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# Examining Scholarly Influence: A Study in Hirsch Metrics and Social Network Analysis

Hirotoshi Takeda
*Georgia State University*

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# Dissertation


# Hirotoshi Takeda


# January 6th, 2011

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The author of this dissertation is:

*Hirotoshi Takeda*
*J. Mack Robinson College of Business*
*Computer Information Systems*
*P. O. Box 4015*
*Atlanta, GA 30302-4015*
*hirotoshi.takeda.05@campus.dauphine.fr*
*htakeda@cis.gsu.edu*
*Phone: 404-651-3880*
*Fax: 404-651-3842*

The director of this dissertation is:

*Dr. Duane Truex*
*CIS Department*
*Room 913 9th Floor*
*35 Broad Street*
*Atlanta, Georgia 30303*
*+1.404.651.3899*
*dtruex@gsu.edu*

*Examining Scholarly Influence: A Study in Hirsch Metrics and Social Network Analysis*

BY

*Hirotoshi Takeda*

A Dissertation Submitted in Partial Fulfillment of the Requirements for the Degree

Of

Doctor of Philosophy

In the Robinson College of Business

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**ACCEPTANCE**

This dissertation was prepared under the direction of the Hirotoshi Takeda Dissertation Committee. It has been approved and accepted by all members of that committee, and it has been accepted in partial fulfillment of the requirements for the degree of Doctoral of Philosophy in Business Administration in the Robinson College of Business of Georgia State University.

H. Fenwick Huss, Dean

DISSERTATION COMMITTEE

Dr. Duane Truex III

Dr. Michael Gallivan

Dr. Michel Kalika

Dr. Balasubraman Ramesh

ABSTRACT

*Examining Scholarly Influence: A Study in Hirsch Metrics and Social Network Analysis*

BY

*Hirotoshi Takeda*

*January 6, 2011*

Committee Chair: *Dr. Duane Truex*

Major Academic Unit: *Computer Information Systems*

This dissertation research is focused on how we, as researchers, 'influence' others researchers. In particular, I am concerned with the notion of what constitutes the 'influence' of a scholar and how 'influence' is conferred upon scholars. This research is concerned with the construct called 'scholarly influence'. Scholarly influence is of interest because a clear "theory of scholarly influence" does not yet exist. Rather a number of surrogate measures or concepts that are variable are used to evaluate the value of one's academic work. 'Scholarly influence' is broken down into 'ideational influence' or the influence that one has through publication and the uptake of the ideas presented in the publication, and 'social influence' or the influence that one has through working with other researchers. Finally through the use of the definition of 'scholarly influence' this dissertation tries to commence a definition of 'quality' in scholarly work.

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# 1 Dissertation Introduction

## 1.1 Introduction

This dissertation research is concerned with how we, as researchers, 'influence' others. In particular, I am concerned with the notion of what constitutes the 'influence' of a scholar and how 'influence' is conferred upon scholars. This research is concerned with the construct called 'scholarly influence' and is both a pragmatic and intellectual concern. Pragmatically, a need to measure a scholars 'influence' exists. The construct is implicitly and explicitly used by 'Promotion and Tenure' (P&T) committees and by academic decision makers allocating resources to academic units and to individual researchers. Scholarly influence is of interest because a clear "theory of scholarly influence" does not yet exist. Rather a number of surrogate measures or concepts that are variable are used to evaluate the value of one's academic work. So to better understand the nature of the construct and the way that influence is either earned or is conferred upon scholars is an important practical question that is intuitive to me. In addition, the matter of how 'having' scholarly influence is somehow related to 'influenc*ing*' or causing change in others exists.

Form the point of view of the practitioner 'scholarly influence' may not be of high interest but the notion of 'influence' can be important. For example, project managers need to understand the duality of influence and influencing. In a project, a manager has to make difficult decisions such as to whom to assign which task in a project. Some of these tasks may be more desirable than others, and some may be tasks that are detested by the worker. The project manager must in these situations conduct the difficult task of influencing some of his/her subordinates to take on these 'detested' tasks. As seen in how 'influence' is interpreted by the practitioner as opposed to that in academics, this dissertation is confounded by the fact that while the term 'influence' is used in common parlance, 'influence' has many meanings and ways it is referenced.

I provide some simple examples of how, in everyday life one might characterize or determine 'influence'. For instance, I might personally thank my high school mathematics teacher for influencing me into studying harder and doing better in math which in turn helped me achieve my college education and career. I may also thank my speed skating coach for influencing me to work harder to improve my skating, which in turn allowed me to have a better skating stride. These are qualitative measures of influence, which are similar to an interview respondents' data. At the same time, there might be some quantifiably measurable statistics that can measure the influence.

Perhaps a score on my SAT math test measured before and after taking the particular teacher that influenced me, giving a measurable score improvement will show a score of influence. With my speed skating coach, possibly a before and after best personal time and a time improvement will show a score of influence.

The current research is concerned with influence in quantifiable ways. Influence traditionally can be thought of as a qualitative measure. For example, one would have a hard time quantifying influence of a writing teacher. Similarly, a disconnect exists in trying to quantify the influence of an academic. This stream of research is a journey into the quantifiable measures of academic influence.

Traditionally P&T committees have used 'journal lists' to measure the influence of an academic. As academics we hear about 'journal lists' from day one in our Ph.D. training. We hear about the 'A-journals' in our academic area and how the ultimate goal is to be published in these 'A-journals'. As a Ph.D. student, the immediate question that comes to mind is 'How do I get an article published in said A-journal?' But a secondary question that came to my mind is 'Why is so-and-so journal an A-journal? Why isn't so-and-so journal a B-journal and not an A-journal?' While most of the answers that I got were statements like: So-and-so journal is an A-journal because they have the most rigorous review process, they have the more restrictive acceptance rate, so-and-so journal is the most reputable journal, the most distinguished authors publish in so-and-so journal, and the most influential papers are published in so-and-so journal. While the first several answers seemed more in tune with accepted reputation, to me the most viable answer was the last one. When a journal publishes the most 'influential' papers they become an A-journal. But then one additional question comes to light. How does one measure 'influence' in the context of publication venues? In addition how can one measure the influence of individual scholars or that of collections of scholars, such as one might have in a research cohort or a department? This research examines each of these questions in turn.

The core research question is: How does one measure the construct called 'scholarly influence'? While the ultimate research question is the quest for defining and measuring scholarly influence, the body of the work will continue onto scholarly influence measures, social networking, how networks influence scholars, and how these scholarly influence measures can be extended to knowledge management systems such as forums in an online community.

### 1.2 The Journey

The dissertation started when it was learned, late in 2006, that Heinz K. Klein (HKK) was diagnosed with terminal cancer. Former Klein PhD students and colleagues determined to host a type of Festschrift for Heinz Klein and I was asked to join the organizing team. Work started in earnest in the beginning of 2007. Not only were we faced with the logistic necessities of getting a conference venue, location, hotels rooms set up, travel logistics to coordinate, but we needed to determine a conference theme and the way to organize content. The HKK Festschrift became a celebration of HKK, and a reflective look at the work of HKK. While working on developing a presentation for the HKK Festschrift, I started struggling with the notion of 'scholarly worth' and how to measure this construct. There were two goals to the Festschrift. One was to get the works by HKK into a book format that we could present to Heinz K. Klein as a gift. And the second was to create a presentation to show the impact that HKK had on the IS field.

As part of the team working on the HKK Festschrift, I was assigned to a group to create the presentation of HKK's scholarly work. This task ended up being a two-part study. First the team looked at conducting a co-citation analysis, and second a co-authorship analysis. My work was tied to the latter. While working on this project my colleague Michael Cuellar explored the h-index. While this index was new at this time (it was only proposed a year earlier), the h-index had spawned various studies trying to see if the h-index really had validity behind it. We were intrigued by this index, it was simple, yet accomplished the measurement of two things, researcher productivity and the uptake of their ideas.

Despite the short time frame and short notice the Festschrift had over 30 academic attendees who made various contributions to the event. I presented an analysis of over 130 piece of works that HKK had produced, the list of people that HKK had worked with in the form of co-authors and PhD students, the frequency of work that each one had co-authored with HKK, and the social network of co-authors. The works by HKK were put into a endnote file and copies of the work were put into the HKK book. For the list of people that worked with HKK, I filtered out the authorship data from the endnote file and created a author frequency list. This identified the most prominent co-authors of HKK. This lead to the creation of the co-author network created using the Pajek tool. The co-author network showed the center as HKK and the more frequent authors closer to HKK, while the co-authors that only worked with HKK once were shown on the periphery (Figure 1).

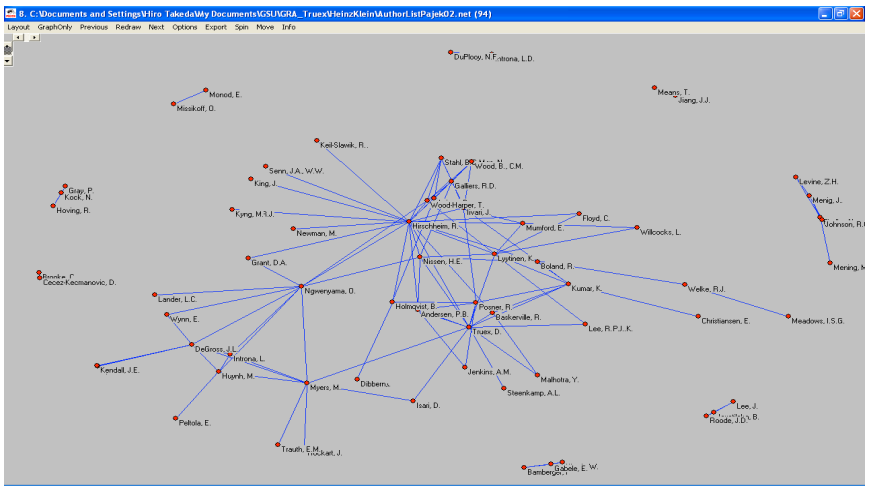


Figure 1. Heinz K. Klein Co-Author Network

When the Festschrift had ended, we had collected data which seemed to be some valid research area. We asked how we might use the methodologies that we used to evaluate HKK's influence on other IS researchers? This question became the basis of the papers that make the body of this dissertation. In 2008 we presented this research expanded to the IS researcher and IS journals at ICIS and AMCIS (Chapter 3) respectively. In the following year the researcher ranking study was published in JAIS (Chapter 2) in 2009.

One of the items that bothered me while learning more about the Hirsch family of indices was that there were two indices, the g-index which accounted for the lifetime of work of a researcher (Egghe, 2007) and the hc-index which accounted for the age of the research (Sidiropoulos & Manolopoulos, 2006), that I felt would be easy to combine. These two methodologies were combined to come up with a composite index that had the attributes of both the g and the hc index. I presented this as a paper at the SAIS conference in 2009 (Chapter 4).

I added social network analysis to the bibliometric measures and presented at AMCIS in 2010 (Chapter 5). An expansion of using the h-index to measure high-level contributors in an online community was studied (Chapter 6). And most recently we have used the example of HKKs work to illustrate and correlate the relationship between ideational and social influence.

### 1.3 The Construct

In this section the various constructs will be defined. First the literature will be reviewed for the meaning of 'influence'. Influence will be examined from social point of view (social influence) and the scholarly point of view (scholarly influence). Then the constructs that make up the definition of scholarly influence will be defined. These

constructs are: what makes some scholarly output measurable, scholarly actions, and scholarly publications.

### 1.3.1 General Definition of Influence

'Influence' is defined as 'the capacity or power of persons or things to be a compelling force on or produce effects on the actions, behavior, opinions, etc., of others' or 'the action or process of producing effects on the actions, behavior, opinions, etc., of another or others' (Dictionary.com, 2010). Yet others define 'influence' as 'the act or power of producing an effect without apparent exertion of force or direct exercise of command' and 'the power or capacity of causing an effect in indirect or intangible ways' (Merriam-Webster, 2010). The Merriam-Webster definition is similar to the free online dictionary that says 'influence' is:

> A power affecting a person, thing, or course of events, especially one that operates without any direct or apparent effort' and 'Power to sway or affect based on prestige, wealth, ability, or position' (Farlex, 2010).

### 1.3.2 In the Literature

Currently the measure of 'influence' is fraught with problems. P&T committees see a need to assess scholars in a quick and easy fashion and have defaulted on a list of journal publications that are ranked A, B, C, premier vs. high-level, and so on. Often P&T committees use these journal lists to assess 'scholarly influence' by a count of the number of articles that were published in these journals (Adams & Johnson, 2008; Wilcocks, Whiley, & Avgerou, 2008) The content or impact of each of the articles seems to be of little consequence. In addition to using a 'journal list', co-authorship in these publications is sometimes seen as a degradation of contribution, as co-authorship with x authors often translate to a simple division by x to the contribution. While these methods are 'an evil necessity' I argue that there is a better way to assess a scholar. While I understand the attraction by P&T committee members of a simple article count to assess the worth of a scholar, the quest of a 'holy-grail' measure of assessing worth is wrought with problems. In fact, the use of research output solely on publication counts has been challenged (Bar-Ilan, 2008; Collin, Johansson, Svensson, & Ulvenblad, 1996; Lee & Williams, 1999). Scholarly output research has identified measures of worth other than a simple publication count.

#### *1.3.2.1 Social Influence*

'Social influence' according to Wikipedia (2010), "occurs when an individual's thoughts, feelings or actions are affected by other people." Herbert Kelman (1958) identified three types of social influence; (1) Compliance is "when people appear to agree with others, but actually keep their dissenting opinions private," (2) Identification is

"when people are influenced by someone who is liked and respected, such as a famous celebrity or a favorite uncle," and (3) Internalization is "when people accept a belief or behavior and agree both publicly and privately" (Kelman, 1958). In the definition of scholarly influence, corollaries to Kelman's three types of social influence can be found. Examples in the way citations are commonly used and can be seen within all three of Kelmans' types. For 'compliance', Kelman refers to a 'dissenting opinion' that is kept private and I acknowledge that in any realm, when someone keeps her/his opinions private the opinion cannot be observed. But when researching only the public opinions, 'compliance' can be seen when researchers agree with a previous researcher and cite the previous researcher as such. Typically when researchers do a literature review the authors are required to do a comprehensive literature review and are expected to cite the 'big name' and well-established authors or 'seminal' papers in the area of research. This is similar to 'Identification' where a famous paper or author 'who is liked and respected' in the field is influencing the author. And finally 'Internalization' happens in citations when authors cite papers and accept the findings in the cited paper.

The concept of 'influence' is also bound up with notions of power. Employers, organizations, governments or nations may influence by force—physical, economic or legal. Parents, professors and administrators have the power to withhold privileges and exert influence though the allocation or resources and rewards. And in the communicative arena the appeal to shared values and truth claims influence the thoughts and behaviors or others. I will look at three views on power and influence. These will be the views of Parsons, Habermas, and Bourdieu.

Parsons "attempted to conceive of power as a steering medium anchored in the political system and exhibiting structural analogies to money. He saw this as a successful test of the generalizability of the concept of a medium. His work on the concept of influence appeared in the same year and was followed a few years later by his analysis of the concept of value commitment" (Habermas, 1985b). When Parsons talked about value commitment he analyzed this in a step sequence of money, power, influence, and value commitment. He "analyzed the basic features of four media, each of which was correlated with one social subsystem: money with the economic system, power with the political, influence with the system of social integration, and value commitment with that of maintaining structural patterns" (Habermas, 1985b). While Parsons saw the 'value commitment' via four media, which included 'influence' and 'money' as two of the four media, Habermas saw 'influence' different from 'money'.

Habermas saw that there was a basic difference between influence and money. For one "it is evident that influence and value commitment are less susceptible of being measured, alienated, and stored than money or even

power" (Habermas, 1985b). Habermas goes on to analyze influence and Parson's steps, and concludes that influence initially can have a carte-blanch validity without the need of backing with knowledge or reason. "If we consider the proposal to apply the media concept to influence and value commitment in the light of our intuitive understanding of these things, our first reaction is ambivalent. It has a certain prima facie plausibility; persons and institutions can have a kind of prestige that enables them to exert influence on the convictions of others, even on collective opinion formation, by their statements-without giving detailed reasons for demonstrating competence" (Habermas, 1985b). This blind validity notion by Habermas is seen by others. Speakers "make truth claims that may influence the listeners' mental images of what may truly, or falsely, exist (knowledge)" (Varey, 2006).

Habermas goes on to state that there is a power differential. When a person of 'influence' speaks to an audience, a power struggle exists between the speaker and the audience. "Influential persons and institutions meet with a willingness in their audience to take advice. The utterances of the influential are not authorized by an official position, but they function as authoritative in virtue of a persuasive power that is manifested in the communicative achievement of consensus" (Habermas, 1985b). The speaker has influence in this situation. Furthermore, Habermas goes on to recognize that influence has many aliases. "'Influence' can be more of less translated as 'prestige' or 'reputation', 'value commitment' as 'moral authority'" (Habermas, 1985b). Habermas also recognizes that this power differential is created by society as a whole. The "ascertation that the medium of influence is institutionalized in the system of social integration, that is, in a public sphere established through the mass media, where the influence of journalists, party leaders, intellectuals, artists, and the like is of primary importance" (Habermas, 1985b).

Bourdieu first looks to the study of politics for understanding the notion of power. "Politics is the arena par excellence of officialization strategies" (Bourdieu, 1990b). Politicians are inevitably trying to get their views heard and their policies to receive attention and funds. "In their endeavours to draw the group's delegation to themselves and to withdraw it from their competitors, the agents competing for political power can only implement ritual strategies and strategic rituals, aimed at the symbolic universalization of private interests or the symbolic appropriation of official interests" (Bourdieu, 1990b). Bourdieu goes onto identify the language of the politicians is hotly contested in politics. "To appropriate the 'sayings of the tribe' is to appropriate the power to act on the group by appropriating the power the group exerts over itself through its official language" (Bourdieu, 1990b). While Bourdieu was talking about politics, this notion that the 'official language' is used as exerting power over the group

can be seen in other areas. In particular we see in Information Systems, the use of the 'official language' by the group exerting power over the group. This notion of power can be seen in 'scholarly influence'.

#### 1.3.2.2 Scholarly Influence

The construct called (scholarly) influence has been assessed/measured in many ways. Extant empirical measures of influence take both qualitative and quantitative forms. In general, influence measures deal with some measure of either strength of reputation or by a count of different kinds of either intellectual or creative output. The qualitative type of influence measure is seen in ranking studies. Some studies try to use survey analysis in order to 'rank' prominent journals, scholars, or academic institutions, which would give a measure of qualitative influence. These surveys measure the notion of the general population in the field by using scholars in the field as respondents to the questionnaires.

Prominent quantitative measures of 'influence' also exist. Citations can be seen as a way that an author gives credit of some varying degree of influence to another author. The count of these citations is a quantitative measure of 'influence' (Blaise Cronin & Snyder, 1998). Citation counts are the basis to various measures that try to identify how much 'influence' one paper has on another paper (or researcher on researcher, journal on journal, department on department). The grouping of citation measures, along with grouping of data points such as scholars, journals, or departments, will start to give a picture of the total influence by that particular data point.

The IS literature typically approaches the notion of influence by examining how often a scholar has been published, the venues in which s/he has published, and by subject and the type of the work published. Each of these criteria is weighted differently depending on disciplinary, contextual, and political circumstances. In general terms, being published more is better than being published less, but the frequency with which others reference an author's published works is the principle measure of success and influence. The set of tools and techniques used to measure the frequency of publication or of reference to concepts and publications is known as "Bibliometrics".

One key difference between social influence and scholarly influence is the fact that direction of agreement is not measured in quantitative scholarly influence. Citations do not have a positive or negative aspect to them. I argue that influence works as an absolute value, a strength that ignores direction. For example if there is someone that I disagree with, and another person that I agree with, both past researchers will influence me, and the direction of influence, whether positive or negative, does not matter in measuring the degree of influence. For social influence the 'compliance' is a positive that is privately a negative influence, 'identification' shows no direction (thus similar

to scholarly influence), and 'internalization' is a positive influence.

### 1.3.3 Working Definitions

Several terms will be defined in this section. While there are commonly accepted definitions for 'influence', 'measurable', 'actions', and 'publications', the current research requires that these terms be defined and their scope be identified. The following section will define and bound these terms for the current research stream.

#### *1.3.3.1 Influence*

The construct called 'influence' extended to the domain of scholarly activities, I term 'scholarly influence'. In the academic world the notion is described in many different ways, and seems to be a fluid construct. Thus the first task one faces is to identify, bind, and define this notion. Once I have a clearer concept of the construct then I can examine how one might measure the notion.

The dictionary definitions of influence and power are often co-referential (see section 1.3.1) in which influence is illustrated by if not defined by power differences. The power differential is demonstrated by situations where influencer and influenced power differences are causing an action by the receiver. The common definition of influence connotes that having of power to be used to wield over the person 'influenced'.

The power aspect of influence is evident in the dictionary definitions but in 'scholarly influence', power is harder to find. In the realm of scholarly citations these power differences are either lacking, are of a more subtle nature, or are often dressed in a subtle veneer of logic and scholarly discourse (Bourdieu, 1990a). When one starts working on a research project researchers are free to look at any of the vast ocean of research that has or has not been published. When researchers start their research, they are free to use any of the millions of previous research publications that are available to them. Researchers that publish are also not trying to influence others, nor do they wield any power, in the sense of the dictionary definition of 'influence'. The researchers are not publishing to try to get others to cite them. Rather in the pure sense of scholarship the researchers want to let the world know of the conclusions they found after a scholarly journey to find the 'truth'.

However, there are situations in which power structures do come into play in the use of citations (hereafter simply called 'the citation game'); through reference to shared explicit and implicit social norms. For example, often times a journal reviewer will 'suggest' that an author add a few citations to their paper in order to 'complete' the literature review and qualify a paper for acceptance at the journal (Adler & Harzing, 2009). Another situation is where an advisor 'recommends' that a student add some citations to their research. There are also co-citations

networks where researchers that are familiar with each other cite each other to increase citation scores (Adler & Harzing, 2009; B. Cronin, Shaw, & La Barre, 2003; Özbilgin, 2009). One can debate whether these additions are truly needed in order to enhance the paper, or the additions are requested to boost the citation counts of the requestor. While these are situations where a power structure is seen, regardless of the motives of the requestor, the number of citations that are added with these situations typically do not take up a majority of the citation lists of a research paper.

Another aspect of the dictionary definitions of 'influence' that exists is the sense of 'indirectness' or lack of 'effort'. For scholarly influence there should be no distinction on 'directness'. An advisor/student relationship is a direct relationship that has profound influence. For citations there may or may not be direct contact with the authors that one cites. One might be citing a researcher that they share an office with. On the other extreme the citer and cited may not even live in the same era, it is possible that one can cite an author from centuries past. So this clarification of 'indirect' is lacking in our definition of 'influence'.

In light of these various issues, for the purposes of this work I will define 'scholarly influence' simply as:

*The capacity of a researcher to produce measurable effects on the actions of another researcher.*

From this point forward when the term 'influence' is mentioned I am referring to 'scholarly influence' as define above. One interesting characteristic of scholarly influence is that it tends to build over time and that when scholarly influence decreases, it is with at a slow pace, which can be thought of as a 'slow fade'. Using the above definition, once an action has been identified, that action is in the past and will never disappear, thus the measurable effect (via citations) will never decrease.

Taking the above definition of 'scholarly influence' we see constructs of measurable effects and action. I need to define these constructs in order to congeal the definition of 'scholarly influence'. In the next section I define the constructs measurable and actions. I also define publications, which are used to measure the actions of a researcher.

#### *1.3.3.2 Construct Definitions – Measurable, Actions, and Publications*

For the purposes of this research I use the term 'measurable' to mean a notion of being able to witness in a quantitative manner. Scholarly influence happens when one scholars measurable action are affected by measurable actions of another researchers. Commonly these measurable actions can be seen in the form of citations, acknowledgements, and from working relations. Working relations can be seen in the form of co-authorship and

advisor/student relations.

For the purposes of this research I use the term 'actions' to be of any type of scholarly activity such as the creation or delivery of publications, lectures, speeches, attendance at a conference, presentations as well as the engagement in conducting meetings or participating in conversations, teaching, and mentoring. In short 'action' is any activity in which someone conveys ideas or positions. These 'actions' might be considered a form of participation in an extended discourse.

In this research I am principally concerned with measurable actions by researchers. I am focusing in on the publications within the different types of actions (such as lectures, speeches, presentations, teaching, and mentoring mentioned above). So the definition takes a narrower look at scholarly influence where the definition of 'scholarly influence' is further refined to mean:

> *The capacity of a researcher to produce through the use of their actions, measurable effects on the publication of another researcher*.

