MS. We used the Hirsch family indices in the place of citation counts to assess influence. In the second study, as a comparison to the largely North American scholar base presented in Lowry et al. (2007), we mimicked their sampling approach to select a set of non-North American scholars.[6] We sought to show the venue independence of influence by repeating the study methodology using scholars drawn from EJIS and ISJ. We took lists of scholars, from the Lowry et al. (2007) work for our first study and extracted scholars from each article in EJIS and ISJ for our second study. From these lists, we calculated lifetime Hirsch family indices for each scholar.

In the present study, we utilized the Publish or Perish (PoP) tool (Harzing, 2008c) to compute the various Hirsch family statistics. PoP is a freely available software tool that retrieves data from Google Scholar™, analyzes the data computes various indices and reports the results (Harzing, 2008a). Google Scholar™ (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 such as books, dissertations, conference papers, and non-ISI journals. Second, GS's search and retrieval considers all authors instead of only the first listed author. Failure to recognize an author's contribution if he is not in the first author's position under represents the influence of that author.[7] Third, GS is able to aggregate minor variations of the same publication title into a single item. Fourth, GS includes Languages Other than English (LOTE) sources that are generally not included in the WoS. And fifth, GS 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 the WoS. Also, GS's automated search process occasionally returns nonsensical results and is not updated as frequently as WoS (Harzing, 2008a). However, GS's inclusion of non-journal sources such as books, dissertations, and conference papers; retrieval for all authors; LOTE materials; and superior coverage of information systems items make it a superior tool that should be used in future studies of this type.

For the first study, to directly compare our results with those of Lowry et al. (2007), we compiled a composite list of all the authors mentioned in their three lists given in their Appendix 5. In this appendix, Lowry et al. (2007) created three rankings using different methods to treat the citations. These different methods resulted in different rankings of scholars in the top 100. To compile our list of scholars, we created a composite list of all of the authors listed in the three different versions provided by Lowry et al. The compiled list yielded a total of 133 researchers. This list appears to be disproportionately North American in representation.

The objective of the second study was 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. Therefore, we acquired the list of authors that had published in two leading European IS scholarly journals–the *European Journal of Information Systems (EJIS)* and the *Information Systems Journal (ISJ)*. 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.[8] Data was taken from EJIS and ISJ

[6] In this study, we use the term North American to refer to those scholars who publish their work primarily in the North American journals such as MISQ, ISR and JMIS. The term European refers to those scholars who publish primarily in European journals such as EJIS and ISJ. Transnational scholars is a term that we will use to refer to those select few scholars who publish in both venues.

[7] The counting of only first authors in the ISI applies to pre-1992 articles, but not to those published after 1992. For more detail on how the WoS and other citation sources recognize authorship, see Harzing 2008a .

[8] 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*

from the years 2000-2004. This time frame was the same as one of the timeframes taken by the Lowry et al. study. This process produced a list of 363 authors.

We then enter the names on each list into PoP using the following process. We recognized early on that PoP would yield different results depending upon the details of how we searched the database. 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 were necessary. Also, certain names resulted in a large number of extraneous listings of scholars with similar names but who were not from the IS field. This suggests that, in the conduct of such research, one has to have a general awareness of the IS research community. The larger number of hits was not an issue with relatively unique names such as Mingers'; however it was a huge issue with names like "M Smith." Therefore, exclusion of extraneous articles was 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), for example. However, when any one of the categories was turned off, this article would not be displayed. Because of this inconsistency and the desire to count all of an author's cited works, we chose to leave all the categories on. We also had to be attentive to occasional misspellings or affectations arising from foreign language keyboards. For instance, data returned from Google Scholar sometimes reports Michael Gallivan's name as "GaUivan" — with the two L's being recognized as a "U". The final process is listed as follows:

1. Enter the name as listed in Lowry et al. (2007). This name was usually listed as "Taylor, S" or "Myers, MD." For the scholars publishing in non-North American journals, we enter 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 MS) 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 are given, for example: "Michael Myers" or "MD Myers."
4. Review each article from the most cited to the articles at a level one lower than the h index reported by PoP. Articles that were not authored by the scholar being examined are "deselected" so as to eliminate them from the calculation of the indices.
5. The values for the h, hc, and g indices are captured in a spreadsheet.

Two of the authors each entered all of the names into PoP and then compared the results. When 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.

4. Results

4.1. The Value Added by the Hirsch Family Approach.

Table 4 below shows a comparison between Lowry et al.'s (2007) ranking based on total citation count and the results of a ranking based on the h, hc, and g indices. In comparing the rankings, we note that there is substantial disconnect between the results produced by the Lowry et al. method and the method utilizing the Hirsch indices. The Lowry rankings for 2000-2004 provided in their Appendix 5 only correlate 8.93 percent with the *h*-index, 12.65 percent with the *hc*-index, and 32.47 percent with the *g*-index. Additionally, we note that some authors at the bottom of the Lowry et al. rankings were at the top of the *h*-index ranking. For example, while Isak Benbasat and Eric Brynjolfsson received similar positions in both rankings, Andy Whinston ranked 90th in the Lowry et al. ranking and first in the *h-index* ranking, and Bill King ranked 74th in Lowry et al.'s ranking and 15th in the *h*-index

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.

ranking. This low correlation is attributable to two factors. First, there is a wider range of data available in PoP compared with that in the ISI Web of Science utilized by Lowry et al. (2007). Second, they collected citations only for those papers reported in MISQ, ISR, and MS during the period studied, whereas we had access to all the data available in GS. So we were looking at a scholar's total productivity, whereas Lowry et al. were examining the citations to a specific set of articles appearing in a few premier journals over a specific time period. Third, as one would expect, the method of calculation of the indices results in a significant difference in results from that achieved by Lowry et al. (2007).

