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Michael J. Cuellar
Georgia State University, mcuellar@cis.gsu.edu

Hiro Takeda
Georgia State University, htakeda@cis.gsu.edu

Duane P. Truex
Georgia State University, dtruex@gsu.edu

THE HIRSCH FAMILY OF BIBLIOMETRIC INDICES AS AN IMPROVED MEASURE OF IS ACADEMIC JOURNAL IMPACT[1]

Michael J. Cuellar
Georgia State University
mcuellar@cis.gsu.edu

Hiro Takeda
Georgia State University
htakeda@cis.gsu.edu

Duane P. Truex
Georgia State University
dtruex@cis.gsu.edu

ABSTRACT

This study examines the use of journal rankings and proposes a new method of measuring IS journal impact based on the Hirsch family of indices (Hirsch 2005; Sidiropoulos et al. 2006). Journal rankings are a very important exercise in academia since they impact tenure and promotion decisions. Current methods employed to rank journal influence are shown to be subjective. We propose that the Hirsch Index (2005) and Contemporary Hirsch Index (Sidiropoulos et al. 2006) based on data from Publish or Perish be adopted as a more objective journal ranking method. To demonstrate the results of using this methodology, it is applied to the "pure MIS" journals ranked by Rainer and Miller (2005). The authors find substantial differences between the scholar rankings and those obtained using the Hirsch family of indices. They also find that the contemporary Hirsch Index allows researchers to identify journals that are rising or declining in influence.

Keywords (Required)

Journal Ranking, Citation Analysis, Hirsch Index, h index, Contemporary Hirsch Index, hc index.

INTRODUCTION

The question of journal ranking is not trivial and has far reaching consequences. In the IS field, journal rankings have gained the status of a surrogate for research productivity and importance. The effect these rankings have on researchers, students, practice, or knowledge creation is difficult to assess, imprecise, and anecdotal in nature. Yet the use of the journal importance metric is apparent and germane to the life of any research faculty aspiring to a tenured position. Promotion and tenure committees, often drawn from different disciplines in one's university setting, need guidance in assessing the contribution of scholars from disciplines different from their own. College Deans and University Provosts need relative measures to assess the strength of one department compared to another in a college or school. Finally, policy makers in various education institutions need metrics to evaluate the strength of one program, school, and campus over another. All these levels need to assess scholarly impact. Over time, the standard process has become to rely on the quality of the journal as a proxy for the quality of the article; publications in a "high quality" journal being assumed to be of high quality, thus creating an expeditious method of discerning the quality of the article. We argue that the process of journal ranking is subjective and inconsistent and should be improved.

The creation of 'approved' and weighted journal lists has been historically a political exercise influenced by personal, geographic, and temporal factors. Often, college and university administrators are pressured to respond to rankings by major publications, such as the *WSJ, BusinessWeek or Financial Times*, each of which make assumptions about the premier scholarly venues for our field. Some schools simply adapt the journal ranking used by these publications as one-size-fits-all list as *de facto* standards or comparative measures for their own faculty and IS academic units. More typically, the journal ranking question is decided by the consensus of influential scholars at a given institution (Mylonopoulos and Theoharakis

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2001). The practice of ranking journals assumes the set of participating scholars are qualified and representative enough to make an appropriate decision. Yet, studies have shown the existence of geo-centrism in the journal evaluation process (Kateratanakul et al. 2003; Mylonopoulos et al. 2001; Schwartz et al. 2004). Personal preferences and ulterior motives may come into play when making the decision to rank the journals. For instance, scholars who are journal editors may be tempted to advocate for their own journal. Finally, there is a lag effect in the recognition of changes in journal quality. A kind of 'halo effect' may protect a journal whose quality has begun to slide. And the quality of newer journals is not immediately recognized.

The process is further complicated because the IS field, which has been described as a "fragmented ad-hocracy" (Banville et al. 1989) has many disparate sub-disciplines, reference disciplines, theoretical frameworks, and methodological inclinations. This fragmentation has contributed to continuous debates about the core concepts, central tenets and constructs, and most relevant topics of inquiry in IS. Thus a splintering rather than a convergence of opinion exists resulting in only two or three venues considered as the top tier journals. The reduction of the 'approved' top-tier list to a small number of journals has resulted in structural pressures on research-oriented academics to publish only in those venues. The limited number of annual issues and consequent page restrictions, coupled with high rejection rates, creates a zero-sum game notion of publication. These publication limits raise concerns for junior scholars who are trying to achieve tenure because achievement appears virtually impossible In fact Dennis et al. (2006) argue that only 2.5% of all IS researchers will publish in both MISQ and ISR, two of the field's premier journals. Although the top-tier journals have increased the number of articles published in recent years, the number of published articles in these journals has decreased relative to the number of research active scholars. This has resulted in creating an academic environment where top-tier publications have become harder and harder to produce.[2]