This may seem like a measure of convenience but current scholar measures takes similar approaches as citation counts and publication counts are heavily used to evaluate the 'worth' of a scholar in academics today. By having a broader definition of 'influence' than using solely citation counts or publication counts, this research tries to improve incrementally on current methodologies.

### 1.3.4 Limitations with Current Measures of Influence

#### *1.3.4.1 Limitations with Raw Citation Counts*

While commonly used as a measure of faculty productivity, citation measures have failings. As influence measures they are limited in at least four ways: they are not a quality measure, they do not discriminate against the varying degrees of influence, questions exist as to whether they are measuring influence, and age skew of citations (Egghe 2006; Sidiropoulos, Katsaros, & Manolopoulos, 2006). Because of the existence of varying degrees of influence and the fact that for citation measures one equal citation is given for highly 'influential' citations as opposed to not so 'influential' citations, citation counts skew influence. A paper may also 'influence' the author of another paper in the traditional definition of 'influence', but unless there is an idea or quote that is used by the second paper, the 'influence' goes un-credited, thus not recording possible 'influence'. Other than to monitor what scholars are reading, these types of 'soft influences' are impossible to measure. Even with these faults, when using bibliometric measures, citation analysis is currently the best way to measure 'influence'.

One major problem with influence (in both definitions, traditional and the current research's definition) is

who can actually gauge the amount of influence. In essence, I argue that only the receiver of the 'influence' can measure the amount of 'influence'. For the math teacher, I'm sure that all academics are trying to 'influence' students in a positive manner, but whether the student receives that 'influence' is hard to gauge from the teachers point of view. Only until some quantitative measure, such as test score improvement, is seen, does the teacher start to realize the amount of 'influence'. Even with this knowledge, I'm sure that my high school math teacher probably doesn't know how much of an impact she had on my studies after leaving high school. In the scholarly realm, citations may not even go noticed by the author that is being cited. Only after a search of citation numbers using some bibliometric database such as Google Scholar or EBSCOhost can the researcher realize the influence of their work.

Another problem with citation counts is the age of the initial research is a major prerequisite for garnering citation counts. While a publication that is 'hot off the presses' may be very influential, there is a requirement that some time has to pass before the publication can start to achieve any citation numbers. This requirement rules out newly publicized articles out of the citation game. The prerequisite also means that older articles tend to have a skew of having higher citation counts.

Finally the practice of the citation game has also been criticized. There are problems with citation counts as there are self-citations, co-citation networks, journal self-citations, and bad citation practices. With self-citations an author will cite their own previous work, even if the previous work does not contribute to the citing research. This practice is seen as unethical but is used by researchers to gain citation numbers (Adler & Harzing, 2009; Blaise Cronin & Snyder, 1998; Katsaros, Akritidis, & Bozanis, 2009; Persson, Glänzel, & Danell, 2004). Co-citation networks happen when researchers that are familiar with each other cite each other in order to improve citation scores for each other. While this is not self-citation, the practice is similar where cohorts are working together to increase each other's citations. The practice is also seen as unethical if done only for the purpose of increasing citation counts. There is a notion of power also seen here as one researcher might cite another researcher with the expectation that the favor will be returned (Adler & Harzing, 2009; B. Cronin, et al., 2003; Özbilgin, 2009). The practice of journals reviewers asking authors to cite previous papers in said journal is also seen as a form of self citation and is deemed unethical, though the analysis of such behavior is much harder to measure due to the fact that review process is never published (Adler & Harzing, 2009). Finally bad citation practices such as 'empty' referencing, where a researcher just 'piggy backs' off of the citation of another researcher and does not refer to the

original study that makes the claim, misrepresented references, false references, and just erroneous references can be counted in citations (Harzing, 2002; Nkomo, 2009).

#### 1.3.4.2 Limitations and Biases in Past Influence Research

Qualitative methods are not immune from problems as well. Some of the problems for qualitative methods are: subject bias, incomplete surveys, inherent reputation of journals, their subjective nature, and the apparent North American bias in IS journal rankings (Galliers & Whitley, 2007; Gallivan & Benbunan-Fich, 2007; Lyytinen, Baskerville, Iivari, & Te'eni, 2007; Whitley & Galliers, 2007; Wilcocks, et al., 2008). In survey studies there is an inherent influencer-influenced bias in surveys. When IS journal surveys are done, the data points or the academic population that is taking the survey are readers of the journal, but they are also the editors, authors, potential authors, and reviewers of articles in these journals. So there is inherent bias by the survey takers or subjects, in the fact that one would try to improve prestige of a journal where the subject is an editor, past author, reviewer, or is inspiring to publish in said journal. By ranking journals that the subject has ties to higher than journals the subject has no ties to, they are enhancing, indirectly the apparent influence of their own work. I am taking an Actor Network Theory (ANT) view on the IS Research Network.

With ANT, science "and technology are dramatic 'stories' in which the identity of the actors is one of the issues at hand. The observer who disregards these uncertainties risks writing a slanted story which ignores the fact that the identities of actors are problematic" (Callon, 1987). There exists an exchange with ANT between the actor and the system (or the agency and structure). "It might be more productive to say that they have alternated between two types of equally powerful dissatisfactions" (Latour, 1999). A social scientist may struggle with this dissatisfaction. There is a need to look at the micro (or the face to face) interaction, but they may find that there is possibly another level. The other level may not even be visible. Furthermore, the need exists to look at all the actors that make up the system. ANT is simply a way of paying attention to these two dissatisfactions, not again to overcome them or to solve the problem, but to follow them elsewhere and to try to explore the very conditions that make these two opposite disappointments possible" (Latour, 1999). By studying these dissatisfactions we see one contribution of ANT, "when one explores the structures of the social, one is not led away from the local sites" (Latour, 1999). Callon realized this ability to see the network in the St. Brieuc bay case, and he was able to "see the simultaneous production of knowledge and construction of a network of relationships In which social and natural entities mutually control who they are and what they want" (Callon, 1987).

By using ANT, I am able to tell the story about influence in a different light than just a journal rank list. "ANT does not tell anyone the shape that is to be drawn – circles or cubes or lines – but only how to go about systematically recording the world-building abilities of the sites to be documented and registered" (Latour, 1999). I am trying to examine different views about scholarly influence with this dissertation. By doing so, I hope to 'document and register' the IS academic world. The use of multiple measures is a different view from other philosophical standpoints. "The difference between ANT and the masses of reflection on modernity and post-, hyper-, pre- and anti-modernity, was simply that it took to task all of the components of what could be called the modernist predicament simultaneously" (Latour, 1999). I am trying to rewrite the use of a single measuring points of journal ranking lists by looking at more components in the 'scholarly influence' arena, While I am not looking at all of the components, I am adding to the current methodologies. I am trying to contribute a basket of measures, thereby creating a different view of IS scholarship from past research.

An important aspect of ANT is the actor and their actions. "ANT was simply another way of being faithful to the insights of ethnomethodology: actors know what they do and we have to learn from them not only what they do but how and why they do it" (Latour, 1999). With ANT we look at the actors, their actions, and we need a way to measure these actions. "Instead it [network pole of actor-network] refers to something entirely different which is the summing up of interactions through various kinds of devices, inscriptions, forms and formulae, into a very local, very practical, very tiny locus" (Latour, 1999).

In the case of the St. Brieuc bay, the actors included the scallops, which may seem as an unlikely actor for this network. "For the case of the scallops (like the fishermen and the scientific colleagues) the interessement is founded on a certain interpretation of what the yet to be enrolled actors are and want as well as what entities these actors are associated with" (Callon, 1987). Here the term 'interessement' "is the group of actions by which an entity (here the three researchers) attempts to impose and stabilize the identity of the other actors it defines through its problematization. Different devices are used to implement these actions" (Callon, 1987). For the researchers the goal was to have the scallops anchor so that the scallops could grow. The researchers imposed the actions on the scallops through the use of netted bags containing support materials for anchoring, floats, towlines, and boats.

The Actor Network Theory view is a 'material-semiotic' method, where all material (humans and things) and semiotic (concepts) are part of the network. The current view of influence, measured only by journal publications, is a completely narrow view. I am trying to include the material and semiotics. With the material the

researchers represent the ‘humans’ and journals, and databases (Google Scholar, Impact Factors) represent the ‘things’. The semiotic is the ‘concepts’ included in the research publications. I am aligning myself with the ANT view, which incorporates the researchers, journals, databases, and concepts, while the current journal publication count method only looks at a narrow view of the material by only focusing on the journal or researcher.

Surveys are also incomplete. Most surveys have A and B level journals, but they do not include all of the lower level journals. Thus there is inherent bias being installed into the survey itself. The survey self installed bias has been termed the ‘anchoring effect’. The ‘anchoring effect’ is where, in a journal ranking survey study, there is a skew towards journals that are listed as opposed to those that are ‘written in’. Studies have shown that there is a bias towards those journal listed in the survey, even if the surveyed are ‘encouraged’ to write in any journals that might have been left out of the journal list (Chua, Cao, Cousins, & Straub, 2002). Survey methods have come under scrutiny for the ‘anchoring effect’ problem.

Finally problems exist with the inherent reputation of the journals. Studies have shown that once a journal has gotten a certain reputation, they tend to keep that reputation even if the actual worth of the journal has changed. Reputation in the minds of the survey takers take a bit more time to change compared to the change in the reputation of the journal. Here we see a ‘slow fade’ of influence of journals that have in the past achieved a certain reputation. There seems to be a lag time from the change in reputation and for that change to appear in the results of survey studies that measure the reputation of a journal. The citation measure does not suffer from these biases.

Other more ‘subjective’ and qualitative measures such as non-ranking surveys of expert and lay opinion, awards, prizes, and patents earned, appear far less frequently in our literature. A third measure, that of the social inter-connectedness, or the strength of a scholar’s ‘social network’, (cloud, Figure 2**)** examines characteristics of the network of people with whom a scholar has published, worked, mentored, or taught. The initial stages of the social network analysis (SNA) of the current research are the ‘co-authorship network’. The ‘co-authorship network’ will look at individuals and their co-authors as the social network in a field. The idea behind studying networks is that social networks are a measure of influence. By working with colleagues a researcher can inflict influence via the social connection.

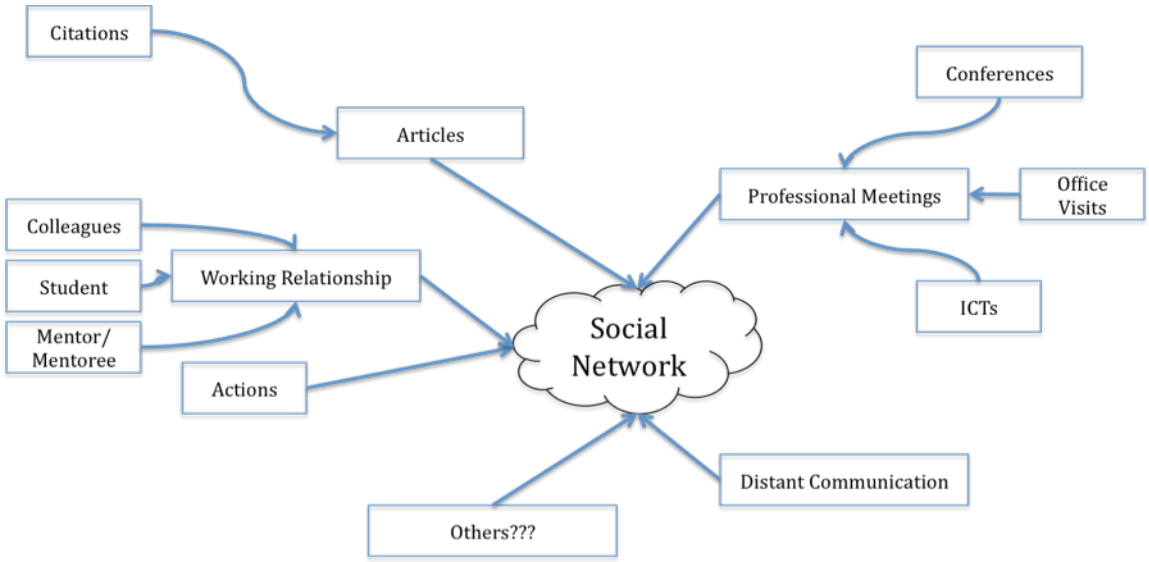


Figure 2. The Social Network and How it is Defined

### 1.4 Theoretical Framing (and the characteristics of Constructs)

The literature that actually defines 'influence' is lacking in specificity and there is an absence of a theory of influence. There are many scholarly publications that deal with measuring the 'worth' of a scholar but the literature review produced little in 'influence' definition or theory (Alexander, Scherer, & Lecoutre, 2007; Clark & Wright, 2007; Ferratt, Gorman, Kanet, & Salisbury, 2007; Geary, Marriott, & Rowlinson, 2004; Hardgrave & Walstrom, 1997; Harzing, 2008; Kodrzycki & Yu, 2005; Korobkin, 1999; Kozar, Larsen, & Straub, 2006; Lowry, Romans, & Curtis, 2004; Martin, 2007; Mingers & Harzing, 2007; Mylonopoulos & Theoharakis, 2001; Nelson, 2006; Nerur, Sikora, Mangalaraj, & Balijepally, 2005; Peffers, Avison, Ein-Dor, & Zmud, 2003; Podsakoff, MacKenzie, Bachrach, & Podsakoff, 2005; Rainer & Miller, 2005; Walstrom & Hardgrave, 2001; Walstrom, Hardgrave, & Wilson, 1995; Wilcocks, et al., 2008). While 'influence' may be lacking in definition and lacking in having a well articulated and cogent body of theory, the notion of 'influence' is tied closely with communication, discourse, and argumentation. In this section I look at theories of communication and discourse by Habermas and argumentation by Toulmin to understand the theoretical background on the notions of communication and argumentation.

The notions of scholarly influence as discussed above are essentially forms of communicative action (Habermas, 1985a) embedded in a context of formal argumentation (Toulmin, 1964). Accordingly this research is informed by the work of the German sociologist and Critical Social Theorist, Jürgen Habermas, in particular his theories of Communicative Action and by the work of British Rhetorician Steven Toulmin. For both Habermas and

Toulmin the nature and pragmatics of communication and of human discourse are central to their work. Habermas' theory of "communicative reason, …, considers the site of rationality to be the structures of interpersonal linguistic communication rather than the structure of either the cosmos or the knowing subject…" (Habermas, 1985b) And as a critical theorist he challenges the Marxist focus on economics (or alienated labor) as the main or sole determining factor of oppression. Habermas argues that the key to liberation is rather to be found in language and communication between people." (Wikipedia.com) Toulmin focuses on the structures and pragmatics of effective argumentation and the way one must develop and support 'truth claims' made in texts. My present research maintains that as academics we are participating in formal and informal discourse through publications (journals, conferences, books, articles, lectures, debates, interviews, podcasts, and teaching etc.), which are the structures of the communication and formal argumentation. We exert influence and assert truth claims about the importance of other measures and of venues through our various texts[1].

"Jürgen Habermas' theory of discourse ethics contains two distinctive characteristics: (i) it puts forth as its fundamental tenet, a prerequisite of participation in argumentation for testing the validity of a norm and (ii) it transforms the individual nature of Kant's categorical imperative into a collective imperative by reformulating it to ensure the expression of a general will and by elevating it to a rule of argumentation" (Hoenisch, 2005). Communication is the ability to manipulate other peoples thought. In the academic realm, manipulation is done frequently by articles being published and then influencing the thoughts of those that read the article. Discourse is the act of argument/counter argument and through this exchange communication is reached. Discourse can be seen as strategic, in the sense that one party is trying to win over the other party to their point of view.

In sociology, and in very general terms, Critical Social Theory concerns itself with understanding structures of society and how they may be used instrumentally to reinforce extant power relations and enslave versus emancipate mankind. One of the principal objectives of many critical social theorists is to uncover, examine, and critique social structures and to support emancipatory goals. Communication/language/speech are all-powerful tools and are forms of social action. "Habermas makes a distinction between three forms of action: instrumental action

[1] As an important aside, I refer to the notion of a 'text' in the post-structuralist sense, not as a mere set of printed words as in a single article, but rather more expansively as a work, a body of works, a discourse a narrative that may be formal and written or informal and oral. Text can be used in interaction (R. Boland, 1978), representation (R. J. Boland, Maheshwari, Te'eni, Shwartz, & Tenkasi, 1992), or to communicate a context (Boland Jr. & Tenkasi, 1995). Boland identifies that actors (people) can use text in different modes than just oral communication including text, picture, graphs, audio, and video. Boland also identifies that each text has interpretations that can have multiple levels of context (Boland Jr., Tenkasi, & Te'eni, 1994).

(oriented to success, nonsocial), strategic action (oriented to success, social) and communicative action (oriented to reaching understanding, social)" (Wijnia, 2010). Communicative action is where people try to reach an agreement to a 'true' knowledge. "True" in this context constitutes agreements fairly and openly arrived through symmetrical discourse and is both time and contextually dependent. "A discussion that evolves about certain things (e.g. about the ethics concerning blogging) is called a discourse" (Wijnia, 2010). According to Habermas there are four levels of discourse. Flow of ideas and thoughts through the four levels of discourse can only happen when there is communicative symmetry between the participants of the communication (Wijnia, 2010). When these conditions are met one approximates what Habermas calls the 'ideal speech situation' or one unobstructed by gamesmanship, power differences and strategic positioning aimed at forcing others to accept one's view. "These conditions are:

- all people involved must have equal opportunity to start a discourse;
- all people involved must have equal opportunity to participate in a discourse;
- there may not be any difference in power between the participants;
- the participants must be truthful to each other" (Wijnia, 2010).

All four conditions are in place to allow exchange of true argumentation; this means that all arguments have to be regarded by all participants of the discourse for the argument to become 'truth'. This doesn't mean that there will be a consensus between the participants of the discourse. Participants my have a range of views from agreement to dissensus (Wijnia, 2010). "When a consensus is achieved this doesn't mean that it's a definitive consensus. It can always be re-discussed in future time"(Wijnia, 2010). Habermas is telling us that there needs to be some ground rules for argumentation to happen. We see in these rules a notion of power being lifted. Everyone in the discourse is 'equal' and has 'equal' rights to participate in the discourse. I have seen less and less of this 'equality' in the discourse of our literature. Different outlets have more power to participate in the discourse. While discourse needs a non-power structure to become a truly fair discussion, influence is still seen in argumentation.

Influence is indirectly affected by social imperative. According to Stephen Toulmin, there are elements to a persuasive argument. The elements are: claim (C), evidence (E), warrant (W), backing (B), rebuttal (R), and qualifier (Q) (Toulmin, 1964). "There must be an initial stage at which the charge or claim is clearly stated, a subsequent phase in which evidence is set out or testimony given in support of the charge or claim" (Toulmin, 1964, p.16). Warrants are "general, hypothetical statements, which can act as bridges, and authorize the sort of step to

which our particular argument commits us" (Toulmin, 1964, p. 98). Backing of warrants is "other assurances, without which the warrants themselves would possess neither authority nor currency" (Toulmin, 1964, p. 103). Rebuttals are "conditions of exceptions" (Toulmin, 1964, p.101). Finally a qualifier is "some explicit reference to the degree of force which our data confer on our claim in virtue of our warrant" (Toulmin, 1964, p.101). The argument model is seen in figure 3. The model argues for a claim C, qualified by some degree of force Q, evidenced by some datum E, due to a warrant W, with some backing B, unless some rebuttal R exists.

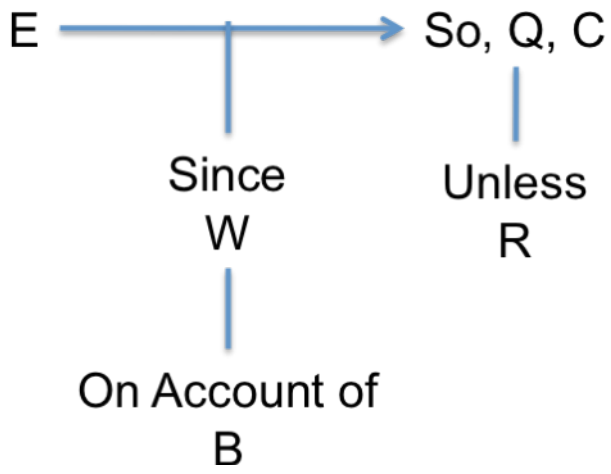


Figure 3. Toulmin Argument Model

Finally influence is a power-laden structure. As we saw with the traditional definition of influence by dictionary.com and Webster (see section 1.3.1) power difference is inherent in the basic definition of 'influence'. We also saw (see section 1.3.2.1) that in the publication game, power struggles also are inherent in requests (Adler & Harzing, 2009).

### 1.4.1 Operationalizing the Construct

In order to measure 'influence' I need to take two measures for the current research, the citation count and the co-authorship. An essential question is of course "Where do I look for citations?" There are many different areas of scholarly output. I recognize that scholarly output can come in the form of teaching, journal articles, conference proceedings, conference presentations, conference attendance, book publication, lectures, speeches, formal meetings, colloquiums, impromptu meetings, and mentoring. While all these forms of output can have influence, I am concerned at this point with formal output of a scholar. These would include journal publication, conference

proceedings, and book publications. The current research, as described earlier, focuses in on only the hard publications, which I categorize as journal publication, conference proceedings, and book publications. The limited target may seem that I'm losing focus and eliminating various outlets in which influence can be seen, but the current research is actually extending the past research. By including more publications than previous work in influence that only looked at journal publications, or only journal and conference publications, the current research is expanding the field of defining one's 'influence'. In addition, the measures of influence on such activities as meetings and mentoring are difficult if not impossible. At this point by introducing the use of scholarly databases and the Internet I am able to collect citation data to include many hard publications.

#### *1.4.1.1 The Constructs*

I will be using the 'publish or perish' (PoP) tool by Harzing to measure the citation construct. This tool uses the Google scholar (GS) database. The GS database incorporates journal publication, books, and conference proceedings. While there are other competing scholarly databases such as the Thomson ISI, the GS database is more complete in that there are no limitations on dates or publication type.

When collecting citation data, meticulous record keeping will need to be kept due to the dynamic nature of citation data. The GS database is being updated daily. New publications sets are being added as well as previously listed publications will come out with their new issues. Thus, the GS database is a living repository with data being added everyday. This means that the citation measures realized from searching GS will also be changing from day to day. Moreover replication of searches will be impossible due to this dynamic nature of the source (GS) and the citation data. Therefore a temporal record must be kept when collecting citation data.

The co-authorship construct is taken from various scholarly databases. While GS was used first there were times where the data was incomplete or missing in GS. When this happened, other sources such as EBSCOhost, Science Direct, IEEE publication, ACM publications, AIS publications, or the journal websites were reviewed. The publication records were then downloaded and saved into an excel spreadsheet. Data was then analyzed to pull the various data points of co-authorship. One future project of this construct is to create a database that would house publication information in an easily searchable format.

### 1.5 The research program

As new methods of measuring influence are introduced, I get a better, or possibly a different, grasp on what

really is influence. There exists no concrete and static definition of 'influence' and what the final monster looks like is hard to tell (Thus, I'd like to keep 'influence' represented as a cloud in figure 2). As more measures are introduced the shape of the entity becomes clearer. The current research tries to address a small part of the measure of influence.

Within bibliometrics one can find techniques such as Impact Factors, Bibliograms, Content Analysis, Data Mining, Infometrics, Webometrics and Citation Analysis. Much of my present research focuses in on Citation Analysis (CA). Within CA there are four commonly used Citation Indices (CI) including: the Institute for Scientific Information's' (ISI) Web of Science (WoS), Science Citation Index (SCI), Social Science Citation Index (SSCI), and the Arts and Humanities Citation Index (AHCI). Each of these indices were developed for different audiences and each is bounded by assumptions that make them less than desirable as a way to generalize and compare indices between or across disciplines. As such, a more ecumenical and general bibliographic measure has been developed, the H-family of indices. This research uses and further develops the Hirsch family of indices into the IS discipline.

Sources of data used to compute CA can also vary widely. These include Thomson Scientific, which owns ISI. Thomson Scientific is the first source to create CA data and has been the de-facto CA source in the past 30 years. Elsevier publishes Scopus, which can give some CA data. Google Scholar is a newer kid on the block and an up and coming data source in the eyes of many researchers. While GS has not had the completeness of data that were seen in other sources, GS has been gaining sources at a high rate. New datasets are constantly added and even during the course of the current research I have seen whole journals being added in a matter of a few weeks. As time goes on GS seems to be becoming more and more relevant in scholarly research. The current research takes data from GS.