Table 4: Comparison of the h-indices values with the results from Lowry, et.al, (2007)-

Lowry Citation Rank	Author's Name	Total Citations	h-index Rank	*h*-index	*g*-index Rank	*g*-index	Hc-index Rank	Hc-index
90	Whinston,A	112	1	42	9	76	6	24
1	Benbasat,I	976	2	41	5	85	8	22
4	Brynjolfsson,E	551	3	40	1	103	1	30
31	Grover,V	233	3	40	13	69	5	25
48	Banker,RD	174	5	38	7	84	8	22
36	Nunamaker,J	208	6	37	25	62	17	19
44	Venkatraman, N	183	6	37	5	85	7	23
3	Orlikowski,WJ	640	8	36	3	102	2	27
89	Barney,JB	112	9	35	4	101	3	26
16	Jarvenpaa,SL	334	9	35	8	79	8	22
51	Kraemer,KL	170	9	35	25	62	17	19
11	Robey,D	458	9	35	19	66	17	19
9	Straub,D	493	9	35	10	75	3	26
5	Zmud,R	538	14	34	11	74	12	20
23	Dennis,AR	267	15	32	16	68	17	19
53	Igbaria,M	164	15	32	27	60	12	20
74	King,WR	125	15	32	40	51	30	16
38	Ives,B	203	18	30	23	64	38	15
52	Valacich,JS	165	19	29	21	65	29	17
39	Watson,R	203	19	29	35	53	24	18
83	Poole,MS	114	21	28	16	68	24	18
50	Kemerer,CF	172	22	27	13	69	17	19
17	Alavi,M	328	23	26	21	65	17	19
69	Davis,GB	127	23	26	24	63	30	16
73	Kauffman,RJ	125	23	26	52	45	24	18
84	Vogel,D	114	23	26	38	52	43	14
40	Gefen,D	195	27	25	29	57	8	22
24	Hitt,L	266	27	25	13	69	12	20
66	Northcraft,GB	134	29	25	49	46	54	12

98	Srinivasan,K	103	29	25	52	45	17	19
33	Agarwal,R	221	31	24	35	53	12	20
94	Bostrom,RP	109	31	24	58	44	43	14
29	Davis,FD	242	31	24	1	103	30	16
12	Mukhopadhyay ,T	416	31	24	34	54	30	16
57	Smith,MD	150	31	24	19	66	12	20
99	Walsham,G	102	31	24	31	56	30	16
61	Watson,HJ	146	31	24	67	40	49	13
6	Venkatesh,V	531	38	23	12	70	24	18
8	Higgins,CA	502	39	22	28	59	49	13
62	Huff,S	145	39	22	62	41	54	12
96	Keil,M	107	39	22	49	46	24	18
28	Sambamurthy, V	248	39	22	62	41	30	16
64	Webster,J	137	39	22	49	46	38	15
47	Barua,A	180	44	21	62	41	38	15
85	Connolly,T	113	44	21	38	52	43	14
92	Guimaraes,T	111	44	21	71	37	59	11
45	Weill,P	182	44	21	43	50	30	16
13	Wetherbe,JC	416	44	21	45	49	59	11
35	Kekre,S	213	49	20	62	41	67	10
60	Kettinger,WJ	146	49	20	52	45	43	14
76	Swanson,EB	123	49	20	70	39	49	13
100	Wei,KK	102	49	20	79	32	54	12
86	Earl,MJ	113	53	19	40	51	43	14
95	George,JF	107	53	19	52	45	54	12
22	Goodhue,DL	290	53	19	52	45	49	13
32	Leidner,DE	224	53	19	18	67	30	16
82	Martocchio,JJ	114	53	19	71	37	59	11
63	Myers,M	137	53	19	35	53	38	15
55	Klein,HK	159	59	18	40	51	54	12
43	Lee,AS	185	59	18	43	50	38	15
68	Pitt,LF	129	59	18	73	36	59	11
46	Dexter,AS	181	62	17	62	41	72	9
72	Howell,JM	125	62	17	45	49	43	14
7	Mclean,ER	510	62	17	32	55	59	11
54	Segars,AH	162	62	17	96	18	49	13
67	Trauth,EM	131	66	16	79	32	59	11
21	Barki,H	295	67	15	67	40	67	10

49	Gurbaxani,V	174	67	15	47	47	59	11
58	Morris,MG	149	67	15	60	43	67	10
80	Beath,CM	119	70	14	76	33	79	8
2	Todd,P	695	70	14	32	55	59	11
14	Bakos,J	352	72	13	29	57	67	10
75	Chidambaram, L	124	72	13	84	29	72	9
27	Hartwick,J	248	72	13	52	45	72	9
41	Karahanna,E	193	72	13	47	47	72	9
88	Kirsch,LJ	113	72	13	86	27	72	9
78	Kriebel,CH	122	72	13	76	33	87	6
37	Cooper,RB	206	78	12	75	34	87	6
42	Newman,M	189	78	12	88	26	83	7
26	Thompson,RL	252	78	12	61	42	67	10
18	Brancheau,JC	328	81	11	67	40	83	7
10	Delone,WH	481	82	10	82	31	72	9
59	Niederman,F	149	82	10	88	26	83	7
20	Taylor,S	302	82	10	58	44	72	9
34	Adams,DA	214	85	9	76	33	79	8
71	Choudhary,V	126	85	9	98	13	79	8
91	Fuerst,WL	111	85	9	85	28	93	5
19	Moore,GC	312	85	9	73	36	93	5
25	Nelson,RR	263	85	9	88	26	83	7
81	Janz,BD	116	90	8	93	25	79	8
56	Reich,BH	155	90	8	88	26	87	6
79	Stoddard,DB	121	90	8	86	27	87	6
15	Compeau,D	340	93	7	82	31	87	6
77	Kavan,CB	122	93	7	93	25	87	6
30	Mathieson,K	241	93	7	79	32	93	5
97	Guha,S	105	96	6	100	7	93	5
70	Iacovou,CL	127	97	4	88	26	97	3
93	Mata,FJ	111	98	3	95	22	97	3
65	Melone,NP	135	98	3	97	17	99	2
87	Kalathur,S	113	100	2	99	12	100	1

Fourth, Lowry et al. ranked the scholars based on a simple citation count of papers identified. In theory, this might include some scholars with a small number of published papers that were cited very highly. In contrast, 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. Consider, for example, Peter Todd, who was ranked #2 by Lowry et al. (probably on the basis of a huge number of citations to Taylor & Todd (1995) in ISR), but who is only tied for #70 in our study. We conclude that Lowry et al.'s ranking approach did not consider the overall contribution of the scholar. That approach, by intentionally constraining which articles in which journals were counted in assessing a scholar's work, privileged scholars who published in those journals in that time period and who had large numbers of citations to those specific articles.