Because of the importance of journal rankings and the subjective nature of how they have been developed, we have sought a more objective method in determining relative importance of scholarly output. Techniques such as author citation analysis (McCain 1990; White 2003; White et al. 1981; Zanotto 2006; Zhao 2006) and survey analysis (Hardgrave et al. 1997; Mylonopoulos et al. 2001; Peffers et al. 2003; Walstrom et al. 1995) are tedious, manual, and time consuming to perform in terms of collecting the data required and performing the analysis. However, recent developments in collection and extraction of scientometric data have been developed which greatly simplifies the collection and analysis of data related to scholar/journal/department analysis.

This paper makes a contribution by proposing a method for ranking IS journals based on the Hirsch family (h-family) of indices using the bibliometric and citation search and analysis tool, *Publish or Perish*, to identify and derive relevant rankings (Harzing 2008b). This methodology provides an objective process to 1) rank journals by impact on the field and 2) identify "trendsetter" journals; i.e., those journals defined as publishing the most influential current material 3) identify the relative weight of the journal's impact, and finally 4) the trajectory of the journal's influence, is it rising or waning. This article proceeds as follows: First, we examine the current state of journal rankings and ratings. Second, we review the literature on scholar and journal ranking methodologies. Third, we critically assess the ranking method's contribution, as well as introducing the ranking articles that we use for the methodology. Fourth, we describe the proposed methodology for ranking journals and identifying "trendsetter" journals. Finally, in the fifth section, we discuss of the current study and some problems and future research.

LITERATURE REVIEW

The process of journal ranking has given rise to a cottage industry of studies on journal rankings (Barnes 2005; Lowry et al. 2007b; Lowry et al. 2004; Mylonopoulos et al. 2001; Nerur et al. 2005; Schwartz et al. 2004; Walstrom et al. 2001; Walstrom et al. 1995). In general those articles attempt to measure influence in one of two ways: 1) by surveys of academics or, 2) by citation analysis. Walstrom and Hardgrave have published three successive articles illustrative of the survey type approach (Hardgrave et al. 1997; Walstrom et al. 2001; Walstrom et al. 1995). They created a survey instrument asking respondents to rate a list of journals from one to four. They also asked the respondents to add journals missing entries from an auxiliary list or from experience. Their instruments were administered to a set of IS academics selected from sources such as the ISWorld

[2] The ISWorld faculty directory lists about 5,500 self-identified IS faculty. The Association of Information Systems (AIS) currently records about 4,012 members (as of April 24, 2008). We use these as a surrogate for the number of likely IS scholars competing for space in the basket of research publication venues. The AIS membership is most likely the best number because the membership roles are heavily influenced by attendance at the AIS supported research conferences (ICIS, AMCIS, ECIS,PACIS) and the research services and library access provided by one's AIS membership.

Directory of MIS Faculty. Survey responses were then averaged to create the mean scores for each journal. These scores were then arranged in a ranking table.

A typical approach to journal assessment using citation analysis is provided by Lowry, Karuga and Richardson (2007b). They counted citations for articles in published in *MIS Quarterly, Information Systems Research* and the IS articles published in *Management Science* as retrieved from Thomson's *Web of Science*. They counted authors and institutions using unweighted, weighted, and geometric methods of assessing the authors' contributions (Chua et al. 2002). They then reported the most frequently cited authors, institutions, institutions by journal, articles, with each reported segment broken out by three different time periods.

Both ranking approaches have received criticism. Survey methods have been criticized as being subjective and having systemic bias. When making their ratings 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, as well as personal preferences and whether they have been published in the journal etc. (Podsakoff et al. 2005). Walstrom, Hardgrave, and Wilson (1995) tested some of these biases. Using consumer behavior theory, they developed a theory of bias in journal ranking in survey analysis by academics. They surveyed IS researchers to test six hypotheses about biases that affect ranking decisions derived from their theory: 1) How underlying discipline; 2) familiarity; 3) research interests; 4) whether they published in the journal or not; 5) whether they were associated with the journal or not, and; 6) the respondent's academic rank. They found support for the hypotheses dealing with underlying discipline, familiarity, and research interest. Another criticism leveled at survey approaches is that surveys are biased by the "anchor" effect. That is, given a list of journals, respondents are inclined to select from the list provided even if that list is incomplete (Chua et al. 2002). Thus research supports the notion that current methods of journal ranking are systematically biased.