The current research looks at the 'measure of influence' in different levels. The use of different levels is analogous to targeting different sets of populations. For example, political campaigns can be looked at in granular or whole sets of data. The smallest group would be the individual and how they vote. Then neighborhoods, districts, cities, counties, states, and the country as a whole can be analyzed for the success/failure of a political campaign.

For my research the 10 feet view of the world is using individual researcher as the unit of measure. At this low level view, each individual is seen as one unit and the measures are done on the whole catalog of work by one individual. I can go up to the 100 feet view to our second level where I am bundling the individual researchers of different groups. At the 100 feet level I may be targeting a group of individuals at one institution. I can go higher up

and look at the 1,000-foot level to see possibly journal groupings. So I am measuring the whole catalog of work done by one journal. I can go even higher to the 10,000-foot level to categorize by country. The groupings here can continue with other possibilities being conference publications, geographic regions, research methodology, PhD granting institution, PhD mentor group, etc.

When studying CA, and moving to higher levels from the individual researcher, the h-indices are aggregated from the lower levels. Note that the h-indices are not a zero-sum game. The addition of two researchers does not combine the h-indices to get a sum of the two researchers, rather the library of work of the two researchers is combined and the h-index is recalculated. This adds to the complexity and time consumption of the CA research.

### 1.6 The Papers of the Multi-Paper Model

This section explains the different papers that will make up the multi-paper model of this dissertation. The current research focuses in on a small aspect of the measure of 'influence'. There will be four major parts to this research stream. First is the use of bibliometric tools on IS researchers. The second section will look at the social network analysis of IS researchers. The third part will concern with combining both bibliometric tools and SNA to the IS researchers. Finally part four will concentrate on using the bibliometric tools and SNA to areas of IS such as knowledge management and groupware.

## 1.6.1 Description of each and how each paper fits the RQs and Research program

The research in h-indices and social network analysis will further the research on defining the influence or academic worth of a scholar.

#### *1.6.1.1 Research Program*

Within bibliometrics I am aiming particularly at citation analysis (CA). Within CA, I am focused on the h-family of indices; the h-index, g-index, hm-index, and hc-index. I focus these bibliometric measures on different sized target populations from small (individual researchers) to larger ones (journals). The individual researcher level is analyzed using the Hirsch family of indices in Chapter 2. Chapter 2 was initially presented at ICIS 2008 in Paris and was published in JAIS in June of 2009. The focus increases in size as the journal level is analyzed using the Hirsch family of indices in Chapter 3. Chapter 3 was presented at AMCIS 2008 in Toronto, and is currently in the re-write/expansion stage for a journal publication. As a side research while using and studying the h-family of indices I identified a void in the h-family of indices. The introduction of the gc-index is the topic for Chapter 4.

Chapter 4 was developed as a student paper and was presented at SAIS 2009 in Charleston and won 'runner-up' for the best student paper award.

The SNA analysis section looked at the co-authorship network of IS researchers in Chapter 5. Chapter 5 has been presented at AMCIS 2010 in Lima, Peru and is the preliminary stages of a re-write and expansion to a journal article. The expansion of the use of the Hirsch indices was targeted for online communities. The h-index was used to identify high-level contributors to a college sports team fan site online community. This paper was submitted to a conference and is waiting the reviewer's decision and is presented in Chapter 6. Finally the Heinz K. Klein research work that first started me on this path was expanded and is going through a third round of revisions for publication in an EJIS special issue dedicated to Heinz Klein.

#### *1.6.1.2 Research Questions*

I acknowledge two important notions. First, that there exists a construct called 'influence' and second, that the definition of 'influence' is ever changing. First, I acknowledge that 'influence' exists; therefore it makes sense to try to define 'influence' and have measures for influence. I also know that there are multiple factors that measure into 'influence'. This brings us to figure F2 (Big Picture). In any social setting one can 'influence' one another via social interactions. These social interactions include telephone conversations, face-to-face encounters, letters, word of mouth, etc. For scholarly influence these social interactions include conversations, letters, meetings, and lectures. Conversations are communications that take place in synchronous settings. These include face-to-face meetings and distant communications. Face-to-face meetings can be one-on-one meetings or office visits, conversations that take place in group settings such as meetings and lectures. Visits to conferences can reveal small group or one-on-one meetings or presentations. Distant communication can include conversations that take place via phone or Internet relay chat or Skype. Letters include those sent by traditional post, email, or fax messages. Influence can be presented via working relationships as well. Actions such as awards, or accolades in the work place or at conferences can also be influence. Finally the written works or publications can exert influence. These publications include journal articles, conference proceedings, web sites, and books.

In using the citation analysis tools of bibliometrics I hope to answer the following question. "How can the use of bibliometric tools be used to meaningfully compare and evaluate scholars?" This question can be expanded to other target sets of IS researchers. The target sets can be groupings of research/researchers such as the groupings of research published in one journal (in Chapter 3), a group of researchers from one institution, or a grouping of

researchers by country. On the SNA side I have the research question, "How can social networks and network components be meaningfully compared to evaluate scholars?" This again can be used to evaluate scholars in different connections such as co-authorship and co-citation connections between researchers. Finally the combination of the two types of analysis leads to the following question, "How do the SNA and H-family metrics provide a clearer picture of the construct 'scholarly influence'?"

### 1.7 SNA Artifacts (Measures and SW Tool)

While the h-index papers have been developed since 2007, the work on the social network analysis (SNA) has been the second step. The SNA has been in development since 2009. There is also a database of IS researchers that is being populated and update using GS. Currently the database has over 500 researchers and over 3000 papers. The program to create an interface with this database will need development in the future.

I am also trying to adapt the 'influence' measures to areas in IS, in particular those in the knowledge management area in the form of online communities discussion forum management. Work has begun on the data collection on an online college sports fan site. Currently there are approximately 5 years worth of data that needs to be mined for this project.

### 1.8 Conclusion

Two main areas for scholarly influence exists: biliometrics and social network analysis. Within bibliometrics many new citation indices exist. The introduction of the h-index in 2005 has lead to a spur of other indices such as the g-index, hc-index, and hm-index. The reason for this spurt is due largely to the introduction of the computing power that has allowed the easier collection and analysis of citation measurements. Without the computing power of searching citation databases and aggregating citation measures, the calculations of these citation indices would be too time consuming for traditional human data manipulation and analysis.

This research targets the citation indices generated from the introduction of the h-index. I target the h-family of indices including the h-index, g-index, gc-index, hc-index, and the hm-index. These citation analyses will be conducted at different levels on IS researchers. Moving from smaller to larger groups, I can conduct CA on individual researchers, group of researchers at an institution, journal level, regional level within a country, country level, and global regional level.

Social network analysis can be conducted in different ways as well. While these are not levels, the network

edges can be defined in two ways: co-authorship or co-citation. With co-authorship the connections are seen as a close bidirectional working relationship between the two authors, or groups of authors. The SNA is build by identifying these connections and the social network is build using these connections. With co-citations the connections are taken from citations. The connections are not as strong as in co-authorship. Also the connection is unidirectional unless the citations run in both directions.

An important artifact of this research is the database that houses the authorship data for IS researchers. Currently 8 journals, 500 IS researchers, and over 3000 researcher paper data have been captured into an Access database. During this dissertation, data collection will continue with the development of an interface with this database that will allow the user to realize the aforementioned h-index statistics, as well as SNA data on the IS researchers.

The last leg of this dissertation is to utilize the CA and SNA tools gained during the first two part and utilize these analysis tools to an IS field, mainly in the knowledge management area. The first attempt of application of the h-indices has begun with analysis of contribution to a college sports fan site using the h-statistics. I hope to expand the use of the CA/SNA tools to other areas of knowledge management.

With the use of CA/SNA tools I hope to gain a better knowledge of how we, as IS researchers as a whole, contribute to the knowledge base in IS. I hope that I am able to provide a better picture on the 'scholarly influence' of a researcher using these metrics, as opposed to just a publication frequency count of A-journal publications. In future research, I also hope to use the knowledge gained in applying the CA/SNA tools to allow an expansion into the 'influence' of individuals in the knowledge management realm.

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# 2 Assessing Researcher Scholarly Influence using the Hirsch Indices

Duane Truex, Michael Cuellar, Hirotoshi Takeda

**Abstract**

This study is part of a program aimed at creating measures to enable 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. We find current approaches toward the evaluation of research productivity to be simplistic, atheoretic, and biased towards 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 with some surprising results. We find 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. We find that other ranking studies, by narrowly bounding the venues included in those studies, distort the discourse and effectively privilege certain venues by declaring them as more highly influential than they are when one includes broader measures of scholarly impact. We found three different categories of scholars: those who publish primarily in North American journals, those who publish primarily in European journals, and a transnational elite who publish in both geographies. Excluding the transnational scholars, we find that North American Scholars tend to be more influential than the Europeans on average. We attribute this difference to a difference in the publication culture of the different geographies.

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).

## 2.1 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. We therefore

suggest the IS field take advantage of the 80 years of work by scholars in the Information Sciences[2] 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 on the Information Science based Hirsch family of indices and rooted in 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 so that they serve to simply reify and reinforce extant power structures and relationships. Historically, the evaluation of scholarly output has been based on publication in "premier" journals. Journal ranking methodology has come under scrutiny by different studies and editorial pieces in both US and European journals (Alexander et al., 2007, Baskerville, 2008, Clark and Wright, 2007, Peffers and Tang, 2003, Rainer and Miller, 2005). Arguments exist 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 over 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 adjudging the worth of a scholar and espousing a need to bring the whole process "under control". Other studies advocate for the removal from consideration practitioner and non-research publications that 'conflate' consideration of a scholar's research contributions (Gallivan and Benbunan-Fich, 2007). We would argue, however, that journal rankings are an incomplete measure of the breath 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

[2] 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

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 by which they can compare the performance and worth of firms in the same industry, and indices to compare firms in different and at times disparate industries (e.g., IBM and General Motors Corp.), university administrators require vocabularies and metrics to compare scholars. Second, as a field we need measures which enable us to assess our own scholarly influence relative to other fields and so we might 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 influentially 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 and not simply a single number representing a ranking or a 'hit rate'. To that end, we are looking to understand and apply a set of measures to help consider a scholar's legacy. This paper is but one stage in that larger program of inquiry. 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 later element would require various types of citations and co-citation analyses. But for this present work we are developing a single component of the larger proposed technique set. In other words, we examine how the Hirsch family of citation statistics may provide a 'fairer' and more transparent measure of scholarly influence than presented by current approaches.

The paper proceeds as follows: In the next section we briefly examine the literature exploring measures of scholarly influence of individual scholars. We then point out weaknesses in these measures and propose 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 with the methodology selected by Lowry et al. Next, we develop a list of scholars drawn from European journals in order to demonstrate the Hirsch statistics ability to generate comparisons. We then discuss the findings and examine the limitations of the study and examine how it provides pointers to our continued project seeking a set of better means to measure scholarly value.

### 2.2 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 research about research with more than 40 published works addressing the issue of journal rankings and scholarly output. Interest in this topic is not limited to our own field. The question of measuring research output by publication counts is prevalent in many of the social sciences (Bar-Ilan, 2008, Collin et al., 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 e.g., (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. A third stream focuses primarily on the metrics and methods used in the first two streams, or propose improvements or replacements to 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).

#### 2.2.1 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 and to add journals missing entries from an auxiliary list or from experience. Their instruments, administered to a sampling of IS academics selected from sources such as the ISWorld Directory of MIS Faculty, were then averaged to create the mean scores for each journal. These scores were then arranged in a ranking table.

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 where European IS scholars representing 25% of all IS scholars only represent 8-9% of those published in the field's 'top-tier' journals (Lyytinen et al., 2007). Gallivan and Benbunan-Fich (2007) set out to examine why in Huang and Hsu's (2005) highly cited article of the "top 30 IS scholars" there were no Europeans and only two women on the list. 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 termed the problem of the "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[3]. Thus, we have a kind of reification by repetition in the way studies are conducted making it relatively more difficult for newer or 'niche' journals to break into the rankings. Another way to look at reification is in 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) "The only solution to replicative fading is to introduce DNA from non-cloned individuals, thus reducing the number of harmful

[3] A reviewer has claimed that we are cloning Lowry, et. al.'s (2007) study in that we are using the same scholars as his output. However, we have used an entirely different analysis methodology as is described in the methods section below.

mutations." (Alpha, 2008) This suggests that studies should be repopulated with updated and fresh selections of respondent choices regularly[4]. Second, and related to the first problem, are a number of factors that tend to make certain publication more recognizable and familiar to respondents. The number of years in print, the relative use in PhD programs, and the reification by repetition suggest that 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 'specialist 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 any study ranking of journals of 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 in play at many universities over the creation of an established 'journal list' used in tenure and promotion decisions (Adams and Johnson, 2008, Willcocks et al., 2008).

### 2.2.2 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 MISQ, ISR and the IS articles published in 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 5-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 as well.

[4] 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 closed list set and not allowing new venues to be admitted, then opening the set would reduce path dependency. But it begs the issue of the subjectivity associated with the list's creation.

But scientometric analysis has its flaws as well. The technique tends to be time consuming because of the tediousness and difficulty required to acquire and tease 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 because many potential representations of an author's name and changing author listing conventions in publication venues and that 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. Other criticisms of citation analysis approaches include the facts 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' by artificially inflating citations. Authors may also skew the process by adding unnecessary self-citations and tangentially related references to colleague's work. Thus decisions by authors as to 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).

### 2.2.3 Other Methods

Other methods have been suggested for ranking journals. One approach that has been suggested is to rank journals based on journal lists of universities. Alexander, Scherer, Lecoutre (2007) investigated the difference in international journal rankings to test for equivalency. They found a low degree of agreement among the six journal ranking systems they examined. Rainer and Miller (2005) present a method to average journal rankings across various lists. The average journal ranking across lists method addresses the variability across journal ranking studies found by Alexander et al. (2007). Templeton, Lewis and Luo (2007) propose to rank 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.

#### 2.2.3.1 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 Management Information Systems Quarterly (MISQ), Information Systems Research (ISR), and Management Science (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 as to 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) try to identify characteristics of European IS research that distinguishes it from IS research undertaken elsewhere. Gallivan and Benbunan-Fich (2007) explored the relative representation of Europeans in US and European-based journals 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. A recent number of opinion pieces in the European Journal of Information Systems (EJIS, v. 17, #2, 2007) address the question of the influence of European IS scholarship as 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.

### 2.2.4 Theory Light vs. Theory Driven Approaches

An unaddressed issue in all of these studies is 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 the development of literature streams which would account for the use of citations and give a theoretical basis of choice of methods or metrics in studying metrics.

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 over 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 are 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 science 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 (Sidiropoulos et al., 2006) and the g-index suggested by Egghe (2006). All of these indices assign a number to an author/researcher suggesting the impact the researcher has had. A higher index means a researcher has more papers that are highly cited than a researcher with a lower h-index. The index is therefore a surrogate number registering influence and has been rapidly adopted and used in natural science fields [5](Glanzel,

[5] 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 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.

2006).

The h-index is calculated as the number of papers h if h of his/her Np papers have at least h citations each, and the other (Np -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 articles than are listed in the example table, but none of

these other articles have 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. 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 9 citations. Thus 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 author's 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 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.

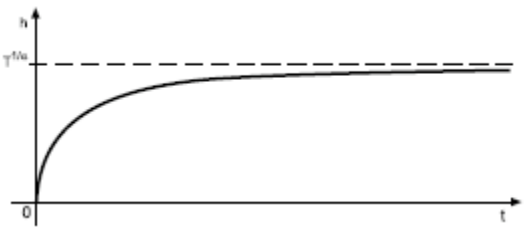


Figure 1: Chart of the growth of an *h*-index (from Egghe (2007))

As the figure shows, the h-index grows in a logarithmic pattern until it is asymptotic to a level described by T1/ $\alpha$ 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 Np (the set of papers) in the previous definition (Egghe and Rousseau, 2006).

### 2.2.5 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 for a shorter period of time, 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 an 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[6].

### 2.2.6 Responses to Limitations in the 'native' h-index

#### *2.2.6.1 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 Sc(i) calculated as follows: 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 $\gamma$ is a constant chosen to increase the effect of more recent papers as $\gamma$ increases, and $\delta$ is a constant chosen to lessen the effect of older papers as $\delta$ increases. In the original paper Sidiropoulos et al. (2006) used $\gamma$ = 4, and $\delta$ = 1. The hc-index takes the Sc(i) score for each paper by a researcher/journal and then

ranks the papers according to the Sc(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 Sc(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.

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[6] 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)

| 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 have added the year of publication to the Table 1 data, calculated the Sc(i) for each article by the formula described above and present the results in Table 2 where the articles are sorted in Sc(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 9 citations has moved up ahead of many articles with more citations because it has had only 1 year to gain those citations suggesting that it will become a very influential article. Applying the same algorithm to Table 2 as to the h-index in Table 1, but using the Sc(i) ranking, we see that there are nine articles with nine or more citations, the rest being less than 9. Hence, Dr C has an hc-index of 9.

### 2.2.7 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 g2 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 | 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 g2. 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 g2 and sum of citations for each remaining article are less than g2.. In this example that point occurs at the 24th article; so our hypothetical Dr. C would have a g-index of 24.

### 2.3 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) which 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 [7]. We sought to show the venue independence of influence by repeating the study methodology using scholars drawn from EJIS and ISJ. Lists of scholars were taken, from the Lowry, et al. (2007) work for our first study and scholars were extracted from each article in EJIS and ISJ for our second study. From these lists we calculated lifetime Hirsch family indices for each scholar.

In this 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™ and analyzes the data computing various indices and reporting 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 including 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[8]. 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 also has superior coverage of social science and computer science compared to WoS.

On the other hand, GS includes non-scholarly citations, has uneven coverage, and under represents older

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[7] 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 elite scholars who publish in both venues.

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

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). 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 as found in their Appendix 5. In this appendix, Lowry et al. (2007) created three rankings by different methods of treating 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 version of the "Top 100" authors list that Lowry et al. present in Appendix 5. The compiled list yielded a total of 133 researchers. This list appears to be disproportionately North American in representation.

The object 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. We therefore 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[9]. Data was taken from EJIS and ISJ 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.

The names on each list were then entered 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

[9] They are not, of course, the only European journals. Our sample omits the *Scandinavian Journal of IS* (*SJIS), Le journal Systèms d'Information et Management (SIM), the Journal of Information Technology (JIT), the European Journal of Operational Research (EJOR)* and *the Journal of Strategic Information Systems (JSIS)* and the *European Conference of IS (ECIS)*. We only claim to provide a representative sample of scholars to illustrate the limitation of perspective introduced by selecting a limited number of journals and to illustrate the relative influence of scholars that publish in venues other than MISQ, ISR, and MS.

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 would not be an issue with relatively unique names such as Mingers'. However larger number of hits became a huge issue with names like "M Smith". Therefore, exclusion of extraneous articles would be necessary. Finally, we identified some peculiarities in the results returned by PoP. For example, PoP allows the user to include certain categories of articles by subject area such as biological and medical, physics and astronomy etc. Early on, we noticed that when pulling data from all subject areas, PoP would return Mingers and Brocklesby (1997). However, when any one of categories was turned off, this article would not be displayed. Because of this inconsistency and the desire to count all of an author's cited works we therefore chose to leave all the categories on. We also had to be attentive to occasional misspellings or affections 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 entered the full name as listed in the journal into PoP.

2. Select an article from the Lowry et al. basket of journals (MISQ, ISR, or 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 were 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 were 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.

## 2.4 Results

### 2.4.1 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 compared with 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% with the h-index, 12.65% with the hc-index, and 32.47% 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 were placed at similar positions in both rankings, Andy Whinston ranked 90th in the Lowry, et. al. ranking while he ranked first in the h-index ranking and Bill King ranked 74th in Lowry, et. al.'s ranking while he ranked in 15th in the h-index ranking. This low correlation is attributable to two factors. First, the wider range of data available in PoP compared with that the ISI Web of Science utilized by Lowry et al. (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 they 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 articles.

### 2.4.2 Comparative Power of the Hirsch Indices

The power of the Hirsch indices can be further illustrated by comparison of the list of scholars generated from the MISQ/ISR/MS sample generated by 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 between the two lists; an overlap of authorship of only 1.94% between the top 100 authors generated by our search of EJIS and ISJ with 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 they 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" vs. "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% 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, the common authors with all 133 scholars in all three Lowry, et al. (2007) lists are highlighted. 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 between the total 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, | 21 | 46 | 14 | 79 | Liu, Kecheng | 13 | 25 | 9 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Wm | | | | | | | | |
| 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) The "Transnational Elite". 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 "elite" scholars are able to or choose to transcend the regional publication standard differences involved in publishing in these journals to successfully have their papers published in these different venues.

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%[10] . The upper end of

[10] 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

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 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%, 81%, and 61% respectively of the MISQ/ISR scholars, indicating that, in general, scholars publishing primarily or exclusively in the European journals have about 75% 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.

**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

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.

publishing in the European journals are 81%, 83%, and 67% 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 and MS and those publishing in EJIS and ISJ, we find that, on average, those publishing in MISQ, ISR and 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 are their older articles and that their influence is approaching that of their North-American peers. In effect the EJIS authors' influence growth rate is faster than that of their Northern American counterparts.

However, since the g-index of the EJIS 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 having 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 publishers have steady and continuous citations streams with fewer blockbusters.

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 while Ciborra and Love did not publish in those journals. Their influence was generated by publication in EJIS and ISJ rather than MISQ/ISR/MS. Similarly, Peter Checkland, who did not appear on either list, has as his most influential works the books in which he articulated his Soft Systems Methodology. His h/g/hc indices are 28, 102 and 15 respectively, which compare

with 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. His influence is generated through his books.

### 2.5 Discussion

## 2.5.1 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 improves over time, like other data sources, 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. The findings therefore should not be considered as a listing of "the most influential IS scholars." These findings only compare the influence of the authors who publish in these venues. To generate a "most influential scholars" list, would require a list compiled of scholars from many different sources. Third, the use of the Hirsch indices should not be considered as a complete assessment of scholarly influence. To complete the analysis, other tools such as social network analysis and co-citation analysis should be used (see e.g. White, 2003, White and Griffith, 1981, Zhao, 2006).

Additionally, as noted above, the Hirsch indices themselves 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 which 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 as to why they aren't published in North American journals. However, what would matter from the standpoint of the Hirsch family of indices would be were 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 the citation records of the scholars 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 the author's research agenda and field of research so that proper comparisons can be made between scholars.

### 2.5.2 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 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 shows that there are some exceptional cases, where certain scholars achieved equivalent levels of influence may be achieved without having

published in the three North American premier journals that Lowry et al. examined. 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 replacing them with internet based publishing methods.

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

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. The manuscript suggests 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 themselves in detail. This process itself 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 towards redressing these limitations in our current assessment of scholarly importance. These measures as demonstrated here provide a theoretically based approach to the

assessment of influence that consider both quantity and uptake of publication as well as the obsolescence of papers.

Some suggestions have been made to exclude "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 include 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, as was shown in this study, the Hirsch studies permit analysis of comparative influence of scholars and groups of scholars and as was shown in Cuellar, Takeda and Truex (2008) simple statistical analysis. Thus instead of attempting to infer that a scholar with a ranking of 6 is more influential than one that has a ranking of 7, 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.

### 2.5.3 Comparative Influence

In this present work we explicitly examined the question of whether publication in adjudged top tier North American versus 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 "elite" 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 may be changing. Given the presence of the global elite authors, this indicates that the "bench" of scholars publishing in EJIS/ISJ is not currently as "deep" as that in MISQ/ISR/MS. The 'bench' is not as 'deep' for EJIS/ISJ due to the drop off in the h statistic being steeper in the EJIS/ISJ authors than it is in 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 indicating that the situation is moving closer to parity.

The presence of the scholars that 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 over 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 why European scholars are not able publish in the 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. For space limits, we focus on reasons one, two and five in the following discussion. First, to 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 afterwards lower citation of their articles leading to lesser influence on the part of those who publish in European journals.

#### *2.5.3.1 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 which we do not tackle at this time. We are of the opinion that the two notions of influence and quality are, however, often confounded in the literature. The argument goes as follows: journal x is ranked as among the best. 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% of 'top articles'[11] were not published in the top journals either due to type II errors or to initial submission of 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% 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

[11] Singh, et al. defined a top article as one having 8 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. 37% were published in the top five management journals and 63% were published elsewhere.

theory, they developed a theory of bias in journal ranking in survey analysis by academics. They surveyed IS researchers to test six hypotheses about biases that affect ranking decisions derived from their theory and found bias arising from underlying discipline, familiarity, and research interest. Other examples of systematic bias are leveled at survey approaches to journal rankings. For instance, given a list of journals, respondents are inclined to select from the list provided even if that list is incomplete, called an 'anchoring effect" (Chua et al., 2002). Another example of bias 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 and that is 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% 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.