4.2. Comparative Power of the Hirsch Indices

The power of the Hirsch indices can be further illustrated by comparing the list of scholars generated from the MISQ/ISR/MS sample found in Lowry et al. and the selection of scholars chosen from EJIS and ISJ (Table 5). The rankings in Table 5 were determined by sorting first on the *h*-index, within that on the *hc*-index, and then on the *g*-index. Comparing the two tables (Table 4 and 5), we make the following observations between the lists.

1) Little Overlap between the Lists. There are only seven names that overlap both lists; this is an overlap of authorship of only 1.94 percent among the top 100 authors generated by our search of EJIS and ISJ and the list of the top 134 authors generated by Lowry et al. (2007) from MISQ, ISR, and MS. A qualifying statement should be made here. The fact that an author doesn't appear on a list does not mean he or she did not publish in those journals. For example, Leslie Willcocks appears as #6 on our list of scholars whose publications in EJIS/ISJ were frequently cited, but he does not appear on the list generated by Lowry et al. for authors whose papers in MISQ/ISR/MS were frequently cited. Willcocks did, in fact, publish in MISQ in 1998 and 1993, but these publications received four and one citations, respectively, and therefore, were not significant in the calculation of the h-statistic and presumably did not allow him to make the top 100 list produced by Lowry.

The low overlap supports previous research indicating that, in general, these European and American journals have different author bases. The different authorship result is consistent with that of Lyytinen *et al.* (2007), which found that European scholars provide only 3-6 percent of the author pool for MISQ and ISR. The low overlap finding indicates that these two groups of journal authors have a somewhat parochial perspective, with each preferring to publish in its own preferred journals. In Table 5, we highlight the common authors among the 133 found in all three Lowry, et al. (2007) lists. Two of the scholars, Rudy Hirschheim and Peter B. Seddon, were not in the top 100 scholars based on total citations ranked by Lowry et al. (2007), but were on the other lists ranked by a weighting of number and order of authors. They don't appear in Table 4, but are highlighted in Table 5 to demonstrate the overlap among all the lists. Only the most highly influential scholars appear to publish in both venues.

Table 5: 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, Stenmark	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

2) T**he Transnational Scholars.** In addition to the regionalism observed in the two tables (Tables 4 and 5), we see that the names that do overlap tend to belong to those who are the most influential scholars. Five of the seven that overlap are found in the top 10 scholars on each list. The finding of overlapping scholars in the top 10 indicates that only the most influential scholars could or would publish in both groups of journals. The overlapping scholar finding seems to indicate that only those scholars are able to or choose to transcend the regional publication standard differences involved in publishing in these journals.

Additionally, since these transcontinental scholars occupy four of the top five spots, they create a significant portion of the overall influence of the EJIS/ISJ scholars. If these scholars are removed from the EJIS/ISJ list, the average *h*-index drops from approximately 18 to approximately 17; a decrease of 5 percent.[9] The upper end of the range of the *h*-index values also drops from 42 to 35.

3) Differential Influence. Besides the distinct publication patterns, upon examining the h-indices, we see that the scholars publishing in EJIS/ISJ are less influential than those publishing in MISQ, ISR, and MS (Table 6). In Table 6, we have the mean values for the *h*, *hc*, and *g* indices for the MISQ/ISR/MS or Lowry et al. (2007) list, and the EJIS/ISJ list. One can see that the MISQ/ISR/MS mean is always higher than the EJIS/ISJ mean. The Percent Difference is also given, which is the percentage amount that the EJIS/ISJ mean covers the mean of the MISQ/ISR/MS list. The Percent Difference is calculated by taking the EJIS/ISJ mean divided by the MISQ/ISR/MS mean. In examining the average values, we see the indices for the EJIS/ISJ scholars are 74 percent, 81 percent, and 61 percent, respectively, of the MISQ/ISR scholars, indicating that, in general, scholars publishing primarily or exclusively in the European journals have about 75 percent of the influence of those publishing in the North American journals (Table 6). Two-tailed t-tests show that the scholars from Table 4 are significantly different in all of the Hirsch indices from those in Table 5, indicating that they do not have the same level of influence.

[9] It was suggested by a reviewer that the transnational elite might have achieved their high index values because they are journal editors and their high index values result from citation of their editorial output: a kind of editorial bias. We tested this assumption by removing the editorial articles from representative editors such as Lee, Benbasat, Straub, Saunders, and Baskerville in the analysis. We found that removing these articles does **not** result in a decrease in the editor-author's indices except in the case of Alan Lee, for whom it only resulted in a one point decrease. We conclude, therefore, that there does not seem to be an editorial bias in the publication records of the transnational elite. Further, we hypothesize that these scholars achieved their journal editor status as a result of their publication and other achievements. It seems the editorial articles are not highly cited and, therefore, do not unduly influence the various h-indices.

Table 6: Comparison of average 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%

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 while remaining statistically significantly different (Table 7). Two-tailed t-tests again show that the top 25 scholars from Table 4 are significantly different in all of the Hirsch indices from those in Table 5, indicating that they do not have the same level of influence. We find a similar pattern, the top 25 scholars publishing in the European journals are 81 percent, 83 percent%, and 67 percent as influential as those publishing in the North American Journals.

Table 7: 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%

Thus, in reviewing the comparative data between the authors publishing in MISQ/ISR/MS and those publishing in EJIS/ISJ, we find that, on average, those publishing in MISQ/ISR/MS are more influential. However, and quite interestingly, when examining the indices, we see that the *hc*-index of the EJIS/ISJ scholars is closer to the *hc*-index scores of MISQ/ISR/MS scholars than are the respective *h*-index scores. From this we infer that their most recently published EJIS/ISJ articles are more influential than their older articles and that their influence is approaching that of their North-American peers. In effect the EJIS/ISJ authors' influence growth rate is faster than that of their Northern American counterparts.

However, since the *g*-index of the EJIS/ISJ scholars is much lower than that of the *h*-index or the *g*-index, we take this to mean that the MISQ/ISR/MS scholars have an edge when it comes to writing the occasional "monster hit" or extremely well cited paper, (e.g., Davis (1989) or Delone and McLean (1992, 2003)). In short, we find that EJIS/ISJ publishers have steady and continuous citations streams with fewer blockbusters.