Studies have suggested that citation analysis is better at ranking journals than the survey methodology because citation analysis is an objective method removing subjectivity from surveys (Kateratanakul et al. 2003; Korobkin 1999; Nerur et al. 2005). However citation count approaches do not escape criticism. For instance, in other nations and in other disciplines citation conventions differ from US or the information systems field conventions. Differing conventions can lead to significant variation in results from study to study. As another example, when editors ask authors to cite earlier articles from their own journals, this "citation rigging" presents a false perception of the journal's influence. Older journals and articles may have more total citations than newer articles, resulting in a skewed distribution. Citation counts have also been criticized for contributing to and encouraging self-citation. (Lowry et al. 2007a).

The Hirsch Index

A different method of evaluating IS journal impact based on citation analyses has been proposed which is grounded in the information science theory (Takeda et al. 2008). Using the *h*-index calculated on data from the *Publish-or-Perish* (PoP) tool (Harzing 2008b), they show that the *h*-index can be used to rank journals. The h statistic is the rank of a paper where the number of citations to that paper is at least equal to that paper's rank and where all other papers are cited less than that paper's rank. More formally, the *h*-index is calculated as the number of papers h if h of a set of N_p papers have at least h citations each, and where all other (N_p -h) papers have no more than h citations each (Hirsch 2005). Via citation counts the *h*-index assigns a number to a journal/researcher that suggests the impact the journal/researcher has had up until the date of the computed h-statistic. The higher the *h*-index, the more highly cited papers the journal/researcher has garnered. The *h*-index is therefore a surrogate number registering influence, and has been rapidly adopted and used in natural science fields (Glanzel 2006).

The *h*-index improves on simple citation counting or simple productivity by combining the notions of productivity and impact to produce a measure of influence. Productivity is considered in the number of papers published. No matter how many times that paper is published a source that publishes only one paper can only receive an *h*-index of one. Citations are used to add a measurement of impact. A source that produces many papers, only one of which has been cited can only receive an *h*-index of one. Productivity and impact are then balanced against each other in the *h*-index to produce a measure of influence. To achieve high influence a source must produced a sustained number of papers with impact on the field.

Studies have used the *h*-index to examine how to qualify papers as being 'genius, basic, or ordinary' based on the *h*-index and the time elapsed since the publication of the paper (Egghe 2007b). Other studies have extended the use of the *h*-index into the domains of chemistry (Raan 2006) and business (Saad 2006). Ashkanasy (2007) compared the Thomson/ISI impact factors with the *h*-index in the ranking of management oriented journals. Effectively he found them equivalent in terms of ranking groups of journals.

One of the key facts about the *h*-index is that it grows over time. A chart of this progression is shown in figure 1.

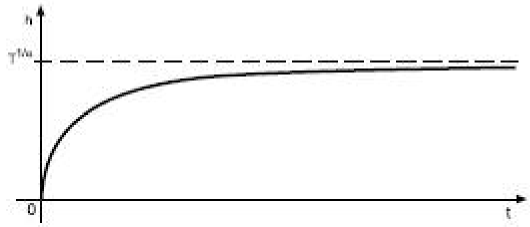

Figure 1: Chart of the growth of an *h*-index (from Egghe (2007a))

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 a source (an author, journal, bibliography etc). In this figure 'T' is the same as N_p (the set of papers) in the previous definition. In the present manuscript, the 'source' of papers is a given journal and α is a constant describing the rate that the number of papers produced by a journal declines from highly cited journals to less highly cited journals (Egghe et al. 2006).

This pattern implies certain key considerations for the use of the *h*-index. First, a journal that has had more time to produce articles for citation will therefore have a greater opportunity to have a large *h*-index than a journal with less time in the field. Additionally, a journal with a larger publication volume gives an opportunity for a greater *h*-index than another journal with fewer publications. Thus we cannot say simply on the basis of the *h*-index that one journal is better than another without ensuring that we have a comparable number of articles and article age. Without equality of those factors we can only say that one journal is more influential than another. Finally, there are different citation patterns dealing with numbers of authors, what is cited and publication venues which may result in differences in the *h*-index for an entire field. For example, biologists are cited more often than physicists who are cited for often than engineers (Molinari et al. 2008). This implies that we must ensure that we are comparing journals that cover the same fields or subfields and come from the same geographies or if different have similar citation cultures.