### 2.5.4 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.

### 2.5.5 Implications for Practice

In using PoP, we find that an approach such as we followed using two researchers cross checking their results is essential to achieve consistent results. 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-indicates how influential their more recent output is. The g-index provides an indication of how their publication of "monster" articles affects their influence.

## 2.6 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 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. Using the Hirsch family of the citation statistics applied to a wider set of publication venues, we suggest provides a 'fairer' measure of scholarly influence than presented by current approaches. In particular the use of the Hirsch family of indices would help both faculty and administration engaged in the promotion tenure process, 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 bias of American centrism of journals (Gallivan and Benbunan-Fich, 2007, Lyytinen et al., 2007) and another bias, namely the question of regional, linguistic, and cultural difference in publication and scholarly influence, and found supporting evidence that this is so.

We believe that the key contribution of this work to be 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 extent 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 that an extended program of research coupling the Hirsch indices to 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 a fostering spirit of free and open discourse where the status quo may be challenged.

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# 3 Assessing Journal Influence using the Hirsch Index: The Hirsch family of bibliometric Indices as an improved measure of IS Academic journal impact[12]

Michael J. Cuellar, Hirotoshi Takeda, Duane P. Truex

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.

## 3.1 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

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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 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.[13]

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

[13] 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.

and future research.

### 3.2 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 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).

### 3.2.1 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.

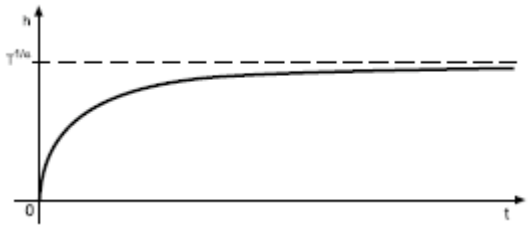


*Figure 1: Chart of the growth of an* h-*index (from Egghe (2007a))*

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 $\alpha$ 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 $\gamma$ is a constant chosen to increase the effect of more recent papers, and $\delta$ 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.

### 3.3 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.

### 3.4 RESULTS

| Journal | Rainer and | *h*-index Rank | *h*-index | *hc*-inde | *hc*-index | *R&M* vs. | *R&M* vs. *hc*-index |
|---|---|---|---|---|---|---|---|
| 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 | 21 | 4 | 69 | 4 | 40 | 17 | 17 |
| Intl Journal of | 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 | 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 | 22 | 16 | 28 | 16 | 17 | 6 | 6 |
| Accounting, Mgt and | 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 | 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 | 12 | 25 | 10 | 24 | 7 | -13 | -12 |
| J Info Tech | 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**

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.

### 3.5 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.

### 3.6 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.

### 3.7 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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# 4 The Introduction of the gc-index: Time is Money, More Bang for the Buck: An Introduction of the gc-index for Assessing Research

Hirotoshi Takeda

ABSTRACT

The current research expands on past research in ranking of information systems journals. A new metric, the gc-index, derived from previous Hirsch family of bibliometric indices, is introduced. Past indices didn't take into account the time or size of citations or ignored both. The gc-index expands on the h-family of indices by taking into account both the time the research has been in existence, via year, and the amount of impact, via citation count. The metric is used to update IS journal rankings. The metric is compared with the previous indices that take into account the size (g-index) and time (hc-index).

Keywords

Citation, citation analysis, citation count, bibliometric tools, h-index, g-index, hc-index.

### 4.1 INTRODUCTION

Previous work in this stream of papers have appeared in the proceedings of the 2008 SAIS conference, 2008 AMCIS conference, and 2008 ICIS conference. This paper adds the new metric of the gc-index, which has not been introduced in any outlet, as far as the literature review by the author is concerned. The new index can be used in other discipline areas outside of IS and is considered to be significant enough to warrant a submission to SAIS 2009.

### 4.2 Journal/researcher ranking history

Journal and researcher ranking studies have been conducted in order to assess the worthiness of a journal or a researcher (Alexander, Sherer, and Lecoutre, 2007; Lowery, Karuga, and Richardson, 2007; Rainer, Kelly, and Miller, 2005). These ranking studies are trying to justify where the worth of the field lies. Whether the worth be in a particular journal or a particular researcher. In turn, these ranking studies have been used by P&T and hiring committees to try and gauge the worth of a researcher. Some researchers may be too junior to even show up on the researcher rankings. This fact does not exclude them from the practice of rankings. Journal rankings are still used to see the worth of the publications of a junior researcher. The publication list of a researcher, no matter how

short, is scrutinized by venue that the research has been published in. This even goes outside of journals as conference proceedings are also ranked according to prestige, difficulty of acceptance, and worthiness in the field.

Most ranking studies focus in on the journal, some focus in on the institution and yet others focus in on the individual researcher (Alexander et al. 2007; Athey and Plotnicki, 2000; Baskerville, 2008; Chua, Cao, Cousins, and Straub, 2002; Clark and Wright, 2007; Ferrat, Gorman, Kanet, and Salisbury, 2007; Geary, Marriott, and Rowlinson; 2004, Hardgrave and Walstrom, 1997; Harzing, 2008; Huang and Hsu, 2005; Korobkin, 1999; Kozar, Larsen, and Straub, 2006; Liang, 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 and MacKenzie, 2005; Rainer et al., 2005; Willcocks, Whiley, and Avgerou, 2008). For the purpose of this paper, 'ranking studies' will refer to as the whole of these three types of studies.

### 4.3 Journal/researcher ranking studies in IS

Ranking studies in the past have typically included two types. One was the survey that was sent out to various researchers in the field to assess what they thought of the worthy journals, institutions, or researcher (Hardgrave and Walstrom, 1997). This type of study tries to get a grasp of the pulse of the field. By asking the very people in the field the survey study is giving voice to those that make up the population. The motivation is honest and unless you ask the populous you cannot find out what the people think. The populous include committee members and are thus the ones that are making hiring and firing decisions based on what they think are good journal rankings so what the populous thinks is valid to the field.

The problem in survey studies are that they are engrossed in subjectivity and what the populous thinks may not be always what the statistics indicate. Survey studies are limited in nature by the fact that surveys cannot incorporate every avenue that research can be published. Typically survey studies list out journals for the surveyee to choose from. The survey may also indicate to the surveyee that they need to 'write in' any journal outlets that may have been omitted from the survey. This has been shown to cause an 'anchor' effect where journals that are listed are more likely to be ranked higher than those that are not listed. Surveyees may also have their own motives to rank a journal/institution/researcher in a particular way. Perhaps they are a high-ranking editor at a journal. Then they would be motivated to push their journal higher up in the rankings. Perhaps they have had multiple publications at a particular journal. Past publications would motivate them to rank that particular journal higher up. Perhaps they

were rejected or had a bad experience with a journal. This would motivate them to rank the particular journal lower. One can assume that in institutional rankings, people are motivated to rank their own home institution higher than other institutions that they do not have ties to. Where they work, where they worked, or their alma mater will probably garnish favorable rankings (Alexander et al. 2007; Baskerville, 2008; Peffers and Tang, 2003; Powell and Woerndl, 2008; Rainer et al., 2005).

The second type of ranking studies tries to take a less subjective approach and try to come from the statistical point of view (Lowery et al. 2007). These studies typically have looked at the citation counts and use this as a surrogate for academic worth. By looking at citations the study is looking purely at statistics. But subjectivity is still incorporated in the citation. A citation is when someone cites a previously published paper. Thus some researcher thought that what was said in the cited paper was worth academic credence, and thus the paper is cited. Here lies the subjectivity in this type of study.

The problem with citation analysis is that the culture of the way a field cites can affect the results (Galliers and Whitley, 2007; Gallivan and Benbunan-Fich, 2007; Whitley and Galliers, 2007). If a journal has a limit to the number of citations, citation counts are artificially being suppressed, thus worthy works that could get citations are not getting the recognition they deserve. In the opposite direction citation padding and self-citation practices can cause unworthy papers to get more citations. A researcher may be inclined to boost their own citations counts so they may add their past research to the current research just for the sake of increasing their citation count. Reviewers may encourage a submitter to include the reviewers' previous works thus padding the reviewer's citations. Journal reviewers may indicate that their own papers be cited in the review process. Citations also don't indicate a strength or direction. For example if a current paper draws multiple ideas from a previous paper and multiple citations are made to the same previous paper throughout the current paper, the previous paper is only credited with one citation. Citations may also be saying something negative about the previous paper. For example if a paper is refuting a previous work and saying that the previous work is flawed and wrong, the citation is made but the negative manner is not recorded. That is still one citation, whether positive or negative, for the previous paper.

Both types of studies are wrought with time-consuming research. Surveys can take months or maybe years to complete. Citation analysis studies include the use of knowledge basis like Thompsons ISI in order to get data and

then careful analysis. In either case, there is a call for ranking studies to be repeated (Rainer et al. 2005; Lowery et al. 2007). The reason for this is that the knowledge creation field is a living, constantly changing area. Some journals may fall out of top rankings. Falling may be due to the degradation in quality of the papers presented, but not necessarily so. A focus change may cause a journal to fall from the ranks of an academically motivated study, but may increase in rank for a practitioner motivated study.

### 4.4 Bibliometric tools

Recent advances in computing technology and the ability to calculate quickly have allowed new and more complex bibliometric tools to be developed and used. Past citation analysis may have been done by hand, or even if computers were used, data collection and analysis may have been done on a spreadsheet or special computer program modules may have been created. There are a few new bibliometric tools that have started to be noticed by the library sciences community and the reach has been to IS as well (Egghe, 2006; Hirsch, 2005; Sidiropoulos, Katsaros, and Manolopoulos, 2006). One of these bibliometric tools are the Hirsch family of indices.

### 4.5 H-index

The H-index is a measure of productivity of a researcher or group of researchers. The h-index tries to give a measure of the worth of a researcher by taking a measure of productivity and quality. Productivity is measured by using the number of papers that the author has produced (Hirsch, 2005). The citation is used as a congregate to quality. The author realizes that quality cannot be solely measured by citations. This is a limitation to the h-index. The problem lies in the spirit of the h-index. The h-index was created in order to have an index that quickly measures the worth of a researcher. The index incorporated quality and productivity. The author agrees that quality can be measured via the actual reading of the work and assignment of some measure of quality. But in order to have an index that is quickly identified, the h-index uses citations. Citations are the only qualitative measure of a paper to identify influence. By influencing other researchers, citations are giving credit to other researchers. Citations may have positive or negative influence.

Citations may bring positive influence by allowing future researcher to cite a paper due to the positive philosophical expanse that the previous paper has provided. The past paper may have made a mistake or is wrong. Future papers may look at the paper negatively and cite accordingly. The h-index does not differentiate. Either way, positive or negative, the past paper has influence on the future researcher. The discussion of influence and

quality is not the focus of this paper.

The h-index is defined as the number of papers h if h of a set of N papers have at least h citations each, and where all other (Np -h) papers have no more than h citations each (Hirsch 2005). In order to get the Hirsch index one needs to get all the papers that the researcher has produced. Then the papers are ranked according to the number of citations that the papers have received in descending order. For example taking a fictional journal, Journal of Indicies (JOI), one need to first rank the papers according to citations (table 1). When the rank overtakes the citation number is where the h-index lies. The table can continue with the complete publication list of JOI but for the purpose of calculating the h-index one only need to get to where the rank overtakes the citation number. One can assume that the remaining papers after rank 9 have 6 or less citations each.

| Rank | Atricle Title | Citations |
|---|---|---|
| 1 | The R index | 45 |
| 2 | The Y index | 42 |
| 3 | The A index | 35 |
| 4 | The E index | 23 |
| 5 | The Bc index | 15 |
| 6 | The Or Index | 7 |
| **7** | **The W index** | **7** |
| 8 | The Pb index | 7 |
| 9 | The Ri index | 6 |

*Table 1. H-index Example*

We see that at rank 7 is where the h-index is. We see at rank 6, we have 6 papers that have at least 6 citations each, but the remaining papers have more than 6 citations (the papers at rank 7 and 8 both have more than 6 citations), thus we need to go more. We see that at rank 7, we have 7 papers that have at least 7 citations each, and the remaining papers have no more than 7 papers each. So the h-index condition is satisfied here. Going one more further at rank 8 we do not see 8 papers with at least 8 citations (rank 6, 7, and 8 have only 7 citations each), so the h-index is seven. Two of the problems (other than the quality debate brought up earlier) with the h-index is that extremely large citations have little influence, and the advantageous nature of older aged researchers contribute the weakness of the h-index (Egghe, 2005; Sidiropoulos et al. 2006).

### 4.6 G-index

The G-Index tried to alleviate the problem associated with the extremely large citations that the h-index does not

address (Egghe, 2005). When a researcher has a particularly large citation count for a low number of articles, with the h-index, those large citations count article only contributes as much as smaller citation count articles. For example two researchers shown in table 2 have the same h-index (3). But researcher R1 has two articles that have a large amount of citations. One can see that R1 has more influence over the field yet the h-index does not account for the size of the citations.

| Rank | R1 Article Title | R1 Citation Count | R2 Article Title | R2 Citation Count |
|---|---|---|---|---|
| 1 | The A index | 5030 | The D index | 6 |
| 2 | The B index | 2303 | The E index | 5 |
| 3 | The C index | 4 | The F index | 4 |

*Table 2. Two Researchers with H-index of 3*

The G-index takes the citation counts into effect by keeping a running total of the citations. The g-index if defined as '*A set of papers has a g-index, g, if g is the highest rank such that the top g papers have, together, at least* $g^2$ *citations (Egghe 2005,p. 132).'* The G-index is found similar to the h-index in that the rankings are put in order and the number at which the rank squared takes over the running total is your g-index. Taking the same examples as seen when calculating the h-index, we see how the g-index is calculated in table 3. The g-index is found at the point of g equal to 14.

| Rank | Rank$^2$ ($g^2$) | Atricle Title | Citations | Running Total |
|---|---|---|---|---|
| 1 | 1 | The R index | 45 | 45 |
| 2 | 4 | The Y index | 42 | 87 |
| 3 | 9 | The A index | 35 | 122 |
| 4 | 16 | The E index | 23 | 145 |
| 5 | 25 | The Bc index | 15 | 160 |
| 6 | 36 | The Or Index | 7 | 167 |
| 7 | 49 | The W index | 7 | 174 |
| 8 | 64 | The Pb index | 7 | 181 |
| 9 | 81 | The Ri index | 6 | 187 |
| 10 | 100 | The Yi index | 5 | 192 |
| 11 | 121 | The Ar index | 4 | 196 |
| 12 | 144 | The Au index | 3 | 199 |
| 13 | 169 | The Bo index | 3 | 202 |
| **14** | **196** | **The Cr index** | **2** | **204** |
| 15 | 225 | The Sn index | 1 | 205 |
| 16 | 256 | The Al index | 1 | 206 |

*Table 3. G-index Example*

One of the main problems with the g-index is that like the h-index, the age of the researcher or journal is still a problem (Sidiropoulos et al. 2006).

### 4.7 Hc-index

The hc-index tries to alleviate the problem of age that exists with the h and g indices (Sidiropoulos et al. 2006). Both the h and g-index favor a researcher or journal that has been around for some time over one that is new in existence. Both are tied to citations so a researchers article needs to be in existence for some time in order for the article to be cited. Also, the longer a researcher article is in existence the more likely that the article will get citations. So $S^C(i) = \frac{\gamma * C(i)}{(Age(i)+1)^{\delta}}$ naturally a new article has little chance of gaining a large number of citations compared to an article that has been in existence for a longer time period. The hc-index uses a formula to compensate for younger articles that are getting citations and older articles that have established citations. The formula is:

The i is the current time. C(i) is the citation that a paper gets at time i. The Age(i) is the age of the paper in years. A current year paper would get an Age(i) of zero. The γ is a compensation factor that allows younger papers to get more recognition as the γ is increased. The δ is a compensation factor that allows older papers to get less recognition as the δ is increased. Originally Sidiropoulos et al. (2006) used γ = 4 and δ = 1, which is what is used in the current research. The hc-index is then calculated similar to the h and g indices. The $S^c(i)$ score is used to rank the papers, similar to the h-index. Then when the rank overtakes the $S^c(i)$ score is where one finds the hc-index. Using the same running example we find:

| Rank | Atricle Title | Age | Citations | $S^c(i)$ |
|---|---|---|---|---|
| 1 | The E index | 1 | 23 | 46.00 |
| 2 | The A index | 8 | 35 | 15.56 |
| 3 | The Ri index | 1 | 6 | 12.00 |
| 4 | The R index | 16 | 45 | 10.59 |
| 5 | The Y index | 15 | 42 | 10.50 |
| 6 | The Or Index | 2 | 7 | 9.33 |
| **7** | **The Bc index** | **6** | **15** | **8.57** |
| 8 | The Ar index | 2 | 4 | 5.33 |

| | | | | |
|---|---|---|---|---|
| 9 | The Pb index | 8 | 7 | 3.11 |

*Table 4. hc-index Example*

Table 4 shows the rankings shows the article title, the age of the article in years, the number of citations, and the $S^c(i)$ score calculated with the equation above. The list is then ranked according to the $S^c(i)$ score. The hc-index is then found in the similar fashion as the h and g indices where the hc-index is where the rank overtakes the $S^c(i)$ score. Here we see that the hc-index is 7 for our running example. Note that now the highest ranked paper is the paper titled "The E index" which was previously ranked fourth but due to the amount of citations (23) and the relative young age of the paper (1 year old) the paper overtakes the three papers before it to become highest ranked in this list. The previously highest ranked paper "The R index" is now ranked fourth because of its age (16 years). In this fashion the hc-index gives more credence to papers that have citations and are younger in age. The problem with the hc index is that larger hits are not accounted for just like the h-index didn't account for large hits.

### 4.8 Introduction of the Gc index

This research attempts to alleviate the problem that the h, g, and hc index by combining the factors that the g and hc-index incorporates and proposes a new index called the gc-index. With this index the $S^c(i)$ is used (as with the hc-index) but a running tab will be kept and compared with the rank squared (as with the g-index). Continuing our running example we have:

| Rank | $Rank^2$ | Atricle Title | Year/Age | Citations | $S^c(i)$ | $S^c(i)$ Total |
|---|---|---|---|---|---|---|
| 1 | 1 | The E index | 1 | 23 | 46.00 | 46.00 |
| 2 | 4 | The A index | 8 | 35 | 15.56 | 61.56 |
| 3 | 9 | The Ri index | 1 | 6 | 12.00 | 73.56 |
| 4 | 16 | The R index | 16 | 45 | 10.59 | 84.14 |
| 5 | 25 | The Y index | 15 | 42 | 10.50 | 94.64 |
| 6 | 36 | The Or Index | 2 | 7 | 9.33 | 103.98 |
| 7 | 49 | The Bc index | 6 | 15 | 8.57 | 112.55 |
| 8 | 64 | The Ar index | 2 | 4 | 5.33 | 117.88 |
| 9 | 81 | The Pb index | 8 | 7 | 3.11 | 120.99 |
| **10** | **100** | **The Yi index** | **6** | **5** | **2.86** | **123.85** |
| 11 | 121 | The W index | 9 | 7 | 2.80 | 126.65 |
| 12 | 144 | The Bo index | 7 | 3 | 1.50 | 128.15 |

*Table 5. gc-index Example*

By keeping a running total of the $S^c(i)$ one is able to find the gc-index in a similar fashion as the h, g, and hc-indices where the $rank^2$ is overtaken by the $S^c(i)$. We find the gc-index for our running example to be 10.

### 4.9 Results

Three journals from North America and three journals from Europe were chosen according to Rainer and Miller (2005). These were *MIS Quarterly* (MISQ), *Information Systems Research* (ISR), and *Journal of Management Information Systems* (JMIS), the *European Journal of Information Systems* (EJIS), the *Journal of Strategic Information Systems* (JSIS), and the *Information Systems Journal* (ISJ). The data was retrieved during October of 2008 from Google Scholar (GS). GS has been criticized and hailed as a possible means of retrieving citation analysis data. The argument of whether GS is a good data source is outside the scope of this paper. After the data was retrieved the g, h, hc, and gc index were calculated. The results are in table 6, and figure 1. There were no changes in the rankings of the journals according to any of the indices.

| | h | g | hc | gc |
|---|---|---|---|---|
| MISQ | 136 | 233 | 76 | 111 |
| ISR | 90 | 160 | 52 | 85 |
| JMIS | 84 | 134 | 47 | 72 |
| EJIS | 47 | 74 | 28 | 41 |
| JSIS | 41 | 63 | 26 | 37 |
| ISJ | 42 | 65 | 27 | 37 |

*Table 1. Results by Journal*

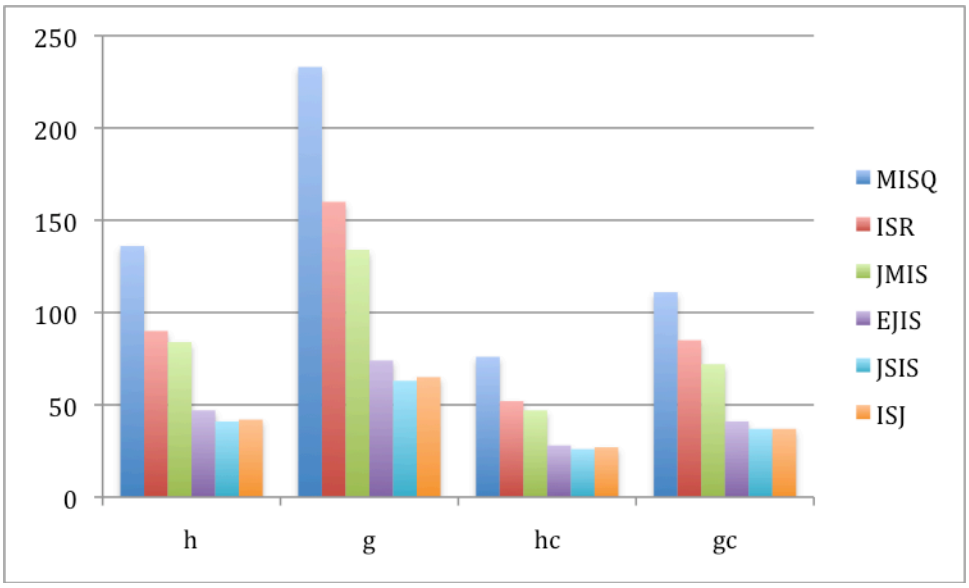


*Figure 1. Comparison of indices*

When looking at the chart we see that the g-index shows a big disparity between MISQ and the other journals while the hc-index shows less and almost no difference between ISJ and JMIS. With the gc-index we see that there is a difference but the lead by MISQ is understated compared to the g-index and the difference between ISR and JMIS is accentuated compared to the hc-index.

These differences are not necessarily a feature of the gc-index and can be a function of the dataset. The gc-index combines the features of the g and hc-indices and thus the results showing a spread may be the function of the gc-index.

### 4.10 Contributions and Limitations

The use of the gc-index is not an end all for journal/researcher ranking. The gc-index is proposed as a measure to add to the assessment of a body of research. The use of the Hirsch family of indices, as well as other assessment methods (quality of papers, reputation), should be used in addition to the gc-index.

The limitations of this research, as well as future research areas are two fold. First, this research is a proposal for the use of the gc-index. The gc-index needs to be tested on more datasets. Second, the dataset was taken from GS, which may not be the most reliable database for taking data.

### 4.11 Conclusion

This paper proposes a new metric for assessing of a body of research. The gc-index was introduced and used for assessing six major IS journals. The gc-index was seen as combination of the g and hc-indices. Although the ranking of the six journals didn't change for the gc-index, the dataset showed that gc-index was different from the other indices.