Table 8 combines the list of scholars from Tables 4 and 5 and shows the scholars' h, hc and g indices and the ranking within each of the indices. The combined table is presented in descending order by the *h*-index ranking. The blue highlighting indicates the transnational scholars; green, the European scholars; those unhighlighted are those publishing only in North American journals.

Table 8: Combined Results Table for the Study						
Author's Name	h- index Rank	*h*- index	*g*- index Rank	*g*- index	Hc- index Rank	Hc- index
Whinston,A	1	42	10	76	6	24
Benbasat,I	2	41	5	85	8	22
Brynjolfsson,E	3	40	1	103	1	30
Grover,V	3	40	14	69	5	25
Banker,RD	5	38	7	84	8	22
Venkatraman,N	6	37	5	85	7	23
Nunamaker,J	6	37	27	62	21	19
Orlikowski,WJ	8	36	3	102	2	27

Hirschheim, R.	8	36	14	69	12	21
Barney,JB	10	35	4	101	3	26
Huber, G. P.	10	35	8	82	13	20
Jarvenpaa,SL	10	35	9	79	8	22
Straub,D	10	35	11	75	3	26
Robey,D	10	35	21	66	21	19
Kraemer,KL	10	35	27	62	21	19
Zmud,R	16	34	12	74	13	20
Willcocks, L.	17	33	31	57	21	19
Dennis,AR	18	32	18	68	21	19
Igbaria,M	18	32	29	60	13	20
King,WR	18	32	47	51	39	16
Ives,B	21	30	25	64	52	15
Lyytinen, K.	21	30	31	57	21	19
Valacich,JS	23	29	23	65	37	17
Watson,R	23	29	41	53	31	18
Poole,MS	25	28	18	68	31	18
Ciborra, C.	25	28	44	52	13	20
Lederer, A. L.	25	28	52	49	39	16
Love, P. E. D.	25	28	104	35	21	19
Kemerer,CF	29	27	14	69	21	19
Alavi,M	30	26	23	65	21	19
Davis,GB	30	26	26	63	39	16
Vogel,D	30	26	44	52	68	14
Chen, C.	30	26	64	45	13	20
Kauffman,RJ	30	26	64	45	31	18
Hitt,L	35	25	14	69	13	20
Gefen,D	35	25	31	57	8	22
Galliers, R. D.	35	25	56	47	39	16
Northcraft,GB	35	25	60	46	92	12
Srinivasan,K	35	25	64	45	21	19
Akkermans, H.	35	25	72	44	39	16
Zairi, M.	35	25	78	41	52	15
Davis,FD	42	24	1	103	39	16
Smith,MD	42	24	21	66	13	20
Walsham,G	42	24	36	56	39	16
Mukhopadhyay,T	42	24	40	54	39	16
Agarwal,R	42	24	41	53	13	20
Bostrom,RP	42	24	72	44	68	14
Thompson, S. H. Teo	42	24	78	41	52	15
Watson,HJ	42	24	86	40	77	13
Venkatesh,V	50	23	13	70	31	18
Dix, Alan	50	23	31	57	77	13
Jones, S.	50	23	64	45	39	16
Higgins,CA	53	22	30	59	77	13
Keil,M	53	22	60	46	31	18
Webster,J	53	22	60	46	52	15

Sambamurthy,V	53	22	78	41	39	16
Huff,S	53	22	78	41	92	12
Swan, Jacky	53	22	89	39	52	15
Mathiassen, Lars	53	22	89	39	77	13
Sarkis, J	53	22	104	35	52	15
Paul, Ray	53	22	156	25	92	12
Connolly,T	62	21	44	52	68	14
Weill,P	62	21	50	50	39	16
Wetherbe,JC	62	21	52	49	110	11
Mingers, J	62	21	55	48	52	15
Kettinger, Wm	62	21	60	46	68	14
Y. K. Chau, P	62	21	75	43	52	15
Barua,A	62	21	78	41	52	15
Heeks, R	62	21	89	39	37	17
Guimaraes,T	62	21	97	37	110	11
Rouncefield, M.	62	21	107	34	52	15
Johnston, R. B.	62	21	166	23	68	14
Baskerville, R	73	20	56	47	52	15
Kettinger,WJ	73	20	64	45	68	14
Kekre,S	73	20	78	41	127	10
Swanson,EB	73	20	89	39	77	13
Ramamurthy, K.	73	20	94	38	77	13
O'Keefe, R	73	20	100	36	92	12
Wei,KK	73	20	120	32	92	12
Irani, Z	73	20	130	30	52	15
Leidner,DE	81	19	20	67	39	16
Myers,M	81	19	41	53	52	15
Earl,MJ	81	19	47	51	68	14
Goodhue,DL	81	19	64	45	77	13
George,JF	81	19	64	45	92	12
Chalmers, M	81	19	97	37	52	15
Martocchio,JJ	81	19	97	37	110	11
Newell, S	81	19	107	34	77	13
Crabtree, A	81	19	111	33	39	16
Sharrock, W	81	19	111	33	110	11
Klein, G	81	19	130	30	77	13
Klein,HK	92	18	47	51	92	12
Lee,AS	92	18	50	50	52	15
Alter, S	92	18	78	41	92	12
Saunders, C	92	18	100	36	77	13
Pitt,LF	92	18	100	36	110	11
Jiang, J. J.	92	18	107	34	92	12
Giaglis, G	92	18	148	26	77	13
Carroll, J	92	18	177	21	92	12
Wigand, R	100	17	37	55	92	12
Mclean,ER	100	17	37	55	110	11
Howell,JM	100	17	52	49	68	14