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

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

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

METHODOLOGY

For this paper we performed two different analyses. First we use the *h*-index to assess the impact of a set of journals. In the second analysis, we use the *hc*-index to examine which of the journals are "trendsetter" journals, (i.e. those which have published recent articles that are deemed influential) and to examine the journals' influence trends.

To collect the data and generate the indices for the study, we used the *Publish-or-Perish* (PoP) software tool (Harzing 2008b). In calculating the *hc*-index, PoP uses the same constants as the Sidiropoulos et al. paper used $\gamma = 4$, and $\delta = 1$, and is consistent in approach to the calculations presented above.

PoP uses the Google Scholar as the principal data source for the calculation of the indices (Harzing 2008a). On the one hand, Google Scholar (GS) is considered to be superior to the *ISI Web of Science* (WoS) or *Elsevier Scopus* sources for the following five reasons. 1) GS expands data sources beyond ISI-listed journals to include additional scholarly sources including books, dissertations, conference papers, and non-ISI journals. 2) In GS's search and retrieval GS considers all authors instead of only the first listed author. 3) GS is able to aggregate minor variations of the same publication title into a single item. 4) GS includes Languages Other than English (LOTE) thereby including sources that are generally not included in the WoS. And, 5) GS is superior in coverage of social science and computer science compared to WoS.

On the other hand, there are four concerns with the use of GS as the citation source. 1) GS includes non-scholarly citations, and sometimes has uneven coverage of the literature, 2) GS may under represent older publications as compared to the WoS. 3) GS's automated search process occasionally returns nonsensical results and is, 4) is not updated as frequently as WoS (Harzing 2008a). However, on balance, given GS's superior coverage in the business, computer science, and social science areas, and given the five advantages described earlier, we believe that the GS based PoP tool represents an improvement on using the WoS as the citation data source.

The *h*-index has been applied to journals before (Braun et al. 2006; Sidiropoulos et al. 2006). The authors argue that a "life time" journal *h*-index should not be calculated because different journal's publication lives are different and because they publish different numbers of papers. We find the authors reasoning flawed because the same objections could be lodged against individual scholars who have different productive lives and publish different numbers of papers. We therefore are calculating "lifetime" *h*-indices for the set of journals under consideration.

In our study, we sought to compare the *h*-index for the set of journals represented in previously published articles presenting journal rankings and quality assessments. As a benchmark, we used the Rainer and Miller (2005) meta-ranking of 29 "pure MIS" journals developed by comparing multiple published IS journal rankings. In using PoP to extract data and calculate the indices, we were able to calculate h-family indices for all but one of the journals. We were not able to extract data for the Journal of Education for MIS from PoP. Additionally, since the journal *Accounting, Management and Information Technology* ceased publication in 2000, we added its successor journal, *Information and Organization* to provide continuity to the present date. In general, very little data cleansing was required in order to arrive at the correct set of articles for each journal. However three journals, *Information Systems Research, CAIS*, and *Data Base,* required significant exclusion of extraneous articles to arrive at the correct *h*-index. This cleansing consisted of, in the case of *Information Systems Research*, of removing articles that contained the words "Information" "Systems" and "Research" in their publication venue's titles from the list of articles considered in the calculation of the indices. Similarly, for *CAIS,* we attempted to remove articles from journals whose titles contained "Communications" that were not CAIS from the list of articles considered in the calculations. For *Data Base*, we had to examine the articles to remove articles from sources other than the *Data Base* journal from the list of articles considered in the calculations. We reviewed all the articles down to the level of the *h*-index ranking and deselected any misidentified articles. We then sorted and ranked the journals in order of the h-statistic and compared them along to the Rainer and Miller (R&M) rankings (Table 1). Additionally, we sought to identify any "trendsetter" journals by extracting the *hc*-index ranking from the same queries that produced the *h*-index in study 1. We then added them to the results reported in Table 1.