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# 5 Evaluating Scholarly Influence Through Social Network Analysis: the Next Step in Evaluating Scholarly Influence

Hirotoshi Takeda, Duane P. Truex III, Michael J. Cuellar

ABSTRACT

*Following previous research findings, this paper argues that the current method of evaluating scholar performance, publication counts in "quality" journals is flawed by subjectivity in generating the list of approved journals and the definition of quality. Truex, Cuellar and Takeda (2009) sought to improve on this method by substituting the measurement of "influence" using the Hirsch statistics to measure ideational influence. Since the h-family statistics are a measure of productivity and the uptake of a scholar's ideas this methodology privileges the uptake of a scholar's ideas over the venue of publication. But influence is built through other means than by having one's papers read and cited. This paper argues that interaction between scholars resulting in co-authored papers is another way to build academic influence. This academic influence, which we term social influence, can be assessed by Social Network Analysis (SNA) metrics which examine the nature and strength of coauthoring networks among IS Scholars. The paper demonstrates the method of assessing social influence by analysis of the social network of AMCIS scholars and compares the results of this analysis with other co-authorship networks from the ECIS and ICIS community.*

**Keywords**

Scholarly contribution, social network analysis, scholarly influence

## 5.1 INTRODUCTION

How does one evaluate the "worth" and the influence of a scholar? This is an important question for all academic stakeholders. Promotion and tenure committees need broadly applicable evaluation criteria allowing them to compare the work and influence of scholars across multiple disciplines. One commonly used evaluative criterion is the number of publications achieved in venues considered to publish only the best quality scholarship over a given period of time – the publication count. Publication counting provides simple-to-compute metrics, but the technique requires making value assumptions that are problematic and citation counting has been extensively criticized as biased. The choice, the ranking and the weighting of the publication (journal) venue is considered

problematic for many reasons (Chua et al. 2002; Walstrom et al. 1995). Five critiques of the concept are discussed more fully in the following literature review. Moreover, the presumption that top journals always identify and publish "top" articles or that influential and important articles do not appear in other non premier publication venues has been challenged (Singh et al. 2007).

Recent research argues that rather than relying on a single simplistic metric-a raw publication count-, a scholar's ability is better measured in terms of a profile of metrics that assess the uptake of the scholar's ideas in a field. The Hirsch family of statistics is argued to provide a fairer and more balanced way of assessing scholarly ability (Truex III et al. 2009). Use of these metrics allows comparisons across different fields of study and provides a measure of both productive output and impact. In effect, these metrics measure the *ideational* impact of the scholar, i.e. the impact of their ideas on the field.

This paper extends the aforementioned research program by proposing the addition of another profile of statistics to the composite basket of scholarly evaluation tools. This approach is one that assesses the networks of a scholar's *social* influence in the field. We argue that as a scholar interacts with other scholars, his/her ideas are shared with others and molded by these interactions. Thus his/her influence grows through the sharing and joint development of ideas in networks of discursive exchanges, interactions and transactions called co-authoring. For this we propose to use Social Network Analysis (SNA) on a co-author network.

By adding SNA we are now examining the degree and frequency of connectedness between persons with whom a scholar works, creates, and publishes her scholarly work. In combining the H-family bibliometrics with SNA we are providing ways to examine two parts of an *extended discourse* we call scholarship. That is, if one considers the inclusion of citations as an indication of '*listening'*, or acknowledging that a party to the discourse as having been heard, and one also considers the patterns, strength, and centrality measures of the networks in which ideas are created and published to be an indication of *'who is talking with whom'* in that discourse, then we have a fuller picture of the nature of the construct called 'scholarly influence' we are trying to access.

The objective of this research is to examine how SNA may be used to evaluate scholars. The research questions that we are investigating are therefore:

RQ1: How can social networks and network components be meaningfully compared to evaluate

scholars?

RQ1:1 If such differences exist what are their key structural characteristics?

RQ2: How do the SNA and H-family metrics provide a clearer picture of the construct 'scholarly influence'?

The paper proceeds as follows. First, we review the research to date in evaluating scholarly contribution including our first contribution: ideational influence. Then we discuss how SNA can be used to measure the scholar's social influence. As an illustration, we present an SNA analysis of the AMCIS conference publications from 1998 to 2005, along with the analysis of the ECIS conference from 1993 to 2005 (Vidgen et al. 2007b) and the ICIS conference from 1980 to 2005 (Xu et al. 2006). Using these analyses, we propose centrality metrics to evaluate scholarly social contribution.

### 5.2 LITERATURE REVIEW

Typically, the research contribution of a scholar has been assessed by whether the scholar publishes articles in journals of appropriate quality. This leads to the question as to which journals are "high quality". This has been resolved by two different methods: survey methods and scientometric methods. The criticisms against those methods and how they have been applied have been reviewed extensively elsewhere (Chua et al. 2002; Singh et al. 2007; Truex III et al. 2009; Walstrom et al. 1995) and therefore we simply summarize the arguments here to conserve space. There are five general criticisms against survey methods (Truex III et al. 2009): 1) they are subjective and reflect a North American bias, (Gallivan et al. 2007; Lyytinen et al. 2007; Willcocks et al. 2008), 2) the studies are self-reinforcing and reifying by repetition, (Galliers et al. 2007; Gallivan et al. 2007; Whitley et al. 2007), 3) certain venues are more recognizable lending to a familiarity bias, 4) these types of studies privilege older generalist journals over newer 'niche' journals (Gallivan et al. 2007) and, 5) a ranking study is reflective of an inherently political process and the results received are a result of the power distribution.

Likewise, scientometric studies have also been criticized for three general reasons: 1) varying citation practices by disciplines and result in varying norm in the number and types of citations, 2) citation 'rigging' can occur when authors are compelled to include specific references in a paper, as in to those journals wherein the paper is under review or to author's who might be reviewers of the manuscript. The practice inflates citation counts, and finally 3) older journals and papers that have been in circulation longer will have had more time to garner more citations,

resulting in a skewing toward these articles and publications (Lowry et al. 2007).

Our review of concerns expressed in the literature suggests that the methods to assess journal quality and therefore support the use of publication counts in "quality" journals are suspect due to bias in the methods of selecting which journals are "quality " journals, an implicit and therefore subjective definition of quality, and the inability of editorial boards to consistently identify and publish "quality" articles. Ths postion may be best summarized by Singh, et al. (2007) when they say:

> *Taking the preceding results as a whole, the conclusion is inescapable that using journal ranking (specifically, distinguishing between the top five and non-top five) can lead to substantial misclassification of individual articles and, by extension, the performance of the faculty members who authored them. (Singh et al. 2007,p. 327)*

### 5.3 The Hirsch Indices

Since the existing method of using counts of publications in "quality" journals has been challenged as being inadequate, it has been recently proposed that our discipline might better use the notion of "influence" to assess the scholarly ability of a faculty member (Truex III et al. 2009). The theory being that the uptake of a scholar's ideas by members of the research community is a better indicator of the quality of a scholar's work than publication in a journal. Publication in a journal indicates only the ability to survive the review process and to appeal to the opinions of less than five or six people. When a scholar's ideas are adopted by a section of the research community by way of citations, this is a sign that their research has struck a chord as a true, original piece of work that deserves notice. Thus the influence that a scholar's ideas encompasses not only takes into account the "quality" of his/her research but also the originality and impact of those ideas.

In the same paper, the authors proposed that a method of assessing the influence of scholarly publications: the Hirsch indices. The use of the indices allows us to assess both productivity and influence. The native "h" index provides an overall assessment of influence (Hirsch 2005). The "hc" index puts more weight on current articles and thus allows us to evaluate if the scholar is becoming more influential in more recent articles (Sidiropoulos et al. 2006). The "g" index allows us to assess whether the scholar is influential as a result of "mega" articles, ones that are very highly cited (Egghe 2006). Finally, the "hm" index allows the assessment of influence on a per paper

basis, taking out the bias that comes from publication productivity (Molinari et al. 2008).

These indices allow us to assess is the "uptake" of the ideas proposed by the scholar which we term, his *ideational* influence. However they do not allow us to assess the influence that the scholar achieves by their personal interaction with other scholars. For that, we need to have a different set of measures. For that we need to examine how influence is spread through personal interaction.

### 5.4 Social Influence

Unsurprisingly, we take the position that knowledge creation and dissemination is a social act. This notion has been well developed in our own field, and the literature review in Xu and Chau (2006) and Vidgen, et al (2007a) each provide an excellent description and survey of the research. Xu and Chau (p.570) remind us that the social identity of the IS discipline is tightly bound to the question of who conducts IS research. They cite Nahapiet and Ghoshal (1998) and remind us that as a field builds "social capital" (c.f., Bourdieu, 1985, 1993) it builds disciplinary strength. We accept the logics as to why social networks are important to any field. But, in this research, we are attending to the particular way those networks are built, maintained, strengthened and more importantly spread as an indication of scholarly influence.

We are focusing on the influence that the scholar achieves though their personal scholarly interaction with other scholars. We liken this to a network of social transactions where in engaging in a bounded task, for instance conducting research and preparing papers, social actors have the opportunity to jointly sense-make, negotiate understanding, build work languages and so on such that intellectual and social bonds of varying strength are forged. These bonds are reinforced and strengthened by further co-creation of research and papers and via sharing cohort activities such as conferences and research workshops. As a scholar interacts with other scholars, his/her ideas are shared with others, they are challenged, tested and further shaped by these interactions. Some ideas survive this crucible and are adopted by others who further develop or refine them. This process is well described by Latour (1987) in which he illustrates how scientific thought may be generally accepted and become "black boxed" and how important scientific advances or engineering ideas are rarely the output of a single person. They are all the product of social shaping.

We take as a given that a scholar's influence grows through the spreading of his/her ideas via the publication process. But that is the tip of an iceberg; publication is an outcome of previous social interactions in the creation

and dissemination of scholarly work and ideas. The scholar therefore gains influence through *social* means and publications are an outcome of the social activity. This social influence is also built in the way we inhabit social cohorts. Vidgen et al (2007a) describe three settings, the conference, the working setting in a university department, and via the PhD student mentoring process. These informal and formal relationships ultimately result in co-authoring relationships, where the scholar joins with others to create articles that spread a combining of their ideas with others, often in jointly written papers. Thus it is that co-author relationships can be used as a proxy for the larger concept of *social influence*. To analyze the nature of social influence in co-authoring we, like others before us, use SNA.

In SNA, one maps the informal organization of relationships between researchers (Vidgen et al. 2007b). We look at the network of co-authoring relationships between authors making the assumption that co-authoring is indicative of relationship between the authors that includes the sharing and acceptance of ideas between them. By examining the *centrality* measures of the various members of the community we can arrive at a profile of measures that assess the social influence of the members of a research community. Proper comparison of these profiles would allow evaluators to assess the social influence of the scholar and along with the *ideational* measures provided by the Hirsch indices create an assessment of the scholar's capabilities. Such an assessment we argue would be superior to that provided by the simple publication count metric.

### 5.5 REVIEW OF METHODS TO STUDY SOCIAL CONNECTIONS VIA SNA

The use of network analysis has stretched from neurobiology and statistical physics, to the notion of 'six degrees of separation', and games such as 'six degrees of Kevin Bacon' that try to link different actors to the famous actor (Guare 1992; Liben-Nowell et al. 2005; Strogatz 2001). The term 'six degrees of separation' coined by Guare (1992) is really a phrase for the 'Small World Problem' by Travers and Milgram (1969), where they found that everyone in a large society were connected in some way by about 5.5 linkages (Travers et al. 1969). In the information systems (IS) literature SNA has been applied several times (Nerur et al. 2005; Polites et al. 2008; Takeda 2010). With the advent of social networking sites such as myspace.com and friendster.com, SNA has been applied to these sites as well (Howard 2008; Kleinberg 2008). Social network analysis has its advantages. "… one of SNA's advantages is that it can in fact uncover subtle, unrecognized relationships between journals, and thus can aid in the development of more accurate classification schemes in the future" (Polites et al. 2008).

There are also two major ways in which SNA can be utilized for analyzing social connection in academic

publishing. The first connection type is that seen in co-authorship networks. Connections are made when two or more people collaborate on a project. During co-authorship network analysis, all co-authors are assumed to know each other. Characteristics of co-authorship connectedness are that co-authors may have stronger bonds, with fewer connections. But the strength of the connections may not be apparent. A second way to use SNA to measure connectedness, is via co-citation analysis.

In co-citation analysis a social connection is considered to have been made when one author makes a citation to another author. In comparing co-citation analysis to co-author analysis, we note that in co-citation analysis the connections are weaker, and there are more connections. But in both the co-author analysis and in co-citation analysis, the strength of connections cannot be measured. For the current research, we chose co-author analysis to assess social influence because co-authoring is a more direct and personal linkage between authors and because co-authorship requires two-way communication and social interaction whereas co-citation analysis is one-way and more passive.

When performing a SNA, several aspects of a network – nodes, edges, connectivity, distance, and components (or clusters) –are identified and examined. A **node** is defined as a point on the network (Barbasi et al. 1999; Coleman 1988; Kleinberg 2000; Travers et al. 1969). An edge of a network is defined as a line connecting two nodes (Barbasi et al. 1999; Coleman 1988; Kleinberg 2000; Travers et al. 1969). In co-authorship networks, the authors are the units (nodes). A co-authorship is represented as a connection (line/edge) made between the author/nodes.

An **edge** can be non-directional, directional, or bidirectional. For example co-authorship will be shown as a non-directional edge. Citations can be shown as a directional edge. If author A cites author B, and author B cites author A, a bidirectional edge would be used. 'Distance' is the length of the shortest path, measured in links, between two distinct nodes (Travers et al. 1969). In some previous SNA studies, the tendency of co-authors to continue to co-author together or the tendency of the same co-authors to publish to the same venue have been analyzed (Acedo et al. 2006; Barbasi et al. 2002; Eaton et al. 1999).

In layman's terms, **distance** is measured by counting the minimal number of edges it takes to go from one node to another node. Traversing edges can take into account the direction of the edge or not. **Connectivity** is a notion of how a researcher (node) in the network is connected to others via an edge. Depending on the research question, connectivity can be measured by the pure number of edges coming out of any given node. The researcher may

want to discover how a researcher is connected so a weight and distance measure to other nodes may be incorporated. Strength of edges and nodes may also be included in the measure. Connectivity may be shown on the network by proximity of nodes –how authors form **clusters**. Using proximity measures can show how many authors are closely related to one author, or how many authors are within a given cluster (Albert et al. 2002; Barbasi et al. 1999; Barbasi et al. 2002; Henry et al. 2007; Vidgen et al. 2007a).

In this research the social network is defined by the set of authors who have co-authored papers accepted in this conference. The network takes the set of all papers submitted to the conference *in which there is co-authorship*. The social network is therefore defined by the set of authors who have co-authored papers accepted in this conference. Sole-authored papers are NOT part of the network. SNA's fundamental metric is distance: how many co-author connections does it take to reach another author. For example, if A and B co-author and B and C co-author and C and D co-author, the distance between A and B is zero, between A and C is one (via B) and between A and D is two (via B and C).

SNA' **centrality measures** –***degree***, ***betweenness*** and ***closeness*** –analyze the aggregate distances between one author and the rest of the network.

**Degree centrality** of a node is defined as: $$Degree \quad Centrality = \frac{\deg ree}{n-1}$$

where degree is the number of edges coming out of the node, and n is the number of nodes. Degree centrality indicates how many co-authors this particular author had indicating that this author has a wide number of social contacts and that his social influence is higher.

Between centrality of a node n is defined as: $$Betweenness \quad Centrality = \sum_{\substack{s \neq n \neq t \in N \\ s \neq t}} \frac{\sigma_{st}(n)}{\sigma_{st}}$$

Where $\sigma_{st}$ is the number of shortest paths from node s to node t, and $\sigma_{st}(n)$ is the number of shortest paths from node s to node t that go through node n. Betweenness centrality indicates how many paths between authors travel through him/her indicating that he is a "hub" for social influence, many ideas either originate or develop through him/her. If this measure is higher then this author has a higher social influence. Transnational scholars should have the highest between centrality.

Closeness centrality of node n is defined as: $Closeness \quad Centrality = \frac{\sum_{t \in N \setminus n} d_G(n,t)}{v-1}$

Where v is the total number of nodes in the graph. This is essentially the geodesic mean distance (shortest path) between n and all other nodes it can reach. Closeness centrality indicates the average number of links when connecting to other people in the network (Freeman, 1977). A smaller number here indicates that this person has a shorter distance in terms of co-authors. This means that the author is more central to the flow of ideas and hence a higher amount of social influence.

In summary: *Degree* indicates how many co-authors this particular author had indicating that this author has a wide number of social contacts and that his social influence is higher. *Betweenness* indicates how many paths between authors travel through an author-node indicating suggesting that authors to be a "hub" of social influence. Many ideas either originate or develop through that core node. Closeness describes the average length of paths from this author to other authors. It also measures how many authors this author is close to and thus an indication of the author's social network.

### 5.6 RESEARCH DESIGN AND METHOD

To explore the use of SNA to measure social influence, this paper has chosen to analyze the AMCIS proceedings from the years 1998-2005 to define a co-authorship network. These dates were chosen in large measure to allow a comparison of the AMCIS network to two previous SNA studies of the ECIS and ICIS conferences.

### 5.7 DATA

The data source was the AIS Electronic Library's conference section (http://aisel.aisnet.org/amcis/). Data was only available beginning in 1998. Data was not available for import into a bibliometric tool, like Endnote, thus copying and pasting to excel was required. Because authorship data was excluded from heading information at the library's website further analysis of data was needed, Data cleansing was required because some author information was duplicated with differing variations of the same name. An example of this was the use of initials and last name in some papers by one author and then the use of full names by the same author in another paper. Once the data was cleansed the connections between authors, such that all directional edges were represented, needed to be created and manually input. An example of this is seen using a three-author paper. Given the three authors A, B, and C then seven edges – AB, AC, BA, BC, CA, and CB – need to be created. Four, five, six, and seven author papers require 12, 20, 30, and 42 edges respectively. Finally the spreadsheet data was output to a .txt file for

import into the analysis tool.

### 5.8 ANALYSIS, TOOLS, AND FINDINGS

The analysis tool, UCINET (http://www.analytictech.com/ucinet/help.htm), was used to generate component, degree, betweeness, closeness, and structural holes analysis.

We started by examining the AMCIS 1998-2005 author co-authorship data (tables 1 & 2). We then compared the AMCIS, ICIS and ECIS co-authorship networks for the dame period. The table 1 data is broken down between single authored papers and multi-author papers. The majority of papers are multi-authored. The data, noting a shift from 60% growing to > 70%, suggests a trend toward more multi-authored papers over an 8-year period.

| Year | Total Papers | Single Authors Papers | Multi-Authored Papers | Percent Single Authored | Percent Multi-authored |
|---|---|---|---|---|---|
| 1998 | 423 | 163 | 260 | 39% | 61% |
| 1999 | 358 | 148 | 210 | 41% | 59% |
| 2000 | 440 | 142 | 298 | 32% | 68% |
| 2001 | 440 | 118 | 322 | 27% | 73% |
| 2002 | 360 | 107 | 253 | 30% | 70% |
| 2003 | 467 | 149 | 318 | 32% | 68% |
| 2004 | 577 | 131 | 446 | 23% | 77% |
| 2005 | 520 | 135 | 385 | 26% | 74% |

Table 1. AMCIS single vs. multi authored papers 1998 - 2005

Table 2 presents the AMCIS co-author network data in years 1998 to 2005. The size of the network is the number of authors that have co-authored in given conference – called Actors. The number of actors in the main component shows the size of the largest co-author cluster. One can see that the number of co-authors has grown through the years from around 500 in the late 90's to around 1000 in the mid 2000's. The largest cluster has also

doubled from around 15 to 30. Single authors can be seen as nodes on their own in the social network. Single authors are networks with a component size of one. With the SNA we are interested in the interactions between the authors, so the remaining evaluation will not take into account the single authors.

| Year | AMCIS | | | ECIS | | |
|---|---|---|---|---|---|---|
| | No. of Actors in Network | No. of Actors in Main Component | % of Actors in Main Component | No. of Actors in Network | No. of Actors in Main Component | % of Actors in Main Component |
| 1998 | 526 | 14 | 2.7% | 688 | 48 | 7.0% |
| 1999 | 443 | 16 | 3.6% | 768 | 64 | 8.3% |
| 2000 | 637 | 14 | 2.2% | 1052 | 74 | 7.0% |
| 2001 | 681 | 17 | 2.5% | 1188 | 95 | 8.0% |
| 2002 | 574 | 15 | 2.6% | 1390 | 174 | 12.5% |
| 2003 | 717 | 16 | 2.2% | 1602 | 237 | 14.8% |
| 2004 | 1019 | 37 | 3.6% | 1796 | 416 | 23.2% |
| 2005 | 868 | 36 | 4.1% | 2009 | 588 | 29.3% |

*Table 2. Development of ECIS/AMCIS Conference over time (ECIS data from Vidgen et al. 2007)*

When comparing the ECIS and AMCIS networks several interesting observations can be made (table 2). On average the ECIS conference is 25% the size of the average AMCIS conference. Despite the gross size difference between the two conferences, as measured by the total number of submitted/accepted papers to either conference, the ECIS network, those co-authored papers, is much larger in the AMCIS network.

In table 3 we compare network measures for the AMCIS, ECIS and ICIS conferences, with the ECIS and ICIS data was taken from the Vidgen et al. (2007) and Xu et al. (2006) papers respectively. Using the degree, betweenness, and closeness centrality measures for all researchers in the AMCIS network, the researchers were rank ordered. The top 10 of each measure are presented in table 3. Each researcher's h-index was calculated and is shown in parenthesis. We can see that the measures of centrality also indicates that the ECIS community is more engaged than is suggested by the centrality measures for the AMCIS network. In simple terms, the ECIS community is tighter and more cohesive than the AMCIS community.

| Rank | AMCIS | | | ECIS | | | ICIS | | |
|---|---|---|---|---|---|---|---|---|---|
| | Degree | Between-ness | Closeness | Degree | Betweenness | Closeness | Degree | Between-ness | Closeness |
| 1 | Zahir Irani *(23)* | Diane Strong *(17)* | David Salisbury (16) | PowellP *(13)* | GalliersRD *(25)* | GalliersRD *(25)* | Andrew Whinston ***(42)*** | M. Lynne Markus (38) | M. Lynne Markus (38) |
| 2 | StarrRoxanne Hiltz (41) | Ed Watson (18) | Alexander Hars (11) | GalliersRD *(25)* | FinneganP (15) | PowellP *(13)* | Richard Watson (29) | Richard Watson (29) | Richard Watson (29) |
| 3 | Keng Siau (23) | M.Lynne Markus (38) | Wynne Chin (28) | FinneganP (15) | PowellP *(13)* | FinneganP (15) | M. Lynne Markus (38) | Krishnamurthy Raman (6) | Krishnamurthy Raman (6) |
| 4 | Glenn Stewart (10) | Jane Fedorowicz (11) | Matthew Stollak (3) | NewellS *(19)* | DoukidisGI *(14)* | Mylonopoulos NA (7) | Jay Nunamaker, Jr. (37) | Tridas Mukhopadhyay (24) | Gordon Davis (27) |
| 5 | Raghav Rao (20) | Judy Scott (10) | Joseph Peyrefitte (7) | VidgenRT *(14)* | LightB (15) | DoukidisGI *(14)* | Vijay Gurbaxani (15) | Benn Konsynski (24) | John King (32) |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 6 | Marinos Themistocleous (16) | John Gorgone (15) | Rodney Pearson (15) | PanSL *(13)* | DamsgaardJ *(11)* | PanSL *(13)* | Raghav Rao (20) | Gordon Davis (27) | Cynthia Beath (14) |
| 7 | Diane Strong *(17)* | Dawn Gregg (14) | Mark Huber (10) | LevyM (10) | Mylonopoulos NA (7) | LybereasP (4) | Kalle Lyytinen *(30)* | Vijay Gurbaxani (15) | Kenneth Kraemer (35) |
| 8 | Michael Rosemann (30) | Paul Pavlou (22) | Craig Piercy (4) | Martakos D (12) | Constantinou ID (5) | WhitleyEA (15) | John King (32) | Andrew Whinston ***(42)*** | Gerardine DeSanctis (36) |
| 9 | James Courtney (10) | Lester Singletary (5) | Allison Harrison (10) | Loebbecke C (17) | FerneleyE (7) | LevyM (10) | Niels Bjørn-Andersen (12) | Jay Nunamaker, Jr. (37) | V. Sambamurthy (22) |
| 10 | Huaiqing Wang (18) | T. Raghu (10) | Jiangfan Zhong (2) | MurphyC (10) | PanSL *(13)* | BallantineJA (20) | Izak Benbasat (41) | John King (32) | Vijay Gurbaxani (15) |

*Table 3. AMCIS (1998-2005)/ECIS (1993-2005)/ICIS (1980-2005) Top Centrality Authors along with h-index numbers in parentheses. Bold numbers are researchers identified as cross cultural, italic are European Researchers, and normal font is North American (ECIS data from Vidgen et al. 2007, ICIS data from Xu et al. 2006)*

**RQ1 Findings.** We learn from table 3 that the social influence of scholars is not uniformly demonstrated by presence at a single conference, even at ICIS, the premier conference. Rather it shows that each conference has a unique network of coauthors that lends itself to building social influence. This finding supports the finding of Truex, et. al (2009) that publishing is geographically parochial. That is that the author communities tend to associate based on geography. Here we see that there is distinct social network for each conference. Additionally, we find that the average h-index for the AMCIS and ECIS conferences is about the same (15.8 vs. 13.6) but we find that the average ICIS h-index in the table is 27.3 a significant difference. We find that in all three conferences, the most socially influential people tend to be ideationally influential and significantly more so

at ICIS. Third, we find that there is a lack of transnationality in social influence as only Lynne Markus appears in both the AMCIS and ICIS highly central authors. There is no commonality with the ECIS conference. This indicates that social influence as expressed by co-authoring does not transcend the geographic boundaries of conferences. The implications of this are that meaning assessments of social influence useful for evaluating scholarly influence should be assessed on a field basis that would incorporate both the conferences and the major journals of a field.