Dexter,AS	100	17	78	41	144	9
Rafaeli, S	100	17	89	39	92	12
Montoya-Weiss, M. M.	100	17	94	38	77	13
Klein, S	100	17	104	35	77	13
Rai, A	100	17	111	33	92	12
Sahay, S	100	17	120	32	92	12
Land, F	100	17	130	30	144	9
Strong, D	100	17	179	20	92	12
Segars,AH	100	17	185	18	77	13
Sharma, R	100	17	185	18	144	9
Ackermann F	113	16	120	32	92	12
Trauth,EM	113	16	120	32	110	11
Martinsons, M. G.	113	16	136	28	110	11
Gurbaxani,V	116	15	56	47	110	11
Morris,MG	116	15	75	43	127	10
Barki,H	116	15	86	40	127	10
Iivari, J	116	15	120	32	127	10
Magoulas, G	116	15	139	27	77	13
Zhu, K	116	15	148	26	52	15
Kock, N	116	15	172	22	110	11
Rose, G M.	116	15	185	18	92	12
Todd,P	124	14	37	55	110	11
Hughes, J.	124	14	94	38	68	14
Valerie Belton	124	14	111	33	144	9
Beath,CM	124	14	111	33	161	8
Townsend, A M.	124	14	111	33	161	8
Byrd, T A	124	14	139	27	110	11
Massey, A. P.	124	14	139	27	127	10
Robertson, M	124	14	139	27	127	10
Vidgen, R	124	14	148	26	110	11
Dhillon, G	124	14	156	25	127	10
Currie, W	124	14	166	23	144	9
Sawyer, S	124	14	172	22	110	11
Doukidis, G	124	14	179	20	161	8
Huang, J. C.	124	14	194	14	144	9
Bakos,J	138	13	31	57	127	10
Karahanna,E	138	13	56	47	144	9
Hartwick,J	138	13	64	45	144	9
Tiwana, A	138	13	111	33	92	12
Kriebel,CH	138	13	111	33	186	6
Hart, P	138	13	126	31	110	11
Chidambaram,L	138	13	134	29	144	9
Smith, H. J	138	13	139	27	127	10

Kirsch,LJ	138	13	139	27	144	9
Davison, R	138	13	156	25	110	11
Pan, S L.	138	13	156	25	127	10
Powell, P	138	13	156	25	144	9
Liu, K	138	13	156	25	144	9
Avgerou, C	138	13	164	24	110	11
Swatman, P. A.	138	13	166	23	176	7
Buxmann, P	138	13	179	20	161	8
Beynon-Davies, P	138	13	182	19	161	8
Thompson,RL	155	12	77	42	127	10
Cooper,RB	155	12	107	34	186	6
Seddon, P B.	155	12	126	31	127	10
Peppard, J	155	12	130	30	127	10
Ngwenyama, O	155	12	136	28	161	8
Newman,M	155	12	148	26	176	7
Lee, H	155	12	166	23	127	10
Tudhope, D	155	12	182	19	161	8
de Moor, A	155	12	189	17	127	10
Edwards, J	155	12	193	15	161	8
Brown, S. A.	155	12	194	14	176	7
Brancheau,JC	166	11	86	40	176	7
Hendrickson, A R	166	11	134	29	176	7
King, M	166	11	139	27	31	18
Poon, S.	166	11	139	27	161	8
Kern, T	166	11	164	24	127	10
Smithson, S	166	11	166	23	144	9
Fitzgerald, G	166	11	166	23	176	7
Damsgaard, J	166	11	172	22	127	10
Stenmark, S	166	11	172	22	144	9
Randall, D.	166	11	177	21	161	8
Pries-Heje, J.	166	11	182	19	161	8
Montealegre, R.	166	11	185	18	161	8
Howcroft, D	166	11	189	17	144	9
Jain, H.	166	11	192	16	176	7
He, X	166	11	194	14	176	7
Taylor,S	181	10	72	44	144	9
Delone,WH	181	10	126	31	144	9
Niederman,F	181	10	148	26	176	7
Moore,GC	184	9	100	36	192	5
Adams,DA	184	9	111	33	161	8
Fuerst,WL	184	9	136	28	192	5
Nelson,RR	184	9	148	26	176	7
Choudhary,V	184	9	197	13	161	8

Stoddard,DB	189	8	139	27	186	6
Reich,BH	189	8	148	26	186	6
Janz,BD	189	8	156	25	161	8
Mathieson,K	192	7	120	32	192	5
Compeau,D	192	7	126	31	186	6
Kavan,CB	192	7	156	25	186	6
Guha,S	195	6	199	7	192	5
Iacovou,CL	196	4	148	26	196	3
Mata,FJ	197	3	172	22	196	3
Melone,NP	197	3	189	17	198	2
Kalathur,S	199	2	198	12	199	1

If the number of transnational, MISQ/ISR/MS, and EJIS/ISJ scholars are counted by decile of the h-index ranking, and the percentages are plotted, we arrive at Figure 2.

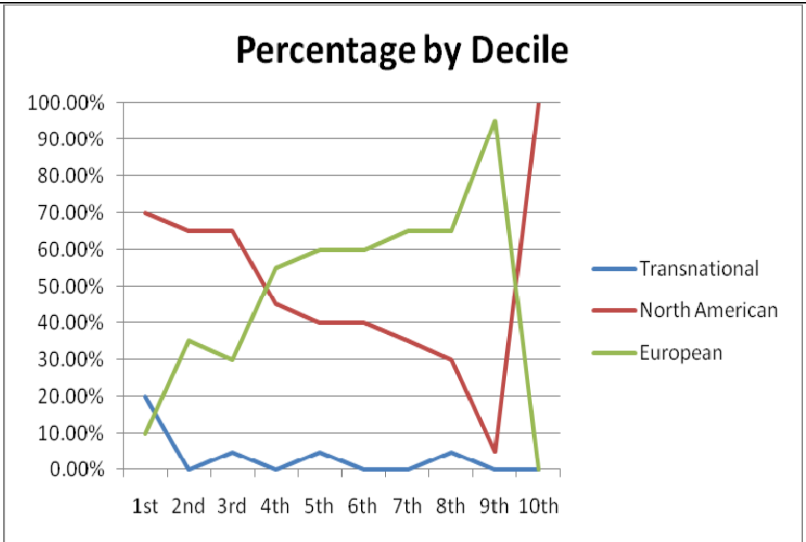

Figure 2. Percentage Composition of Each Decile

The transnational scholars are largely clustered in the top decile, with all but one being in the top half of the distribution. The MISQ/ISR/MS scholars decline as a percentage of the composition of the decile steadily, while the EJIS/ISJ proportion increases steadily until the last decile where the MISQ/ISR/MS scholars comprise the total group. We see that 40 percent of the North American (NA) scholars are found in the first three deciles, the next 40 percent of the NA scholars set are scattered between the 4th-9th deciles. And the last 20 percent of the NA scholar set are in the 10th decile. This compares to the European scholar set, 15 percent of whom are found in the 1st-3rd deciles and the remaining 85 percent who are in the 4th-9th deciles. Thus, the European set is clustered in the middle, and the NA scholars are at the tails of the distribution.