RESULTS

Journal	Rainer and Miller (R&M)	*h*-index Rank	*h*-index	*hc*-index Rank	*hc*-index	*R&M* vs. *h*-index DELTA	*R&M* vs. *hc*-index DELTA
MISQ	1	1	128	1	69	0	0
JMIS	3	2	78	2	43	1	1
ISR	2	3	72	3	42	-1	-1
IBM Systems Journal	21	4	69	4	40	17	17
Intl Journal of Man-Machine Studies	13	5	66	13	22	8	0
DSS	4	6	64	6	39	-2	-2
I&M	5	7	61	5	40	-2	0
Omega	27	8	51	7	31	19	20
Interfaces	18	9	50	8	26	9	10
EJIS	6	10	44	9	26	-4	-3
JSIS	10	11	38	10	25	-1	0
Journal of Information Science	28	12	37	14	20	16	14
JIM	9	13	36	12	23	-4	-3
ISJ	15	14	35	11	24	1	4
Intl J Tech	16	15	32	15	19	1	1
Info Sys Mgt	22	16	28	16	17	6	6
Accounting, Mgt and Information	19	17	26	18	14	2	1
J of Info Sys	23	18	22	21	10	5	2
J of Sys Mgt	25	19	19	23	7	6	2
Info Res Mgt	29	20	18	19	12	9	10
Info and Org	*	21	18	17	15	-	-
Database	11	22	14	20	11	-11	-9
Data Base	14	23	13	22	9	-9	-8
DB P&D	26	24	11	25	5	2	1
J Info Sys Ed	12	25	10	24	7	-13	-12
J Info Tech Mgt	20	26	6	26	4	-6	-6
CAIS	8	27	3	27	2	-19	-19
J Intl Info	24	28	3	28	2	-4	-4
J DBA	7	29	1	29	1	-22	-22

Table 1. Rainer and Miller (2005) and Hirsch Index Rankings for "Pure MIS Journals",

These rankings are interesting because for many of the journals we find substantial differences in the rank given by the h-family indices when compared to the R&M rankings. The relative difference from the R&M meta-rankings is represented in the last two columns. For instance, we see that the rankings for *OMEGA* increased 19 places, the *IBM Systems Journal* increased 17 places, and the *International Journal of Man-Machine Studies* increased 8 places. The changes from the *h*-index to the *hc*-index are also interesting. The *International Journal of Man-Machine Studies hc*-index fell eight spaces compared with the *h*-index while the *hc*-index for *Information and Organization* has risen four spaces.

DISCUSSION

The difference between R&M's rankings and those arrived at by use of the *h*-index family may be due to a number of factors. Since rankings used by Rainer and Miller were largely constructed by surveys of scholars, the differences may be due to respondent bias due to discipline, familiarity, or research interest such as that found by Walstrom, Hardgrave, and Wilson (1995). These would create a difference when compared to the data from GS. As an example, the *IBM Systems Journal* and *International Journal of Man-Machine Studies* when ranked on the *h*-index are much higher than what is found in the R&M findings. This could be caused by citations coming from fields other than IS despite R&M's designation as a "pure MIS" journal. A cursory examination of the top cited articles in that journal shows authors not normally considered to be top scholars in the IS field and subjects not normally considered as MIS subjects. Similar to *Management Science* or *Decision Sciences*, *IBM Systems Journal* and *International Journal of Man-Machine Studies* publish IS articles but may also publish articles from other fields such as Computer Science. An alternative explanation could be that these journals publish articles from a different community than that represented by those participating in the studies consolidated by R&M. These journals publish largely from the design science, development, and AI communities and thus might not be familiar to those performing the rankings if drawn from the behavioral IS community. Thus in this case, using the *h*-index allows us to overcome biases due to familiarity.

Another possible explanation for the position of *IBM Systems Journal* relative to other IS journals is that, as one of our reviewers has pointed out, it publishes many more articles per issue than other journals such as MISQ. This gives it a higher opportunity to gather more citations than other journals (Molinari et al. 2008). They imply that the high *h*-index is an artifact of how the *h*-index is calculated rather than its quality as a journal. This begs the question of what the *h*-index measures. We argue that the *h*-index is a direct measure of the influence of a journal and only indirectly the quality. If influence is taken to the number of scholars that read and cite articles from a journal then the *h*-index definitely measures influence. An article may be cited because it is taken to be of a high quality and an article that states the truth. It could also be cited because it is a "bad" article that is methodologically or logically invalid and therefore must be refuted. Either way the article is influential as it is read and cited, but it is not necessarily of high quality. Thus, a high *h*-index might result from quality or from controversy. Therefore, if a journal publishes many articles that are highly cited, we argue that it is an influential journal. If it publishes many articles that are not cited, it is not an influential journal. Contra Molinari and Molinari, we argue that a journal that is older has a greater opportunity to be influential than a younger journal. One that publishes many articles also has an increased opportunity to be influential. We argue then that the *h*-index be used as a measure of influence and only as a secondary measure of quality. Other measures should be included in the assessment of quality.