**RQ2 Findings**. How do the SNA and H-family metrics provide a clearer picture of the construct 'scholarly influence'? In table 3 the h-index of the European researchers is in italic type. Those authors 'transcending' Europe and North America are shown in bold. In comparing we see that there are stronger h-index numbers for the key players in the ICIS conference author network than in the other conferences. This indicates that the social network power is more diffuse in the ICIS conference core than in the other two conferences. The authors in the co-author network in ICIS are more established in the publication world and have more research paper history. With ECIS and AMCIS we see lower h-indices in the top 10 indicating that younger less established authors are in power positions in the co-author social network.

For the ECIS and ICIS conference the top players using one measure are also top players using the other two measures. For example for the ECIS conference, Galliers, Finnegan, and Powell take the top three spots in the centrality measure, no matter which measure is analyzed. With the ICIS conference Markus, Watson, and Raman are in the top three positions (with Whinston the only exceptions here). While the AMCIS co-author social network we don't see such a convergence. In contrast to ECIS and ICIS the top three centrality measures positions are held by three different people in the AMCIS network with little overlap, even when looking at the top ten. This indicates that the top social network power players in the ECIS and ICIS conference are easily identified while for AMCIS the person that works frequently with others is different from the person that is a 'hub', who is also different from someone that is central in the network.

### 5.9 CONCLUSION- Contributions, Limitations and Future research

This paper illustrates how co-authoring papers is a means of building academic influence and how this influence can be measured using assessed by Social Network Analysis (SNA). The paper compares the co-authorship networks in AMCIS, ICIS and ECIS illustrating that, when combined, these measures of ideational influence and

social influence provide us a better picture of the concept of scholarly influence. Ideational influence, as measured by the Hirsch indices, tells us how the field views the intellectual contributions of a scholar. The network centrality measures illustrates the social relationships between authors, expressed in co-authorship relationships, through which we see how authors mold and shape each other in terms of interactions. Both perspectives are needed to gain a complete view of scholarly influence in the field.

This study has six limitations. First, this study is a preliminary attempt at mapping the social network of co-authorship of the AMCIS conference and comparing that network to the ECIS and ICIS conferences social networks. Coauthoring relationships are an incomplete surrogate measure of social influence, because scholarly ideas are communicated even when researchers do not coauthor in their work. This kind of influence is not measured in this methodology. Second, compared to journal authorship the authorship network of a conference is possibly dependent on location. We would expect that journals authorship demographics (such as where they are working) would not change much from year to year. But in conferences such spanning two continents, we can expect some differential in the networks between conferences held in North American as opposed to South America. Third the dataset is also small compared to the IS field as a whole. When looking at only one year of one conference, networks of smaller components can appear more readily. The different areas of research are harder to identify. This problem is less of a problem as we include more sets of data in the network. Fourth, our comparison across conferences was dependent on data retrieved from research papers, which didn't necessarily compare the same years when looking at the network (table 3). Fifth, we did not address any author order issues, nor did the network include single authored papers. We recognize that the order author's names are listed on a paper may reflect different cultural practices. It may be an implicit indication of the contribution to the article. It may reflect a simple alphabetical listing or in research teams developing many papers together first author position may be assigned on a rotating or pre-agreed basis and may NOT be an implicit indication of the degree of contribution to the research. But since we were looking at connections between authors in the paper and did not take into account the author order. Whereas in micro-level analysis single authored papers have no bearing on the data, when analyzing the whole network, or macro-level data, one must include single authored papers. Sixth, the research does not take into account geographic factors that might inhibit publishing in a conference. One stipulation that is common for inclusion into the proceeding of most conferences is that at least one of the authors would attend the conference. This means that our dataset excludes those that cannot afford to attend a conference, or at least don't have the ability to find a person to co-author with that has the means to attend the conference. Therefore the dataset in the current study is skewed towards those that have the economic means to travel to, pay the conference fee, and attend the conference.

**Future research**

We continue to identify and collect data on an ever-growing set of co-authorship networks by adding other IS conferences and journal publications to the data set. In continuing research we are comparing these networks and their components to one another. We are examining and comparing the characteristics of these networks to other measures of productivity and scholarly influence. We plan to run correlation analysis on the data and properties of the conference networks to see if there are any measures of SNA, h-index, or conference properties that might correlate. We are building and testing models to better understand relationships between scholarly networks and publication productivity and strength. In so doing we will build a cumulative profile of these interactions. Finally whereas the current study included only micro-level (researcher) data in future work we plan to include macro-level (network as a whole) SNA properties.

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# 6 Introducing the Hirsch Index for Assessing Online Community Contributions: All Contributions are Not Created Equal: Measuring User Relevance in Online Communities with [Hirsch Indices] [Bibliometric Measures]

**Brett Young, Michael Cuellar, Hirotoshi Takeda**

**Abstract**

*Increasing the number of page views is a key concern to website owners. This research investigate the dynamics of online community websites and how they attract users to return and thus increase the number of contributions and page views. By using data from a college sports fan site, we examine the dynamics of super-users. We hypothesize that new threads and super-users threads drive page views. We use a bibliometric measure, the h-index, to identify super users. Then with the use of PLS techniques we analyze the data from the college sport online community. The results of these analyses indicate that new threads in the discussion boards increase page views more than external events and that highly influential users increase page views more than other users.*

## 6.1 Introduction

How can a website owner increase the page views on the website? This is a fundamental question that all website owners seek to answer because the number of page views a website receives is often the key factor in how much revenue a website generates. This is especially true in the case of the "fan" or community website. In this case, a site does not primarily sell products but rather serves as a conduit for news about an object or organization of interest to a community. Historically, these website owners know that a continuous stream of news and opinion is important. However, research has not been done to show exactly which type of news or opinion is the most effective in driving page views of a site.

This paper continues a stream of research [13] which found that major events and informed articles did increase page views. In this research, the area of community opinion (expressed in the form of message board discussion threads) is examined to determine the effect of this type of community activity on page views. The research questions that we examine include:

RQ1: Are discussion boards more or less important than events and articles in driving page views?

RQ2: Are all posts equal or are some posters capable of driving more page views than others?

These questions are of interest to website owners since knowing the answers to these questions will help determine whether to emphasize collecting opinion articles or encouraging more discussion posts in order to increase page views.

This paper is organized as follows. First, we provide an overview of the relevant literature for online communities and impact measures. Second, we describe the research context. Third, we introduce our research model. Fourth, we describe our variables of interest. Fifth, we introduce our measures. Sixth, we present our hypotheses. Seventh we provide our detailed analysis. Eighth, we discuss our findings, limitations, and offer future research opportunities. Finally, we provide a summary and conclusion.

### 6.2 Literature Review

This section provides an overview of the extant literature in the areas of online communities and an overview of the new bibliometric impact measure, the Hirsch index.

#### 6.2.1 Online Communities

In this paper, we use the term online community (OC) to mean an "aggregation of individuals or business partners who interact around a shared interest, where interaction is at least partially supported and/or mediated by technology and guided by some protocols or norms" [10]. For example, in our research, fans interested in collegiate athletics and who are located across the United States comprise the aggregation of individuals; an online message board used and visited by those fans is the technology supporting interactions; and the message board's agreed-upon rules constitute the protocols and norms of the online community.

The growth and sophistication of the internet, paired with the decrease in technology costs, has allowed website owners to easily create, maintain, and promote their OCs. OCs are now abundant and exist for every topic imaginable. Website owners may increase their profits from advertising when the website's visitors increase usage of the OC. In this way, the financial success of the website is tied to the participation of users, either by viewing content or creating new content within the OC. The literature suggests the degree of success of an OC is determined by user participation [3, 1]. Other research suggests the sense of community (SOC) is how community success can be gauged [14]. However, success is not guaranteed and visitor participation in OCs is not static [9]. Iberari and Leroy found that OCs evolve and have distinct lifecycle stages [8]. The challenge for OC owners and managers is to understand what factors and which users are integral to the success of the OC.

The first gap that exists and will be addressed by is the limited amount of research on smaller, independently owned OCs with hundreds or thousands of users. Most research focuses on large, well-known OCs and social networks with tens of millions of users like Facebook, MySpace, and transaction-based communities like eBay [2]. The research stream begun with [13] and continued here will work to evaluate smaller OC's such as our subject college fan site, using the criteria setforth in this paper.

The second gap that will be addressed is what drives page views for smaller OC's?, In this paper, we examine the impact of discussion boards on the page views of the site. We perform an exploratory investigation of the impact of discussion boards on the number of page views. We hypothesize

*H1: An increase in discussion board threads increases the overall page views of the OC site.*

Third, given that H1 is true, it seems intuitive that not all posters are equally capable of generating discussions that increase page views. There are some users that can generate more page views that others due to their insight into the object of community interest or by virtue of their ability pose a controversial question. Thus, we hypothesize

*H2: Some authors are more influential at generating page views.*

The fourth gap this paper will address is to how to identify influential users. Currently, no good method exists for identification of influential users. Some communities list the most active members – meaning those that create the most threads or replies. For example, currently, a message board may just take the users that show up at the top or show up a lot in the top 100 posts. This type of count measure is not very useful because users can post many 'fluff' posts just so that they can get onto these top 100 lists. The top-lists don't take into account how many users are actually listening to the posts. Therefore, the top 100 users may not be the most impactful on the OC's success.

In response to this issue we are proposing the use of bibliometric measures based on the Hirsch index [7] as a way to assess individual users' impact on OCs. The following section provides an overview of the extant research on bibliometric measures.

### 6.2.2 Bibliometric Measures

The Hirsch index (h-index) is a bibliometric measure that utilizes citation counts of a subject to measure the

impact of the subject. The h-index utilizes the citation counts of all of the subject's publications. By doing so the h-index allows a measure to incorporate the spectrum of the subjects work as well as the impact of each of those works into one measure. Formally the h-index is defined as:

> *"A scientist has index h if h of his/her Np papers have at least h citations each, and the other (Np − h) papers have no more than h citations each."* [7]

The h-index has created buzz in the academic world with studies conducted in IS, chemistry, physics, and economics [5, 12],. The h-index is rapidly being accepted as a measure of impact in the academic publishing field and the current research is one of the first to introduce h-index to the measure of impact in an OC.

Given its strength as a measure of influence, we hypothesize

> *H3: Those posters with a higher h-index will be the one's whose threads generate the most contribution to page views.*

In order to use the h-index concept in OCs, the variables used in the calculation of the index must be changed. The 'papers' is now a 'thread start.' The 'citations' are now 'replies.' The 'scientists' (normally researchers in bibliometrics) are now the individual 'usernames' on the OC. The thread start is a new topic that any user can create and post to the OC. The replies are the number of replies that a certain thread start receives. Additionally, another form of h-index can be generated based on how many times the thread is viewed. A threads' page views may be influential on how many times the rest of the site is viewed. The username is a unique identifier of an individual OC member. Making these changes allows us to create "pseudo" h-indices that assess the influence of posters in generating page views.

One distinct advantage is seen with the OC that is not seen in bibliometrics. In bibliometrics it was only possible to count citations but it was impossible to count the number of times an article was read. By utilizing the data-mining abilities of the OC there is now a second distinct measure that can be used with OCs that were not possible in bibliometrics. In addition to replies, the OC is able to measure views. Views are the count of the number of clicks on a thread. Although one can argue that views are not complete 'reads' (or re-reads) by an individual of the whole thread, views do present a measure we can use to create a second h-index using views.

### 6.3 Research Context

BigUFans.com is an online community for fans of Big U and its athletic teams. The site is the largest free and independently owned community for Big U fans. The site is supported through advertising and merchandise sales. BigUFans.com was created in 1999 as a gathering place for Big U's fans worldwide. The site is most active during months of the college football season (August through February).

BigUFans is owned by an alumnus of Big U (and one of the co-authors of this paper) and many volunteers who help manage the site. BigUFans.com has twenty moderators who manage specific message boards on the site, three super-moderators who moderate the whole site, and four administrators. These individuals evaluate the site's content, monitor message board posts, and remove any spam or incendiary posts or duplicate threads. Moderators have the ability to remove posts, threads, and ban users as warranted. Moderators are also responsible for starting interesting threads that members will read and reply in.

Because the site is strictly moderated, members are expected to keep threads and replies on-topic. For example, all threads in the football forum are expected to be related to football. Similarly, all posts in a topic about a specific player would be expected to be relevant to the original thread topic. Posts that do not follow these guidelines are subject to being moved or deleted and members who repeatedly make non-relevant posts are subject to suspension from the site. Positive feedback that BigU.com receives from the users is that threads and boards tend to stay on topic and are relevant due to the closely monitored message board.

Each month during the 2009 college football season, which includes the months of August through January – the most active period each year – the site averaged 2,094,226 page views, 2,219 new thread topics, and 151,286 unique visitors . Visitors remained on the site an average of 8 minutes 41 seconds and viewed 6.6 pages each visit during the football season. An average of 1,075 registered members logged into the site each day and 13 new members registered. A site-conducted survey during 2009 revealed that most BigUFans.com visitors are male (92%), college educated (72%), and middle to upper income (71%).

There is a base level of site page views during the football off-season (e.g. 30,000-40,000 daily page views during February through July) reflecting the interest that Big U fans have regardless of the existence (or not) of related Big U football-related events. However, a sample of site data from this period (April 9 through June 14, 2010) suggests that an average of less than four percent of daily signed-in users create new a thread and less than

thirty percent of signed in users post a reply.

BigUFans.com competes with four similar sites covering Big U athletics. However, BigUFans.com is the only totally free site among the five competing sites. The other sites allow free registrations but most of their content and main message boards are available only to paid subscribers.

The primarily revenue source for BigUFans.com is banner advertising. The site uses several third-party ad aggregators (like Google Adsense, Burst Media, and Advertising.com) to sell and deliver ads for the site. Occasionally the site sells ads directly to local businesses.

### 6.4 Research Model

The super users were identified using a program to calculate the h-index for replies (hr-index) and h-index for views (hv-index). The data was collected from February 2001 until May of 2010. This accounted for 101,153 threads started by 4924 unique users. During this timeframe there were 2,413,360 replies to thread postings and 95,447,504 views of the thread postings. The posting data was put into a java program to identify the hr and hv indices. The top 50 users are identified in Table 1 in Appendix A.

### 6.5 Variables of Interest

Data collection and variables of interest are introduced here. These are broken into three main categories. The Message Board Variables, User Variables, and the Online Community Variables.

## 6.5.1 Message Board Variables

These variables are particular to the message board information:

a) **Post** – A reply within a thread or the first contribution in a thread.

b) **Thread** – A collection of posts. An individual post is a thread when it is the first post. The reply itself is a post as well but not a thread. The thread is the seed to a discussion that garnished one ore more replies.

c) **Thread id** – the unique identification of a specific thread

d) **Reply count** – number of replies to a post

e) **Date** – date that the initial post was created.

f) **Thread Views**– Number of views that each thread receives.

### 6.5.2 User Variables

These variables are particular to user information:

a) **Post user id** – the unique identification of a user that created a post.

b) **Threads created** – number of threads created by an individual user.

### 6.5.3 Online Community Variables

These are variables that pertain to the OC, overall:

a) **Major Events.** Number (by week) of football games against the biggest rivals, post-regular season games, and football recruit signing days.

b) **Minor Events.** Number (by week) of games against smaller rivals and other, less impactful school events.

c) **Articles.** Number (by week) of articles published on BigUfans.com.

**d) Page Views.** Number (by week) of page views for the entire OC.

## 6.6 Bibliometric Measures

The application of the h-index to the BigU.com OC statistic is introduced. In particular the hr-index and the hv-index.

### 6.6.1 hr-index and hv-index

The Pseudo H-index is calculated by taking each user and ranking their threads started by the number of replies to their threads. A user has an hr-index of hr where they have at least hr threads with hr replies and the other threads have hr-1 replies or less. The h index is broken into two different types. The hr-index is counting replies to threads and the hv-index is counting views of threads. The ranking process for the hv-index is the same as the hr-index, differing only in counting views as opposed to replies. So a user has an hv-index of hv where they have at least hv threads with hv views and the other threads have hv-1 views or less. For example, if a user has an hr-index of 50 that means that the user has started at least 50 threads with at least 50 replies each. Similarly, if a user has an hv-index of 1000, that means that the user has started at least 1000 threads that have at least 1000 views each.

For each of the indices we used Google analytics to create a spreadsheet that listed the thread id, post user id of the author of the thread, the number of replies to the thread, and the number of views to the thread. This data

was then fed into a Java program, which in turn took for each user id, all of their threads and ranked them according to replies. The program also took for each user id, all of their threads and ranked them according to views. These two lists were then analyzed to generate the hr-index and hv-index for every user id that created at least one thread. This list is shown in table 1.

The calculations of the hr-index and hv-index revealed some characteristics of the super users.Looking at the top 50 in replies and views, we see first that there are more views (1064 for highest) than replies (112 for highest) which is expected since one has to view before replying, thus views will always be equal to or more than replies. We also see that administrators, moderators, and super moderators make up the majority of the top posters (11 out of the top 50 and 8 out of the top 10 for replies and 15 out of the top 50 and 5 out of the top 10 for views). We also see that there is overlap between the two lists (4 users show up in the top 10 in both lists and 34 users show up in the top 50 in both lists).

### 6.7 Analysis

To test the hypotheses, we examined the relationship between page views on at BigUfans.com and the generation of threads on the message boards. We collected usage data from BigUfans.com and time periods associated with relevant events. This data was aggregated into weekly totals for analysis. In performing the analysis of the data we utilized the Partial Least Squares (PLS) methodology as implemented in SmartPLS [11]. PLS is a second generation data analysis technique [4] which tests not only the structural model but also the measurement model in a single analysis rather than two unrelated analyses as in the first generation techniques. Additionally, PLS is able to identify path loadings across the entire model in a single run as opposed to multiple runs required using regression echniques. This results in a more rigorous analysis than using factor analysis and regression alone [4]. As does regression analysis, PLS seeks to show rejection of a null hypothesis of independent variables having no effect on the dependent variable while accounting for a significant amount of the variance in the dependent variable [4].

PLS techniques perform the analysis by iterating between factor analysis and path analysis until the change in variance explained is not significant. It then uses bootstrapping to estimate the significance of the paths. “Neither of these PLS significance estimation methods require parametric assumptions. PLS is thus especially suited for the analysis of small data samples and for data that doesn‟t necessarily exhibit ...multivariate normal distribution...” [4].

It is also appropriate where the goal is hypothesis testing rather than model testing [6].

### 6.7.1 Data

The data set was made available by the owner of the site (one of the researchers) to the research team. Data includes directly measured data from analytical tools located on the site, including Google Analytics, 24/7 RealMedia, and vBulletin message board software. Google Analytics and 24/7 RealMedia place a small code on each page delivered to viewers of the site and then collects various types of data.

### 6.7.2 Study 1

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**Findings.** Because the data is single indicator variables collected from an automated system, no testing of the measurement model is required. A structural model was developed in PLS and the model accounted for 62% of the variance in Page Views. The path analysis shows that the path from new threads to page views is significant while none of the control variables were significant (See Table 2 in Appendix B). Thus our hypothesis one is

confirmed.

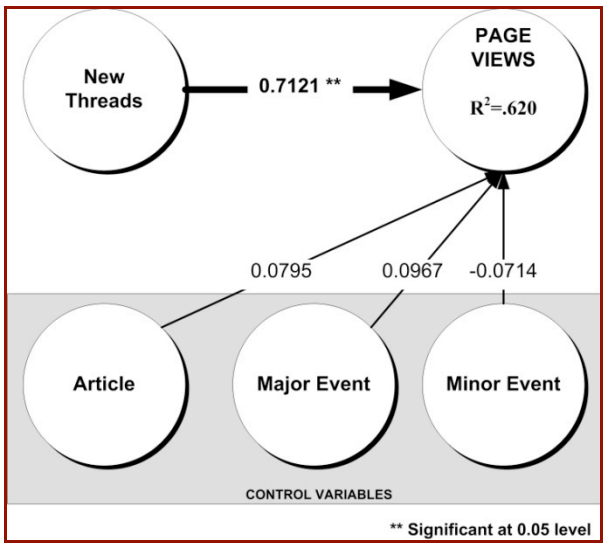


**Figure 2: Model tested (Analysis 1)**

### 6.7.3 Study 2

For the second analysis, to compute the pseudo h-index values for each week, for each poster that started a thread on a particular week, we multiplied the number of threads started by each of the pseudo h-indices to compute an "impact factor" for the week. These were then summed up for each day to compute a total impact factor for the week.

The theoretical model used in the first analysis was modified by the addition of either the computed impact factor based on the replies or the views. This model is shown in Figure 3.

Due to collinearity between the two pseudo h-statistics, we ran two separate PLS analyses using the same characteristics as in study 1, one for each pseudo h-index. (See Appendix A for path coefficients from the bootstrap analysis).

**Findings.** In this analysis, the $R^2$ of the analysis increased to .678 (h based on replies) and .647 (h based on thread views). The small increase in $R^2$ over that of analysis 1, shows that the addition of these variables has a small effect size and that each of these statistics is about equivalent in effect.

The paths from the h statistics to the total number of page views is positive and significant showing that each has a positive effect on the total page views of the site. Thus confirming hypothesis 2, that threads started by the

more influential posters result in a greater increase in total page views for the site. The fact that we received significant results indicates that the pseudo h-indices are useful measures of influence.

The calculations of the hr-index and hv-index revealed some characteristics of the super users. Looking at the top 50 in replies and views, we see first that there are more views (1064 for highest) than replies (112 for highest) which is expected since one has to view before replying, thus views will always be equal to or more than replies. We also see that administrators, moderators, and super moderators make up the majority of the top posters (11 out of the top 50 and 8 out of the top 10 for replies and 15 out of the top 50 and 5 out of the top 10 for views). We also see that there is overlap between the two lists (4 users show up in the top 10 in both lists and 34 users show up in the top 50 in both lists) (table 1)

### 6.8 Discussion

This paper extends research begun in [13]. That paper found that events occurring in the life of the OC and articles published by well-regarded columnists on the OC were positively associated with the number of page views the OC received. This paper, in study 1, finds that those factors are, in fact, mediated by new threads created to the number of page views received by the site (Figure 3). This information implies that events and articles cause members of the OC to begin discussion threads on the discussion boards of the site. Others who view the threads to reply and perhaps to view other parts of the OC, thereby increasing page views. This information suggests that OC owners should take steps to increase the number of threads started on the discussion boards.

In study 2, we find that the relative influence of the posters tends to generate more page views. This suggests that all threads started are not equal. Those threads started by posters who are more influential will tend to generate more page views than threads started by those who are less highly regarded. This influence may stem from being highly regarded, as suggested above, or it may come from the content of the post on the thread started. Regardless, the findings imply that certain members are adept at starting threads that entice others to view or reply in the thread. Therefore in either case, OC owners should identify those members who are highly influential and find some means to encourage those posters to start more threads.