Figure 2 suggests that the European journal scholar set, while not as influential, on average, as the North American journal scholar set, is as a whole, more tightly bunched around a common level of influence. This tight grouping means that for the Europeans scholars to make the top 100 requires having relatively more influence than for the North American scholars. That is, for the scholars who published in these journal sets during the period covering this analysis, to make the top 100 European scholar list, they had to have an h index higher than 11. Whereas, to make the top 100 US scholar list scholars only had to have an h index higher than 2.

4) Having disciplinary influence without publishing in MISQ/ISR/MS. This study shows that, in general, the MISQ/ISR/MS scholars are more influential than their EJIS/ISJ counterparts. Importantly, however, this study also shows that scholars who do not publish in MISQ/ISR/MS can achieve high levels of influence. For instance, Willcocks, Ciborra, and Love obtained *h*-index ratings over 27 without publishing highly cited articles in those journals. As noted above, Willcocks had two relatively insignificant articles in those journals, while Ciborra and Love did not publish in those journals at all. Their influence was generated by publication in EJIS and ISJ rather than MISQ/ISR/MS. Similarly, the most influential works of Peter Checkland, who did not appear on either list, are the books in which he articulated his Soft Systems Methodology. His *h/g/hc* indices are 28, 102, and 15 respectively, which compare with the highest scholars on either list. He did publish in ISR in 1991 and EJIS in 1995; however, those papers were not his most influential works. His books are, by far, more cited than either of those papers. Thus Checkland's influence is generated through his books.

5. Discussion

5.1. Limitations

This study is limited by the following considerations. First, as indicated above, while providing a more representative universe of cited works than other citation sources, the Google Scholar data source is not a complete source of bibliographic information. So while *Google Scholar*, like other data sources improves over time, it is incomplete and may not properly represent the influence of a scholar. Second, in this study we only assessed scholars who published in five different journals. Therefore, the findings should not be considered as a listing of "the most influential IS scholars." These findings only compare the influence of the authors who published in these venues during the time period considered. To generate a "most influential scholars" list would require a list compiled of scholars from many different sources. Third, the use of the Hirsch indices should not be considered 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 and Griffith, 1981, Zhao, 2006).

Additionally, as noted above, the Hirsch indices have limitations. Care should be taken when making comparisons across differing citation subcultures such as those arising from geographic or sub-disciplinary boundaries. The work reported herein does not cross sub-disciplinary boundaries. This work is based on generalist IS journals that publish a certain subset of the IS discipline: the IS management and generalist subset. By drawing our data from generalist journals, we are excluding some important segments of the IS community such as the Design Science and software engineering communities, which typically have not been published in those journals.

This paper compares the influence of authors publishing in journals based in North America and Europe. So one might ask if this is violates the limitation of comparing across geographic subcultures? The answer is yes *only if* it entails comparing regions with *different citation practices*. It has been argued that the European *publication culture* is different from that of North America but not that the citation practices differ from those in North American journals. For instance, Lyytinen et al. (2007) have pointed to differences in publication culture. According to them, European scholars have different views of (1) the contribution, (2) the writing, (3) the orientation, (4) the goals, (5) what counts as a valid knowledge claim and how you communicate it, and (6) the reviewing benefit of academic publication. Additionally, they tend to eschew the incremental contribution of the article, favoring instead the paradigm-shifting conception of the book. All of these differences contribute to what might be an explanation for why they aren't published more frequently in North American journals. However, what would matter from the standpoint of the Hirsch family of indices would be differences in the ***citation culture*** between the two populations. We find no empirical evidence that the citation culture of European IS researchers differs from that of North American researchers. Accordingly, we assume that the citation culture of European scholars is similar to that of North American scholars.

Additionally, in this study, we did not examine scholars' citation records for excessive self-citation. In future studies, citation records should be checked for excessive self-citation. As self-citation does not expand one's influence in the field, these citations should be removed from the record and not considered in calculation of the indices.

Finally, as noted above, this is not the last word in the assessment of influence. The statistics should be used in a general program that includes social network analysis and co-author and co-citation analysis. These should be factored along with a description of each author's research agenda and field of research so that proper comparisons can be made between scholars.

5.2. Ranking Methodologies

Our findings indicate the incomplete nature of ranking methodologies such as that employed by Lowry et al. (2007). To simply extract a set of articles from journals held *apriori* 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.

Previous studies, Takeda and Cuellar (2008) and Cuellar, Takeda, and Truex (2008), suggest that MISQ is the most influential IS journal and that ISR and *Journal of Management Information Systems (JMIS)* are next in influence within the IS community. However, this study demonstrates that while MISQ, ISR, and the IS articles from *MS* 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 EJIS/ISJ scholars show that there are some exceptional cases, where certain scholars achieved equivalent levels of influence without having published in the three North American premier journals examined in Lowry et al. (2007). Accordingly, ranking studies that narrowly bound the venues, privilege, or weigh certain venues as being more influential than the empirical data shows, distort 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, techniques like ranking studies, wherein only select journals count, militates against European scholars who write books and publish only or predominantly in European journals.

The use of the Hirsch family of indices changes the discussion from the *venue of publication* to the *consumption of publication*. As Singh (2007) pointed out, premier journals, for many reasons, don't publish all the influential articles nor do they publish only influential articles. To focus on only publications in a certain set of venues creates a distortion of the measurement of influence. The use of the Hirsch indices places the emphasis on how the scholarly output is consumed rather than where it is published. This change in emphasis removes the subjectivity from the part of the process dealing with selection of premier journals and their evaluation. The Hirsch indices would also, if widely adopted, eliminate the log jam of articles pending at the premier journals and foster the creation of "open publication and review" journals (Easton, 2007), which, along with electronic search engines, dis-intermediate the journals and replace them with Internet-based publishing methods.

To accomplish this shift, it is important that a complete and inclusive a publication record for each a scholar is 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.

In terms of indices, we suggest 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. We suggest that the present processes deployed are *atheoretical* because they are based in the pragmatic need to access scholarly import without having to go through the time and subject area knowledge-intensive effort to examine the subject scholar's papers in detail. This process is based on intuited assumptions of the nature of premier journals and not on a theory of journal quality or of scholarly influence.