Perhaps the most interesting difference is in the ranking of the three most important journals: *MISQ*, *JMIS* and *ISR*. A common belief in the MIS discipline is the top two journals are *MISQ* and *ISR* (Dennis et al. 2006). However, as shown in table 2, when ranked on the *h*-index, we see that the IS community places *MISQ* as the top journal by a large margin; *MISQ* has an *h*-index three standard deviations above the mean for all the journals. Almost two standard deviations below *MISQ* are *JMIS* and *ISR* which are in a virtual tie with JMIS slightly higher.

Journal	**Number of Standard Deviations above the Mean**
MISQ	3.18
JMIS	1.44
ISR	1.24
IBM Systems Journal	1.13
IJMMS	1.03

DSS	0.96
I&M	0.86

Table 2: Top Journals Distance from the Mean of the *h*-index

This virtual tie indicates that the IS community cites *JMIS* as much as *ISR* indicating that *JMIS* should be considered as a peer journal with *ISR in terms of influence*.

In looking for "trendsetter" journals, we found that for the most part, the rankings produced by using the *h*-index were replicated when using the *hc*-index. We did find the following interesting results. The *International Journal of Man-Machine Studies* fell eight positions, the *Journal of Systems Management* fell four positions, and the *Journal of Information Systems* fell three positions which indicates that the articles most recently published by these journals were not as well cited as those in the past, or the journals that surpassed them are publishing recent articles that are cited more, indicating that these journals are falling in influence. This could be due to a decline in the quality of the journal, or publishing articles not popular in the research community. On the opposite side, we note that *Information and Organization* (*I&O*) rose four positions indicating that *I&O* is publishing articles being well received and being well cited. Also interesting is the fact that *Accounting, Management and Information Technology* which has not published since 2000 has only fallen one space on the *hc*-index rankings which indicates the importance of its articles in that they continue to be well cited.

Finally, in looking at the use of the *h* and *hc*-index, we find that they provide more information than a simple ranking. In looking at tables 1 and 2, we see that *MISQ* is placed 50 points or almost 2 standard deviations above *JMIS* which lets us know that there is an over 90% probability that *MISQ* is more influential than *JMIS*. From use of these indices we can get a statistical description of the differences in influence between the journals.

LIMITATIONS AND FUTURE DIRECTIONS

The limitations of this paper include the limitations of Google Scholar as a source of data. GS does not have an exhaustive list of all publications and is therefore limited in coverage as noted above. In using the PoP tool, we note that there is substantial variation that can be received based on how the journal name is entered. In future work, at least two researchers should be used to achieve consistency of results. Also, since GS updates itself periodically, the results are not strictly replicable. PoP queries done after an update may not generate the same results. Due to space limitations, we did not pursue differentiating our analysis on the basis of IS subfield. This might be profitable as the publication culture of the design science and development subfields might be different from that of the management research subfield. Further research is needed to determine if these cultures are the same or different. Similarly, research is required to understand the publication culture of non-North American journals. It is possible that their publication cultures might be different resulting in a misrepresentation of their journals' influence. Space limitations also precluded description and application of Molinari and Molinari's (2008) h_m which is a way to account for large numbers. This should be done in subsequent papers.

Some future research that can arise is the extension of the use of the *h*-index to individuals and institutions, the use of different measures, and the continual analysis of the current state of the journals. The *h*-index can be used to analyze data on individual researchers, thus giving a view of how a researcher has impacted the field. The *h*-index can also be used to analyze institutions in IS to give the contribution of research institutions to IS. The *h*-index can be used to analyze sub-disciplines in the IS field. Breaking the analysis down to the sub-discipline level will allow analysis of impact across sub-disciplines and outside the IS field as well.

CONCLUSION

This paper has shown that the assessment of journal influence is an important consideration in the IS field. Previous methods of assessing journal influence: surveys of scholars and simple citation counting were shown to be problematic. This paper introduces a methodology using the *h*-index family of measures as an alternative procedure to more objectively assess journal influence. In our study, we showed that use of the *h*-index provides substantially different results than that previously determined in a study by Rainer and Miller, which might be due to rater biases in the Rainer study. We also showed that the use of the *hc*-index allows the researcher to identify journals falling or rising in influence. Additionally, we saw the use of the *h*-index family allows for finer discrimination between the journals including whether one journal is statistically more influential than another. From these findings, we argue that the *h*-index family of measures shows promise of being an improvement over other methods of assessing journal quality. We believe the *h*-index family is a quick way to analyze the influence of a body of work and is worthy of further development and research.

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