Finally, we have developed the concept of the "pseudo" h-indices for use in measuring the influence of posters in OCs. The pseudo h-indices measures based on research from the scientometric fields, can be used to assess the

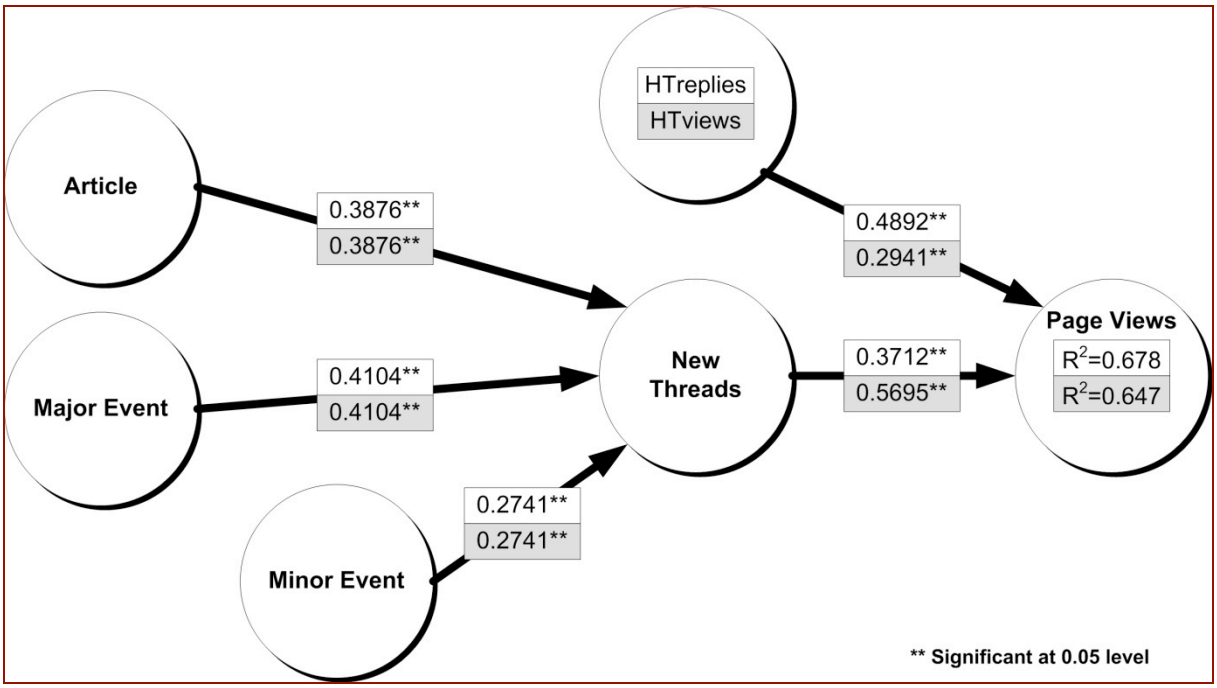


**Figure 3: Model tested (Analysis 2)**

influence of posters in the OC realm.

### 6.9 Limitations

There is an inherent risk in translating the h-index to OC's. In addition to the problem of counting 'views' as 'reads', where we are assuming that a user is reading when a 'view' is counted, there may be problems with the replies. The replies are not necessarily replies to the original thread. So replies may be counted when they are actually replies to intermediate replies.

We feel that there are two reasons to overlook this limitation. First, with the dedicated monitoring by the administrators in the BigU.com fan site, we believe that the replies that run off-topic from the original thread posting is minimized. Second, in order to assess what posting that each reply is referring to, one would have to read all postings in the OC. This inherently is not why the h-index was created. The h-index was created for having a quick way of assessing influence, and has garnered much validity in other fields. We believe the h-index should be applied in the same spirit to our OC.

Another limitation is that we used only one type of OC. While this was an initial look into the dynamics of an OC, we cannot generalize our findings to other types of OCs such as health management OCs, political OCs, or computer programming language OCs.

### 6.10 Future research

Some of the questions that remain unanswered by this research are (1) What is the effect of specific events on user participation? (2) What is the effect of events on the number of page views prior to the event?); (3) What is effect that different types of visitors to the website have page views and revenue generated? And (4) How do super-users' H-indices change over time? These questions will be investigated in future research. (5) Can we generalize our findings to other types of OCs?

### 6.11 Conclusion

This research set out to find how OC's can continue to generate page views and interest of the users. We hypothesized that an increase in threads would increase views. We also hypothesized that there were super-users that generated more page views. We used the bibliometric h-index measure to identify the super-users. We finally hyposthesized that users with high h-indices would drive page views. We utilized PLS methods and data from a college sport OC and found support for our hypotheses.

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**Appendix A: Results of H-index Analysis**

**Table 1. Top 50 h-index**
**(Role: A=Administrator, S=Super-Moderator, M=Moderator)**

| h-replies | | | h-views | | |
|---|---|---|---|---|---|
| Anonymized Username | Hreplies | Role | Anonymized Username | Hviews | Role |
| user1 | 112 | A | user3 | 1064 | S |
| user2 | 67 | A | user4 | 742 | A |
| user3 | 60 | S | user1 | 661 | A |
| user4 | 53 | A | user11 | 576 | M (former) |
| user5 | 53 | M | user25 | 534 | A |
| user6 | 52 | M | user5 | 532 | M |
| user7 | 51 | | user27 | 484 | |
| user8 | 48 | M | user16 | 474 | |
| user9 | 46 | | user24 | 442 | |
| user10 | 45 | M | user17 | 416 | |

| | | | | | |
|---|---|---|---|---|---|
| user11 | 45 | M (former) | user51 | 415 | M |
| user12 | 44 | | user19 | 415 | M |
| user13 | 44 | | user9 | 414 | |
| user14 | 43 | M | user14 | 405 | M |
| user15 | 42 | | user52 | 402 | M |
| user16 | 42 | | user6 | 402 | M |
| user17 | 42 | | user44 | 399 | |
| user18 | 42 | | user7 | 396 | |
| user19 | 41 | M | user53 | 390 | (AUTO-POSTER) |
| user20 | 41 | | user8 | 385 | M |
| user21 | 40 | | user12 | 369 | |
| user22 | 40 | | user37 | 359 | M |
| user23 | 40 | | user20 | 354 | |
| user24 | 40 | | user2 | 337 | A |
| user25 | 40 | A | user13 | 333 | |
| user26 | 39 | | user54 | 322 | |
| user27 | 39 | | user10 | 315 | M |
| user28 | 38 | | user55 | 314 | |
| user29 | 37 | (A - former) | user18 | 309 | |
| user30 | 36 | | user56 | 300 | |
| user31 | 36 | | user57 | 297 | M |
| user32 | 35 | | user58 | 291 | |
| user33 | 35 | | user59 | 286 | |
| user34 | 35 | | user60 | 281 | |
| user35 | 34 | | user61 | 280 | |
| user36 | 34 | | user35 | 277 | |
| user37 | 33 | | user23 | 274 | |
| user38 | 32 | | user36 | 274 | |
| user39 | 32 | | user22 | 273 | |

| | | | | | |
|---|---|---|---|---|---|
| user40 | 31 | | user62 | 272 | |
| user41 | 31 | | user63 | 263 | |
| user42 | 31 | | user29 | 261 | (A - former) |
| user43 | 31 | | user64 | 260 | |
| user44 | 31 | | user65 | 255 | |
| user45 | 31 | | user49 | 250 | |
| user46 | 30 | | user46 | 238 | |
| user47 | 30 | | user33 | 237 | |
| user48 | 30 | | user15 | 225 | |
| user49 | 30 | | user39 | 225 | |
| user50 | 30 | | user66 | 224 | |

**Appendix B: Results of Bootstrap Analysis**

| Table 2. Results of Bootstrap Analysis (Study 1) | | | | | |
|---|---|---|---|---|---|
| STUDY 1 | Original Sample **(O)** | Sample Mean **(M)** | **(STDEV)** | **(STERR)** | **T Statistics** |
| Article ➔ Page Views | 0.0795 | 0.0791 | 0.0705 | 0.0705 | 1.1284 |
| Major Event ➔ Page Views | 0.0967 | 0.0969 | 0.0848 | 0.0848 | 1.1399 |
| Minor Event ➔ Page Views | -0.0714 | -0.0671 | 0.0691 | 0.0691 | 1.0335 |
| New Threads ➔ Page Views | 0.7121 | 0.7090 | 0.0904 | 0.0904 | 7.8730 |

| Table 3. Results of Bootstrap Analysis (Study 2 – With H-index calculated on thread replies) | | | | | |
|---|---|---|---|---|---|
| STUDY 2 – Thread Replies | **Original Sample (O)** | **Sample Mean (M)** | **(STDEV)** | **(STERR)** | **T Statistics** |
| HTReplies ➔ Page Views | 0.4892 | 0.4888 | 0.0809 | 0.0809 | 6.0482 |
| Article➔ New Threads | 0.3876 | 0.3909 | 0.0606 | 0.0606 | 6.3989 |
| Major Event ➔ New Threads | 0.4104 | 0.4064 | 0.0734 | 0.0734 | 5.5909 |
| Minor Event ➔ New Threads | 0.2741 | 0.2745 | 0.0776 | 0.0776 | 3.5331 |
| New Threads ➔ Page Views | 0.3712 | 0.3706 | 0.0783 | 0.0783 | 4.7413 |

| Table 4. Results of Bootstrap Analysis (Study 2 – With H-index calculated on thread views) | | | | | |
|---|---|---|---|---|---|
| STUDY 2 – Thread Views | **Original Sample (O)** | **Sample Mean (M)** | **(STDEV)** | **(STERR)** | **T Statistics** |
| HTViews ➔ Page Views | 0.2941 | 0.2988 | 0.0704 | 0.0704 | 4.1774 |
| Article ➔ New Threads | 0.3876 | 0.3923 | 0.0632 | 0.0632 | 6.1293 |
| Major Event ➔ New Threads | 0.4104 | 0.4042 | 0.0697 | 0.0697 | 5.8849 |
| Minor Event ➔ New Threads | 0.2741 | 0.2737 | 0.0765 | 0.0765 | 3.5841 |

# 7 Conclusion and Reflections

## 7.1 Introduction – Chapter Focus, Reflection on the Work Accomplished

In Chapter 1 of this dissertation I describe how early attempts to measure Heinz K. Klein's (HKK) scholarly influence raised issues that led me to explore the nature of and measure of scholarly influence. As my assigned part of the Festschrift team I was tasked with determining and developing representations of the Klein co-author network.

My work started with finding all of Klein's work, then filtering out the co-author data, and creating a list of co-authors and the number of times each researcher had co-authored with Klein. This required creating a frequency analysis as well as a social network of researchers that had worked with Klein. While exploring the influence of Klein, my co-authors and I came across an interesting bibliometric measure called the Hirsch index (h-index). Using this h-index we were able to measure both the productivity, with the number of publications, and the uptake of ideas, with the number of citations, of IS researchers (Chapter 2) and IS journals (Chapter 3).

Chapter 4 presents a composite index, the gc index, one of my creation. The gc index measures all citations to a work of a researcher discounted by the length of time that the researcher's output had been out in the academic world. In Chapter 5, I return to the notion of social influence by examining co-author networks. I expanded the social network to look at the co-author network of IS scholars. In Chapter 6, I applied the h-index to online communities, where the measure of productivity is the creation of new threads and the 'uptake' of ideas is the view/replies to the threads. Finally, I compare the intersections of both social influence and ideational influence by examining correlations of h-indices and network centrality measures. I use the work of HKK to illustrate these results.

The h-indices can be argued as being a way to measure 'influence' because to achieve a high h-index other scholar/authors must have encountered one's work and found it sufficiently useful to cite it in their own publications. In this dissertation and the dissertation chapters we refer to this process as the 'uptake of publications.' The meta-theme of this body of research is on how I assess a particular influence, namely that called 'scholarly influence.' But on reflection it seems that I was using the term 'scholarship' or 'scholarly' unproblematically. I was using the term 'scholarly' to mean academic work but I did not identify what 'scholarly' work means. Therefore it became necessary to also step back and review the nature of the construct 'scholarship'.

A review of the literature and definition of 'scholarship' is the focus of section 2 and 3 of this chapter. Section four looks at how quality has been defined in the past and how notion of quality can be used in future work. Section five looks at issues with bibliometric measures. Section six looks at the dissertation research stream and section seven reflects on the dissertation work. Section eight looks at future areas of the current research stream and section nine conclude this dissertation.

### 7.2 IS Research: How Does this Dissertation Research Fit?[14]

This research continues a line of IS meta-research that discusses the nature of the field, what constitutes IS research and how is the research output and researchers are evaluated. Meta-research has a long history in the Information Systems discipline being published in all the major journals and conferences from the very beginning of the discipline. Mason and Mitroff (1973) published the first meta-research with their discussion of a research agenda for IS; their work preceded the existence of the first IS journals. The first ICIS included two meta-research papers (Hamilton & Ives, 1980; Keen, 1980). This research has continued up to the present day (Basden, 2010).

IS meta-research, for analytical purposes, may be divided into roughly four separate but related streams. The first, roughly termed 'what is the IS discipline', examines the question of the existence of IS as a separate field of study versus being a mere offshoot of more traditional disciplines. The second and related stream, examines the nature the field's relationship to its relevant reference disciplines and whether it is evolved into a reference discipline in its own right. The third stream, centers on attempts to tie down the nature of the thing being studied. This is the so-called 'core' of the discipline debate. Finally, a fourth stream considers how we may evaluate IS research and the work of the IS researcher. A common thread in these streams is the attempt to define, to refine and to protect disciplinary boundaries. The first stream considers the legitimacy of IS as a unique field of study. The second and third stream refine the boundary conditions. The fourth stream discusses how IS research should be evaluated according to the standards established in preceding streams. Also running throughout each of these streams are continuing discussions dealing with what constitutes appropriate theory development from within the discipline as well as what constitutes appropriate and rigorous methods an IS researcher might use in investigating IS research questions. I next discuss each of these streams in turn. But first I wish to make one point clear. The

[14] Section 2 is a co-creation with authors Mike Cuellar, Duane Truex and Richard Vidgen for a paper currently in revision for a journal submission of this research stream.

theme of this present research, namely the nature of scholarly influence and how it might be measured and applied when looking at IS academics, is IS research as it is situated in an old, venerated, and continuous discourse in the IS discipline.

The IS discipline may be considered to have been legitimized by two events in the early 1970's: 1) the production of the first MIS PhDs and 2) with the offering of management information systems courses as part of college curricula. Using these criteria I date the beginnings of the field in the early 1970's. One finds early identification of actual MIS academic programs as early as 1971 (Meltzer, 1971). As mentioned above, Mason and Mitroff (1973) and Keen (1980) defined the first IS research agendas. Then literature and managerial treatises began to appear addressed to the management of these systems. (Bentley & Forkner, 1983; Cooke, Drury, & Hazen, 1980; Duff & Asad, 1980; Higgins, 1976; Lundeberg, 1976). And, by the mid 1980s, I begin to see articles that define the first stream of meta-research, namely those exploring the notion that IS as a separate discipline. (Bakos, 1985; Brancheau & Wetherbe, 1987; M. Culnan, 1986; M. Culnan & E. Swanson, 1986; Gorgone, Ho, & McGregor, 1987; Kaplan & Duchon, 1988; W. Orlikowski & Baroudi, 1989; Van Gigch & Le Moigne, 1989; Weber, 1986)

As early as 1991 articles began to appear in US (Davis, 1992) and European journals (Backhouse, Liebenau, & Land, 1991) that define the second stream of meta-research, namely the question of the boundaries of the field and its relationship to its references disciplines. These articles address the establishment of common and shared definitions of the field and its key constructs (Sutton, 1992) to the very notion of how I mean 'being a discipline' (DE Avison, 1993; Jones, 1997; Mingers & Stowell, 1997). The discussion of our fields 'reference disciplines' and our distinctiveness form those disciplines began appearing early in the life of the discipline. The earliest of these use analysis of citations to establish the people and fields being used as referents and warrants in IS research (M. J. Culnan, 1986; Culnan, 1987; M. J. Culnan & E. B. Swanson, 1986). Later articles examine the diversity of IS research (Adam, Howcroft, & Richardson, 2004; T. J. Larsen & L. Levine, 2005; Vessey, Ramesh, & Glass, 2002). A whole class of review articles explore how IS researchers and their published works draw from reference disciplines (Alavi & Carlson, 1992; Banker & Kauffman, 2004; Barki, Rivard, & Talbot, 1988; Chapman & Brothers, 2004; T. J. Larsen & L. Levine, 2005; W. J. Orlikowski & Baroudi, 1991; Pinsonneault & Kraemer, 1993; Swanson & Ramiller, 1993). This kind of self-examination also continues to the current day (D. E. Avison, Dwivedi, Fitzgerald, & Powell, 2008). The discourse has matured somewhat as some IS scholars have begun to posit that the IS field itself may have become a reference discipline to other fields of inquiry (Baskerville & Myers,

2002; Katerattanakul, Han, & Rea, 2006; Wade, Biehl, & Kim, 2006) and indeed what constitutes a proper importation of theories from other fields into our own research (Truex, Holmström, & Keil, 2006)

The third stream, work addressing the boundaries and the 'core' of the discipline and what should be considered IS research and its relation to other disciplines, began appearing as early as 1998 (Frank & Hampe, 1998; Moscove, Simkin, & Bagranoff, 2002; Weber, 1999). Prominent in this stream is Benbasat and Zmud (2003) and it many response articles (Alter, 2003a, 2003b, 2003c; DeSanctis, 2003; Galliers, 2003; Ives, Parks, Porra, & Silva, 2004; Robey, 2003; Westland, 2003; Wu & Saunders, 2003). Discussions include the nature of IS as a reference discipline (Baskerville & Myers, 2002; Katerrattanakul, Han, & Rea, 2006). This discourse continues to the present day (D Avison & Elliot, 2006; Basden, 2010; T. Larsen & L. Levine, 2005; Rowe, Truex, & Kvasny, 2004; Sidorova, Evangelopoulos, Valacich, & Ramakrishnan, 2008).

The fourth meta-research stream examines how IS research should be evaluated. This stream arises from the need for administrators to be able to evaluate the work of IS scholars. This has typically been done by publication count in targeted journals. This requires that the journals be evaluated themselves to determine if they are appropriate venues. This process of journal evaluation has given rise to a cottage industry of studies on journal rankings (Alexander, Scherer, & Lecoutre, 2007; Barnes, 2005; Ferratt, Gorman, Kanet, & Salisbury, 2007; Lowry, Karuga, & Richardson, 2007; Lowry, Romans, & Curtis, 2004; Mylonopoulos & Theoharakis, 2001; Nerur & Sikora, 2005; Rainer & Miller, 2005; Schwartz & Russo, 2004; Templeton, Lewis, & Luo, 2007; Walstrom & Hardgrave, 2001; Walstrom, Hardgrave, & Wilson, 1995). The evaluation of scholars has also created its own stream of research (Chua, Cao, Cousins, & Straub, 2002; Huang & Hsu, 2005; Karuga, Lowry, & Richardson, 2007; Truex III, Cuellar, & Takeda, 2009). Additionally, there are analyses of the social networks in the field (Takeda, Truex III, & Cuellar, 2010; Vidgen, Henneberg, & Naude, 2007; Xu & Chau, 2006).

The research reported in this dissertation continues the work in the fourth meta-stream. My dissertation also contributes to the entire fourth stream of IS literature by continuing the development of a methodology to be used to evaluate the production of IS scholars that supersedes that of publication counts in targeted journals or simple citation counts. In short, this present dissertation is part of a long-standing, well-established IS discourse in information systems research.

### 7.3 Defining Scholarship

Currently there are two principal views of scholarship. The first privileges the research and production of knowledge. The second is a more complex view incorporating teaching, service, knowledge creation and other factors. The shift to research production as the principal indicator of scholarship dates back to the 1980's (Dirks, 1998). This transition is not without controversy. In Ernest L. Boyer's book "*Scholarship Reconsidered*" (1990) sponsored by the Carnegie Foundation for the Advancement of Teaching, Boyer challenged the notion of using publication counts as a criteria for measuring scholarship. This book became a launching point from which institutions began to examine how they evaluated scholars. In the 1990's there were many calls to reconsider the journal count, redefine scholarship, and to set clear criteria methodologies for evaluating scholarship (Boyer, 1990; Dirks, 1998; Glassick, 2000; Slanger, 1997) The Carnegie Foundation report created intent in examining 'scholarship' and the 'criteria' to measure 'scholarship', however in recent years the discourse has stagnated. In the last decade in IS we have seen the return to the status quo of using journal publication counts and has again become the de-facto method in evaluating scholarship.

#### 7.3.1 Identified Critiques with Current System

A persistent challenge is the lack of a standardized and generally accepted definition of scholarship. Without such a definition there can be no measure of scholarship nor criteria for measuring scholarship. "Once scholarship is more broadly defined and evaluated according to common criteria, reward structures must be created to motivate and institutionalize the change" (Dirks, 1998). But even with a standard definition of scholarship, it may be impossible to create a single criteria for measuring scholarship (Krahenbuhl, 1998). An alternative may be analogous to the way the technology industry creates separate criteria for 'technical' and 'managerial' tracks to evaluate different types of workers.

The return to the use of journal citation counts has certain benefits and disadvantages. The benefits are that the journal citation counts are simple, easy to cross compare, and it is a single measure. The disadvantages of using citation counts include the lack of fairness, lack of openness and transparency, and a citation count criteria is power laden. The general approach institutions seem to follow is to use a journal ranking system to evaluate the worth of a scholar but this model has many flaws. First, this one-size-fits-all measure, while useful for administrators, is by no

means a fair measure for all institutions or their faculty. By instituting a research journal publication evaluation method across the board, professors at schools that are more traditionally 'teaching' school suffer.

Second, some of the consequences of emphasizing too much on research are that other areas of scholarship become victims to the system. The emphasis on research output can put a strain on our focus on teaching. Dirks (1998) identifies studies that indicated that a majority of scholars feel that the emphasis on research is compromising the quality of their teaching, that they are not awarded for good teaching, and that there is little overlap between their research work and teaching work. As some institutions "the reward system was heavily weighted toward published research, not effective teaching" (Glassick, 2000).

Third, by emphasizing 'research' we are getting further from key activities of the scholar such as teaching and service, and this is perceived as such by the public. "By the end of the 1980s, incentives for faculty work were very heavily focused on research and writing for publication, which the public had come to see as an increasingly serious distortion of the goals it sought for higher education institutions" (Dirks, 1998).

Fourth, these journal publication counts are just that. They are counts of 'hits' and do not address the quality of the works themselves. More than a third of faculty "supported the proposition that at their institutions, publications were 'just counted, not qualitatively measured'" (Glassick, 2000). Journal publication counts are closely tied with journal ranking lists. Each institution adopts some sort of journal ranking list. The 'A', 'B', and 'C' level journals are identified and researchers strive to reach the 'A' level journal. The adoption and ranking of journal lists are wrought with politics where researchers try to place journals congruent with their affiliation to higher position in the journal list, whether they publish in those journals or are on the editorial board of such journal. This leaves researchers like Clyde Holsapple who predominantly publish in management journals in a quandary, where IS journal list do not have their target journals. They must decide whether to continue there IS research or try to conform their research to the journal lists adopted by their institutions. IS researchers continue to publish in non-IS research venues like finance, marketing, and management, and journal lists with IS journals continue to minimize contributions in non-IS journals. The use of bibliometric measures does not discriminate the way journal lists discriminate againsts non traditional IS research.

Therefore the initial step is to identify what scholarship entails. Scholarship can be defined widely. One of the two major problems that Glassick (2000) identifies is the fact that it is hard to pin point "the meaning of 'the

scholarship of teaching'". The next two sub-sections will identify what the literature has said about defining scholarship. Once scholarship has been defined the next problem is trying to measure scholarship for the researcher. The second major problem identified is "the question of *how the quality of scholarship shall be measured*" (Glassick, 2000). Section 2.4 will explore why measuring scholarship is a challenge.

### 7.3.2 Boyer's Four Areas of Scholarship

Boyer identified four areas of scholarship: the scholarship of discovery, the scholarship of integration, the scholarship of application, and the scholarship of teaching (Boyer, 1997). The scholarship of discovery is the traditional notion of research and the creation of knowledge. The scholarship of integration is research that is at the boundary of a discipline and makes a connection with other disciplines. The scholarship of application is where the research is applied to a real life problem. Scholarship of teaching are activities that pertain to pedagogical endeavors (Boyer, 1990).

Others have proposed models similar to the Boyer typology and have worked off of the Boyer four area model. Slanger (1997) offers these four criteria "research that keeps faith with our training, research that makes a contribution to the field, research that serves as a model for students, and, finally, research that is personally and professionally renewing" (Slanger, 1997). Krahenbuhl offers a results oriented model focusing on knowledge transmission, knowledge generation, and knowledge application (Krahenbuhl, 1998). Glassick (2000) identifies "six standards of excellence in scholarship...clear goals, be adequately prepared, use appropriate methods, achieve outstanding results, communicate effectively, and then reflectively critique their work" (Glassick, 2000). A summary of how these different views of scholarship and how they are similar to Boyer's four area model is given in Table 1.

| Criteria/Typology of Scholarship | Boyer (1990) | Slanger (1997) | Krahenbuhl (1998) | Glassick (2000) |
|---|---|---|---|---|
| Traditional Research | Discovery: Traditional research, creation of knowledge | Research that keeps faith with our training | Knowledge generation and knowledge transmission. | Research that use appropriate methods, achieve outstanding results, and communicate effectively. Research that has clear goals, be adequately prepared, and then |
| Boundary/Cross Discipline Research | Integration: Boundary research, cross discipline research | Research that is renewing | | |

| | | | | |
|---|---|---|---|---|
| Research Application | Application: Real world application | Research that contributes to field | Knowledge application | reflectively critique their work |
| Pedagogical | Teaching: Pedagogical endeavors | Research that serves as a model for our students | | Not addressed |

Table 1. Scholarship defined compared to Boyer model

### 7.3.3 Integrating Definitions of Scholarship

Some universities have even adopted and offered definitions of scholarship. For example, at Fort Hays State University (FHSU) in Kansas, scholarly activities is "defined as original, innovative intellectual contributions in the form of research, practice, creative activity, or performance. FHSU recognizes and values the diversity of types of scholarship, including discovery, pedagogy, integration, engagement, and application" (Boyer, 1997).