The use of the Hirsch indices is one step toward redressing these limitations in our current assessment of scholarly importance. These measures provide a theoretically based approach to the assessment of influence that considers both quantity and uptake of publication as well as the obsolescence of papers.

Some suggestions have been made to exclude "non-scholarly IS journals" such as Harvard Business Review or Sloan Management review (Gallivan and Benbunan-Fich, 2007). We argue that this determination depends on the type of influence desired to be assessed. To arrive at a scholar's complete influence across all areas — research, practice, and the public perception — one must include all different venues. Only if one desires to consider the impact on other scholars should the number of venues be limited to Scholarly IS journals.

Another perspective that this study illustrates is the analytical capability inherent in the use of the Hirsch indices. As opposed to simple rankings the Hirsch indices permit analysis of the comparative influence of scholars and groups of scholars. (*c.f.,* Cuellar, Takeda and Truex, 2008 for use of the indices in simple statistical analysis). Thus, instead of attempting to infer that a scholar with a ranking of six is more influential than one with a ranking of seven, we can evaluate the *h*-indices and determine how much more influential one scholar is than another and if a scholar is statistically and significantly more influential than another.

5.3. Comparative Influence

In this present work, we explicitly examined the question of whether publication in adjudged top tier North American vs. top-tier European journals signals a difference in scholarly influence. This study showed that the authorship of articles in EJIS/ISJ was substantially different from that of MISQ/ISR/MS. The small overlap in authors tended to be that of a select few scholars who are able to publish in many journals. The results also showed that influence of the EJIS/ISJ author base is not, as yet, as influential as that of the MISQ/ISR/MS base, but that that this situation may be changing. Given the presence of the transnational authors, this indicates that the "bench" of scholars publishing in EJIS/ISJ is not currently as deep as that in MISQ/ISR/MS. This is indicated by a steeper drop-off in the h statistic for the EJIS/ISJ authors than it is for the MISQ/ISR/MS authors. The *hc*-index for the EJIS/ISJ authors, however, was closer to that of the MISQ/ISR/MS authors than the *h*-index indicating that the most recent articles published were closer in influence, which suggests that the situation is moving closer to parity.

The presence of the scholars who have published in both the MISQ/ISR/MS journals and the EJIS/ISJ journals shows the impact of experience on the scholar. Each of the seven scholars that published in both lists has been active in research for more than 15 years. Over that time period, they have been able to develop the skills necessary to negotiate the diverse publication cultures of both groups of publications, and their publications have had more time in circulation and more time to influence other scholars.

An explanation for the differential influence of those that publish in the North American journals is not difficult to find. Lyytinen et al. (2007) have proposed explanations for why European scholars are not able publish in North American journals. They have pointed out that the "old world" possesses:

> *(1) the lack of appreciation of the article genre, (2) weak publishing cultures, (3) inadequate Ph.D. preparation for article publishing, (4) weak reviewing practices, (5) poorer command of research methods, (6) poorer understanding of the reviewing protocols, and (7) institutional shaping of research funding in Europe.(p. 317).*

Each of these factors could cause a decrease in influence. We focus on reasons one, two, and five in the following discussion. First, a focus on books vs. articles reduces the publication count and, therefore, automatically places a limit on the value of the *h*-index. We have seen, however, that those European scholars who have begun focusing more on articles have generated higher *hc*-index values, which indicates a potential change in this focus. Second, the weak publishing culture is manifested in a focus on the great leap vs. incremental advance, poetic vs. technical writing, philosophical discussion vs. technical analysis, and failure to adhere to the regimes of truth held by the journals (pp. 320-322). When scholars attempt to publish paradigm-shifting articles, or those which challenge the existing regime of truth, they are, as Kuhn suggested, subjected to intense scrutiny and critical challenge that, may, in turn, result in low rates of acceptance and subsequently low levels of citation. Similarly, using philosophical vs. technical argumentation results in a violation of the regime of truth not only of reviewers but also of readers that could result in lower uptake of their ideas. Third, poor command of research methods leads to what is perceived as non-rigorous writing, which could result in poor uptake of the propositions put forward by the articles and books. All of these issues could result in lower publication and, afterward to lower citation of their articles, leading to lesser influence on the part of those who publish in European journals.

Influence and Quality

In this paper we did not address the issue of scholarly *quality* directly. We certainly recognize that any field may need quality measures, but we see that issue as important work-in-progress that we do not tackle at this time. We are of the opinion that the 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. Article 1 is published in journal x and article 2 is not. Article 1 is, therefore, better. This scenario is flawed for two reasons.

First, such reasoning is flawed because there is evidence that publications in top-tier journals are not necessarily superior in quality than articles published in other venues (Singh et al., 2007). Singh et al. sought to identify type I and type II errors in management journal article acceptances. This subject is also addressed in a recent MISQ editorial by Detmar Straub (Straub, 2008). According to Straub, "The IS community's view of 'good' papers and 'weak' papers may not be known *a priori*, but citations are one way to assess this *post hoc*. The argument would be that stronger papers are cited more by the community than weaker papers …" (Straub, 2008, p. vi). Type I errors represent a research community's judgment, as reflected in low citation rates, that a paper is "weak." Similarly, a type II error represents the rejection of a paper that should have been accepted, and which may later turn out to be influential based on high citation rates. A type II error manifests itself by the rejected paper being published in a lesser regarded journal, ***and*** receiving a high number of citations.

Singh et al. (2007) found that 63 percent of "top articles"[10] were not published in the top journals either due to type II errors or to initial submission of the article to a "lesser" venue rather than a top journal. Further, they found that while top management journals did have high proportions of top articles they also noted that some 25 percent of the articles published in top tier journal were not rated as top articles (type I errors). So not all articles published in top-tier journals qualify as top articles. These findings indicate that top management journals are not the sole venue, nor even the majority venue, where these so called top articles are published.

Interestingly they also found that some non-top journals had similar or higher proportions of top articles compared to the top tier journals. A top journal may have a better long term "batting" average than other journals; but one can also conclude that publication in journals rated as other than top-tier does not necessarily relegate those articles to second-class status. Publication of an article in a non-top journal does not necessarily mean that its quality is less than that of an article published in a top journal. In fact, there is suggestion in this present study that influence, often used as a surrogate measure for quality, may be venue agnostic.

Second, 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

[10] Singh et al. defined a top article as one having eight or more citations. This is the mean number of citations for the articles in their study. In an analysis of citation data from the Social Science Citation Index, this yielded a total of 486 articles out of 1554 total. Thirty seven percent were published in the top five management journals and 63 percent were published elsewhere.

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 found in ranking studies was that respondents may 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, personal preferences, and whether they have been published in the journal (Podsakoff et al., 2005). Thus, research supports the notion that current methods of journal ranking are systematically biased.

At this point, we must stress that we are not arguing that the Hirsch indices should be used to evaluate the *quality* of scholarly output. These indices are measures only of influence and only point toward quality, but do not indicate it. Further research is required to create measures of quality from the Hirsch indices. At this time, Singh et al. (2007) may provide the best guidance toward an indicator of quality: to look for articles that are cited more than the mean for the field. Alternatively, for articles too young to have achieved a large citation count, publication in a journal that has a ratio of over 50 percent of "top" articles (those cited more than the mean) for the field might be an appropriate proxy for quality. However, we are quick to add, to our knowledge, there does not yet exist a theory of research paper quality nor a theory of journal quality. It is, however, a subject we ponder and are approaching in continuing work.

5.4. Implications for Research

We have shown that future work in influence studies of IS scholars should abandon the homegrown measures and approaches used in previous studies such as Lowry, Karuga and Richardson (2007) in favor of the metrics and approaches developed by the Information Science discipline. Such an approach will theoretically ground further studies and provide a ready reference for additional indices and approaches that can be applied to this area.

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. The tenure vs. pre-tenure study is possible by taking advantage of the time-based nature of the *h*-index (Egghe, 2007). Other areas for research would be to investigate the various constants used within the formulas. For example, Lotka's constant varies by academic field (Egghe, 2005). 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 a method of evaluating scholars on influence using the Hirsch indices, co-citation analysis, co-author analysis, and social network analysis.

5.5. Implications for Practice

In using PoP, we find that an approach such as the one we followed using two researchers cross checking their results is essential to achieve consistently. Knowledge of the subject scholars and their publication records would be useful in ensuring that all of the key publications for a scholar are considered in the research being performed. Without such an approach, not including key papers or misidentification of papers belonging to a scholar is a threat to valid results.

In evaluating scholarly influence, we recommend that P&T committees abandon the practice of evaluating a scholar's influence by publication in key journals. We suggest that a better practice is to compare the scholar's Hirsch indices against reference scholars at the same stage of their development. The *h*-index provides an indication of their overall influence. The *hc*- index indicates how influential their more recent output is. The *g*-index provides an indication of how their publication of "monster" articles affects their influence.

6. Conclusion

This paper suggests a new approach that the IS discipline could use to assess scholarly influence. We argue that this new approach to scholarly influence analysis in the IS field is needed because the existing methods of assessing scholarly influence are *atheoretically* derived, exhibit several types of systematic bias, and are methodologically incomplete. Because of these concerns, we suggest the IS discipline utilize the Hirsch family of indices and the Google Scholar™ search engine and demonstrate that by adopting this methodology, the IS field could overcome many of the issues related to bias (Walstrom et al., 1995) and politics (Gallivan and Benbunan-Fich, 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, our research does not accept that the measurement of scholarly influence requires one to 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. We suggest that using the Hirsch family of indices when applied to a wider set of publication venues, provides a fairer measure of scholarly influence than that presented by current approaches. In particular, the use of the Hirsch family of indices would help both faculty and administration engaged in the promotion and tenure process to compare scholarly influence across sub-disciplines in the IS research domain and even to compare influence with scholars in other fields. A better assessment method would add a greater degree of rationality and transparency to the P&T process.

While acknowledging our field needs quality measures, we did not address the issue of scholarly quality directly. We cautioned against existing quality measures 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, and 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.

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

We believe that the key contribution of this work is that in illustrating the application of the Hirsch family of indices, we offer theoretically based and less biased measures that can be used as part of a comprehensive methodology to assess scholarly influence. We tap into an extant and rich stream of research from the Information Sciences to compare scholarly influence, thus addressing the concerns relating to the lack of theoretical background in current approaches. Utilization of GS allows us to avoid the biases of subjective selection and limited viewpoint from the selection of a limited number of venues. By suggesting an extended program of research that couples the Hirsch indices with social network and influence analysis network techniques, we provide a research path leading to continuously improved means of assessing scholarly impact.

Finally, we would caution against reification by repetition. Simply stated, a danger exists 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 fostering a spirit of free and open discourse where the status quo may be challenged.

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About the Authors

Duane Truex, an Associate Professor of Computer Information Systems (CIS) in the J. Mack Robinson College of Business at Georgia State University, researches the social impacts of information systems and emergent ISD. He is an Associate Editor for the *Information Systems Journal* and has co-edited two special issues of *The Database for Advances in Information Systems.* His work has been published in the *Communications of the ACM, Accounting Management and Information Technologies, Communications of the AIS, The Database for Advances in Information Systems, the European Journal of Information Systems (EJIS), le journal de la Societé d'Information et Management (SIM), the Journal of the AIS, the Information Systems Journal (ISJ), the Scandinavian Journal of Information Systems, the Journal of Arts Management and Law, IEEE Transactions on Engineering Management*, and fifty-five other assorted IFIP transactions and edited books and conference proceedings.

Michael J. Cuellar is an Assistant Professor of Computer Information Systems at North Carolina Central University. His research focuses on the areas of project management, outsourcing and social theory for Information Systems. He has substantial experience in industry having held management positions for EDS and American Software managing software product development and infrastructure services, as well as systems management sales. He has published papers at conferences and journals such as *ICIS, AMCIS, the International Research Workshop on Project Management, the e-Services Journal* and *the European Journal of Operational Research.* He is a member of the Association for Information Systems and the Academy of Management.

Hirotoshi Takeda is a Graduate Advancement Program (GAP) Fellow and PhD student in Computer Information Systems at Georgia State University and the University of Paris Dauphine. He has degrees in electrical engineering and computer science from UC Irvine, a Masters of Electrical Engineering from the Georgia Institute of Technology and his MBA from Southern Methodist University. His research interests include discourse analysis, mobile computing, bibliometrics and knowledge management. His research has appeared in the proceedings of the AMCIS, SAIS, UKAIS, ICECON, IFIP WG 8.2, and ICIS SIG-ED.

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