### 7.3.4 Measurement Challenges

The major problem that Glassick (2000) identifies after the problem of scholarship definition is "the question of *how the quality of scholarship shall be measured*". In the current dissertation the theme has been concerned with after defining 'scholarship', then how to measure this 'scholarship'. The citation measures and social network measures are concerned with this 'measurement' issue. The measurement criteria of scholarship are an important part of the academic process. Tying criteria to a reward and value system is crucial. Due to the lack of a clear or a too narrow of an evaluation criteria, scholars are calling for a clearer set of goals that integrate the institution's mission and tie these criteria to faculty rewards (Dirks, 1998; Glassick, Huber, & Maeroff, 1997). "The measure of one's scholarship is the fundamental criterion for all meaningful rewards in colleges and universities, including retention, advancement, perquisites and recognition" (Dirks, 1998). Dirks (1998) is calling for a more broad definition of scholarship, to include not just research but teaching, service, and the integration with other areas outside of the typical scholarly world. Once 'scholarship' has been defined more broadly, measures and incentives need to be put in place to reward all component elements of scholarship.

The criteria would need an update depending on the definition of 'scholarship'. By using a multi-tiered definition like Boyer has suggested, there is a need for criteria measuring each of the component elements. Dirk says that "Redefinition of scholarship must be combined with changes in incentives, which requires that all the forms of

scholarship in the broader definition be evaluated with parity" (Dirks, 1998), and Boyer tells us that "at my institution, we need better ways, besides publication, to evaluate scholarly performance" (Boyer, 1990).

To recapitulate a more diverse set of citation criteria, defining scholarly influence is needed and wanted by academics. These criteria would help require change in faculty reward structures. "Among other changes, diversity of faculty jobs would create a diversity of rewards for faculty that conflicts with many fundamental collegial values" (Dirks, 1998). A view of 'scholarship' that includes Boyer's (1990) four components Discovery, Integration, Application, and Teaching, can also provide a basis for measuring scholarly influence.

### 7.4 Scholarly Influence Types

## 7.4.1 Ideational and Social influence

If we accept that there are several facets to the notion of scholarship it stands to reason that there are several ways to build scholarly influence. Publishing and being cited is but one way a scholar builds or exercises influence. Scholarly research is a social activity (Latour, 1987) in which scholars influence each other as they meet in conferences, co-author work, review for conferences and journals, comment informally on papers, mentor PhD students and junior colleagues, visit other institutions, present in scholarly colloquia, and so on. Through this social activity surrounding the research process, scholars become aware of other work and papers, discuss this work with others, and form co-authoring relationships. Thus we have hypothesized that social influence may be associated with ideational influence and may even drive the growth of ideational influence. Given this hypothesized importance, it seems logical that in evaluating scholarly influence, we need to refine the concept of social influence, i.e., how scholars influence each other during the research process and identify measures for this construct as well.

In chapters 2, 3, and 5 my co-authors and I explored the relationships between two approaches towards describing a scholar's influence. First, ideational influence – a measure of a scholar's productivity (measured in papers published) and the degree to which others refer to her/his work (citations analysis). Second, social influence – measured as a scholar's position in a network of other scholars. In the most recent papers (chapter 5) we focus on how to assess social influence and examine the relationship between social influence and ideational influence.

#### *7.4.1.1 In the Literature*

Reflexively I have been developing better understanding of and better measure for the construct 'scholarly influence'. But it occurs that much of the debate on how the field and how administrators assess scholarship assumes

the notion of publications in top journals or of scholarly output or scholarly influence is also supposed to be a measure of quality. I disagree with such notions. We do not yet have a theory of scholarly quality. But it may be that this research is a stepping stone toward the development of such a theory. The following sections 4 through 4.5 provides a brief literature review and exploration of selected definitions of quality to better frame what a theory of academic quality must address.

### 7.5 Quality

Commonly 'quality' this has been taken at face value of the ranking of journals for a specific discipline. If a journal was ranked high, then they were considered of 'higher quality' than those ranked below them. Typically a split was made to where the top 3 or 5 journals in the ranking would be considered 'A journals'. The second tier was also identified as 'B journals'. A third tier as 'C journals' and so forth. While this method is a quick and easy way to evaluate a scholar, it lacks any real measure of quality. In the next few sections I will take a look at the general definitions of 'quality', how philosophy has defined 'quality', how 'quality' has been defined in business and will then move on to more of a notion of 'quality' for the current work.

## 7.5.1 Other Definitions of Quality

In the next three sections I examine the domains in which there have been attempts to define 'quality'. These come from philosophy and the business realm. In the past quality has not been operationalized in a quantified fashion. One in the business realm has there been an attempt at quantifying quality. In the business arena there have been strategies that take measurements of the product or the production process to ascertain the level of quality.

In the domain of the business literature 'quality' can be seen from two different lenses. One view is from the producer point of view where the measures are seen from a production process side and the second view is from the consumer point of view where the measures are taken on the end product. The producer or conformance view can be seen as trying to achieve high 'quality' in the manufacturing process in order to make sure that the process minimizes the number of defective final products. Quality from the conformance point of view is therefore targeting the production process and whether the product was produced correctly. Quality assurance, which tries to prevent defects and ISO 9000 that guarantees a minimal standard in the production process are aiming to improve the quality from the conformance point of view. From the consumer point of view, they want the final product to work as expected. The consumer point of view, or the specification quality looks at the final product and tries to determine if

the product is free of defects (Wikimedia, 2010). The methods to achieve high consumption quality and high specification quality are similar and often the same. The differences being the focus of the methods, whether satisfying the customer or focused in taking actions on the manufacturing side. These notions are explored in more detail below.

### 7.5.2 Philosophy of Human Nature

Aristotle defined ten objects of thought one of which he called quality and which he characterized as an attribute of some being (Honderich, 2005), such as a dog having a 'white' coat. Quality identified as 'white' being the color of the dog. Aristotle divided quality into four different types. First was the state of being or condition, such as being hot or cold. The second type was the quality of some virtue, whether in a natural capacity or incapacity, for example being healthy or sick. The third kind of quality was quality of affections such as different tastes. The fourth kind was the shape of things (Barnes, 1984).

In the 18$^{th}$ century Locke introduced two different types of quality. 'Primary quality' was similar to Aristotle's quality structure. For Locke, primary quality was a property of attribute of an object, determined independent of the observer. The fact that a baseball was round is a primary quality and no one would be able to argue that the baseball was a cube shape. According to Locke, the secondary qualities are determined by the observer. The primary quality was the traditional quality that Aristotle had defined centuries ago and was in common use, while the secondary quality brought in interpretation, "It was held further that the idea of a primary quality resembles quality, while the idea of a secondary quality does not" (Honderich, 2005). In Locke's definition there was objective interpretation put into the secondary quality. This provided some differentiation between different observers. An example of Locke's 'quality' would be something like taste. One person may interpret sushi as tasting good, while another might find the taste offensive. In the current dissertation, I am hoping to expand this secondary quality, the quality that is determined by the observer, to IS research. Neither Locke nor Aristotle addressed operationalizing the observational quality, yet in business today, there have been attempts at operationalizing quality. Before operationalizing quality for IS, I need to take a look at how business has taken Locke's secondary quality and operationalized quality for the manufacturing process, merely as consumption quality and specification quality.

### 7.5.3 Business - Consumption Quality

In consumption quality, the manufacturer is concerned with making sure that the final product has reached a certain level of product performance. This is the secondary quality by an observer identified by Locke. The observer may be the final consumer or the manufacturer in the business situation. For consumption quality the observer is the manufacturer, while for specification quality (next section, 4.4) the observer is the consumer. There are several definitions for the final product performance whether the product functions correctly or the product withstands certain conditions. There are also many standards of manufacturing that tries to assure high consumption quality.

An example of function of a product or a product withstanding a certain condition can be demonstrated with a nail. A nail would need to perform a certain function, of holding two pieces of wood together but would also need to withstand some environmental conditions. Functionally the nail would need to be able to be driven through a piece of wood and into another piece of wood. The nail must stay in place and keep the two pieces of wood from moving away from each other. For environmental concerns the nail would need to withstand normal temperatures and conditions. A poor quality nail would be a nail that dissolved when applied with water or melted at 60 degrees Fahrenheit. While high final product quality is the goal of a business, businesses have determined that the final product quality is tied directly to the manufacturing process.

There are manufacturing process-oriented standards that have come into play in business. The manufacturer and auditors of the standards observe these process-oriented specifications. Because there are observers, these standards are addressing Locke's secondary definition of quality. Two examples of this are the International Organization for Standardization (ISO) 9000 standard (ISO, 2010) and the Six Sigma strategy (Motorola, 2010). The ISO is an industry level standard where manufacturers will go through an audit of their practices in order to achieve a 'stamp of approval' from the ISO governing board. The ISO is more concerned with standards in the manufacturing process rather than focusing in on the end product and how it performs or whether it fits a specification (ISO, 2010). The Six Sigma strategy is a set of manufacturing rules that Motorola had developed in order to maximize the output of semiconductors from a single silicon wafer. The more yield that one can get from a single wafer, the less resources will be used, thus allowing maximum output of a product using scarce resources (Motorola, 2010).

Even these standards see quality in slightly different ways. ISO sees quality as a 'degree to which a set of inherent characteristics fulfills requirements" (ISO, 2010), while Six Sigma sees quality as being the number of defective parts per million and the minimization of the defective parts (Motorola, 2010). Neither of these methods are targeting logistically the end product that comes off the line and are saying 'this is a high quality product'. Rather ISO simply certifies that the infrastructure for manufacturing is of a certain standard, and Six Sigma is trying to instill good habits and specific strategies in the manufacturing process to improve yield.

### 7.5.4 Business - Specification Quality

There are manufacturing philosophies and strategies that look at a product from the point of view of the consumer. Total Quality Management (TQM) is a manufacturing philosophy that reverses the look at quality in the production process from the consumption quality point of view. Typically in a manufacturing business one would create a product, make the product the highest quality product they can, then put the product on the market, and see if the consumer will buy the product. TQM starts with the consumer first. TQM first looks at the satisfaction of the consumer of the product, second it goes back one step and tries to improve the quality of the final product, and finally goes back another step and looks to carefully manage the production process. Similarly Total Quality Control (TQC) is a set of measures that looks to identify why sales are decreasing despite improvements to the manufacturing process and the quality of the final product (Wikimedia, 2010). TQC and TQM are both concerned with the specification quality or the quality of the end product.

'Quality' in the end product is defined by several different sources. Drucker (1985) says that "Quality in a product or service is not what the supplier puts in. It is what the customer gets out and is willing to pay for. A product is not quality because it is hard to make and costs a lot of money, as manufacturers typically believe. This is incompetence. Customers pay only for what is of use to them and gives them value. Nothing else constitutes quality." Drucker goes on to explain that businesses used to think that putting effort, time, and money into a product was thought to be of good quality. The vacuum tube radio had thirty years of experience behind it, was bigger, much more expensive, and required skill to build compared to a transistor radio. The transistor radio required low-skilled labor, was cheap to build, cheap in cost to the consumer, and was smaller. The manufacturer of the vacuum tube radio thought they were producing a quality product, yet the consumer thought the transistor radio was of higher quality (P. F. Drucker, 1985). The American Society for Quality (ASQ) says that 'quality' is subjective term "for which each person or sector has its own definition. In technical usage, quality can have two meanings: 1. the

characteristics of a product or service that bear on its ability to satisfy stated or implied needs; 2. a product or service free of deficiencies" (ASQ, 2010).

While specification quality methods may not have tight steps or standards seen in ISO and Six Sigma, they do define what quality is in the end product. I want to use a variance of the quality definitions from Drucker and ASQ to try to define what quality might lie in academic research. A summary of quality, philosophically and how quality is measured in business is given in table 2.

| | Primary Quality | Secondary Quality | Proponents/Users |
|---|---|---|---|
| Aristotle | 1) State of being or condition<br>2) Some virtue<br>3) Affections<br>4) Shape of things | N/A – Aristotle did not define a secondary quality nor did he bring in observation into the definition of quality. | Aristotle |
| Locke | Attribute of an object, determined independent of the observer | Objective observation determined by an observer. | Locke, Businesses today |
| Consumption | Seen as an attribute of the process such as an ISO 9000 approved process or not | Observed by the manufacturer. Process oriented specifications | ISO 9000, Six Sigma Process |
| Specification | Seen as an attribute of the final product, such as the color of an automobile | Observed by the consumer. Final product adaption point of view. | Consumer, TQC, TQM, ASQ, Drucker |

Table 2. Philosophical Quality and Their Uses.

### 7.5.5 Definition of Journal Quality

The preceding sections may help conceptualize a definition of 'journal quality' in the following way. We, as the IS field, are measuring quality through the peer review process. The reviewers are the journal gatekeepers. Peers reviewing is claimed to be keeping the quality of a journal to a certain standard. But I do not find this satisfactory in part because the journal quality has been not been well defined and is used implicitly within the literature (Locke & Lowe, 2002). The h-indices has been suggested as a reasonable surrogate for scholarly quality based on concept of "fitness for use" (ASQ, 2008; P. Drucker, 1985; ISO, 2005). Although I do not believe this to be a sufficiently rich argument I explore the rationale to illustrate some of the challenges in creating a 'theory of quality'. The "fitness for use" tradition looks at the behavior of the customer, and tells us that if the customer finds

the quality good enough, the customer will purchase and use the product. We may apply this to the notion of the journal as the 'product', the customers as other academics or practitioners in the field. And as 'use' being defined as reading of the article or an update of the idea presented in the article. Using the citation as an observable event indicating that the uptake of the idea has occurred. A measure of quality can be operationalized using the citations as a basis measure.

One measure that is indicative of the uptake of an idea is the Hirsch family of bibliometric measures. The Hirsch indices (Egghe, 2006; Hirsch, 2005; Molinari & Molinari, 2008; Sidiropoulos, Katsaros, & Manolopoulos, 2006) are a set of bibliometrics that measure the uptake of an idea by examining the citations of the set of work by an individual researcher. The Hirsch index measures both productivity and impact. The other measures in the set of h-family of measures compensate for such factors as age of the work, unusually large hit works, and quantity of output.

While the Hirsch family of indices are useful, they represent a time stamp measure of a researcher. The Hirsch family of measures are very time dependent, due to the fact that they are dependent on author publications and citations. Both the h-index and g-index can increase as time goes on. The hc-index, which accounts for the amount of time that a publication has been around to gain citations, is the only metric that can actually move either up or down as time goes on. The increase in the Hirsch-family of indices over time is dependent on two measures: citations and publications.

Over time citations to an authors work increases because authors are reading and taking cues from publications, hence new citations to extant works are being made all the time. As citations start to appear in more papers, journals can move up on the h-index list, thus increasing the authors' h-index. With citations one could increase one's h-index even after an author is no longer research active.

The h-index and g-index do not have a time value built into their calculation. This means that the h-index and g-index can only increase over time. Once you achieve a certain level of h or g, you will never go down. The hc-index is different from the other Hirsch family of indices in that is can increase but can also decrease. Since the hc-index strives to give a fair time controlled measure, as a year passes, all the publications on the h-list become a year older, and further, decrease a years worth in the value of the hc-index. Given all things equal, the hc-index will decrease over time. In reality since the hc-index is still dependent on publication and citations, as the authors

publication list grows or citations are realized the hc-index can go up. But when an author no longer publishes and no longer gets citations, the hc-index can only decrease over time. The true selectivity and variability of the h-indices do not constitute a measure of quality because citation counts are not tied directly to the quality of the paper being cited. Using citation measures will only be using citations as a surrogate of the notion of quality. The only other option possible is to read all papers and give a subjective measure of quality of the paper.

While using citation measures as a surrogate for quality is not ideal, the use of citation measures is increasing the number of gatekeepers from using journal publication counts, which uses a handful of reviewers that review an article in a journal. I believe that using citation measures is a step towards observing the IS field as a whole rather than using a journal publication count which relies only on a few reviewers as a surrogate for quality. While citation measures are an improvement on journal publication counts, there are still issues with citations measures. I will discuss those issues next.

### 7.6 Bibliometric Issues

With the extensive use of citation counts and indices as indicators of scholarly influence in this dissertation, I need to address any issues that might arise or have arisen with the methodology of this dissertation. Some of these are issues that might bring the validity of the measures of 'influence' into question while others are opportunities for expanded research.

While the democratic nature of the use of bibliometrics can be seen as a 'leveling of the playing field' this may also be seen as a negative. The contributions of a journal article and conference paper are seen as different levels in IS, the journal article typically being seen as of higher quality. Within conference papers there are differences in contribution between completed research, research in process, research proposals, and panel discussions. 'A' level journals are seen also as being more rigorous in the review/publication process compared to a 'C' level journal. Yet bibliometric measures will count these are being the same contributions given citation counts are equal.

Within the publication, review, and citation process there are several problems that come to light. These are citation gaming, authorship, and affiliation issues.

### 7.6.1 Citation Gaming

Some of the problems associated with citations are researchers that try to game the system, which include (this is not an exhaustive list) self-citations, citation swapping, and small community citations. Other issues that are inherent in citations are the direction of the citations, the nature of the citation whether the citation was positive or negative, the meaning of the citation, and the number of citations and each is discussed in turn.

#### *7.6.1.1 Self Citations*

Self-citations happen when a researcher uses their own previous work in a subsequent research project and cite the previous work. While constant self-citation is frowned upon, researchers frequently have a stream of research, or extend their previous work and requires making self-citations.

One possible gaming strategy to improve one's h-index score is to self cite all previous work. Conceivably a researcher can, without any outside citations, grow their h-index to n/2 where n is the number of papers published. This is done by self-citing all their previous works. So for example if a researcher published 10 papers, the first paper will not have any self-citations. The second paper will cite the first paper. The third paper will cite the first and second paper, and so on until the tenth paper cites all nine previous works. For this example the researcher has an h-index of five by only receiving citations from their own subsequent work.

While this strategy may work for possibly up to five papers, after five papers one would find it difficult the navigate the peer-review process when they have more than five papers cited with the same researcher. Given that any research active author is likely to have and h-index greater than five there is little threat to the metric from self-citation. Moreover, a reviewer would and should identify the abuse of self-citation when they see the same author cited for example seven times. I do not see this strategy as something that we need to address given the doubly blind peer review process.

While this 'gaming' strategy of the system might not be significant, self-citation still poses an interesting bias in the citation analysis game. Controlling for self-citations would be an interesting extension of this research. The PoP tool does not address the self-citation issue so the database being created with this dissertation could allow self-citations to be identified and controlled for when calculating the h-family of indices and the practice can be put under the microscope as comparisons can be made with and without self-citations.

#### 7.6.1.2 Citation Swapping and Small Community of Citations

Citation swapping is another gaming approach that is similar to self-citations. With citation swapping two researchers agree in some form to cite each other in order to artificially increase their citation numbers. A small community of citations is an extension of citation swapping where a small group of researchers agree to cite each other in order to increase each other's citation numbers. While these types of citation swapping or citation groups in the past were hard to find future research of this dissertation will be able to identify these citation groups or citation swapping pairs.

One of the extensions of this research is to extend the social network theory from the co-authorship network to the citation network. Once this is done, cliques will be easier to identify. When the citation swapping pairs or groups are identified, the research can start to control for these citations.

#### 7.6.1.3 Citation Direction – Positive or Negative

One of the problems with using citation analysis is that citations can have a direction whether positive or negative. But then there is great difficulty in teasing out the direction of the citation and interpreting whether it is being positive or negative or neutral. In a positive citation, the citing author is giving kudos to the cited author. The cited work is viewed positively according to the citing author and the citing author is using the cited author's work as an example of something that is contributing to the work by the citing author. The majority of citations seem to fall into this category.

A negative citation is one in which the citing author thinks that the cited author's work is mistaken or is doing something that is wrong. The citing author is using the cited author's work as a negative example and criticizing the cited authors work as being misguided or even outright wrong. When authors use citations in this manner they usually have a small number of citations that they are criticizing, hence the number of citations that fall into this category should be small compared to the positive citations. Also authors do not want to create too many enemies and criticizing a large number of authors can be politically dangerous, so the practice of citing too many authors in a negative fashion are not something that is typically seen. Finally citations are seen as academic capital in the sense that someone that is cited numerous times is seen as being somewhat influential in the field. Giving citations to people you disagree with is not something that is inherent in human nature.

I also believe there is a middle ground where there is no direction to the citation. For example when I give examples of works done in a field to show how prominent something is in other fields, the work is used as an example of how the work is spreading but there is no positive or negative notion to this citation. In the current dissertation when I cited Raan (2006) as a research study that used the h-index in the field of chemistry, I was not saying whether the study of positive or negative, rather just citing Raan for conducting a study, hence a neutral citation. If citations were categorized in this manner the majority of citations should fall into this neutral category.

One major problem of categorizing citations as being positive or negative is that the nature of the citation needs to be understood. In order to understand the citation, one must read the research and understand the citation. The time required to do this is enormous and would require the reading and understanding of all papers in a field, which is humanly impossible. The one promising option is to use some sort of context analysis tool, that can tease out the meaning of each citation and categorize them. The problem with this method is first the interpretation by these programs is still not satisfactory. The other problem is that negative citations are often made in a very subtle fashion. Because of the abrasive nature of criticizing another researcher these criticisms are typically toned down. For example, a citing author may be required by their co-authors, reviewers, and editors to make the criticism subtler. One way to do this is to claim they are 'enhancing' the previous study. It may take an evaluation of their model or equation to understand that the two authors (the cited and citing) are in complete disagreement. Due to the required analysis to even figure out that the citing authors disagree with the cited authors, there is a subjective nature to interpreting negative citations. At this point context analysis tools would not be able to do this type of categorization.

#### *7.6.1.4 Number of Citations – Relative Strength of a Citation*

Citations can have different selective importance to any given paper. That is a significant work may be cited many times, but will appear only one time in the bibliography. Just looking at the citation/bibliography list does not see strengths of citations via number of times cited. In the same paper author A may be cited many times while author B is only cited once, yet the two authors will only appear once in the bibliography and more importantly receive only one equal citation according to the citation analysis tools. Minimal work has been done on counting the strength of the citations. The strength of a citation can be calculated by the number of times that a citation occurs in the citing text. For example the current dissertation is heavily dependent on the h-index, and owes and gives Hirsch (2005) many citations. The strength of the Hirsch citations can be calculated by counting the

number of times that the citation occurs. This would be simple to do using the 'search' capabilities of a computer program. The program would be able to count and tally up the citations for each author that appears in the reference list. While this capability is currently available I am not aware of any tools that does this type of citation counting. This line of research would be possible as a future research study.

### 7.6.2 Authorship Issues

Author order is an issue that is frequently brought up with authorship analysis. What is signified by order of authorship? Is the order made by convention as in alphabetical listing, high profile or powerful first, or are there other motivations?

#### *7.6.2.1 Author Order*

Some studies have corrected for author order. Typically in IS the first author is thought to be the most prominent and the one that did the most work on the research paper. As the order of the authorship continues the amount of contribution is thought to depredate. So one interprets that the second author did more work than the fourth author.

Typically studies that look at analyzing authorship fall into two categories. One would account for the order of the author, and the other doesn't. The interpretation of an authorship by the former is that there is a depreciation of contribution as the author number increases. While the latter interprets that there might be an equal amount of contribution and author order may be determined by alphabetical order, by turns over a multi-paper research stream, or by random order. This dissertation takes the latter view when creating the co-author network.

There are two typical strategies to account for multiple authors. One is to interpret the contribution as equal but spread. When this view is taken the contribution is divided by the number of authors. So if there was a paper that was written by authors A, B, and C and the authorship order was A-B-C, all three authors would be credited with 1/3 of an authorship. This method believes that a paper has a contribution of one, no matter how many authors are on the paper. So when the co-authorship analysis is done, the total number of authors will equal the number of papers.

A second strategy is to interpret the order as being the strength of contribution. The strength would be depreciated by an inverse quotient of the author number. So with our running example A would get one authorship. Author A has first authorship so the contribution would be 1/1 where the quotient is the author number in this case

first or one. Author B is the second author so the contribution would be ½ where the quotient is the second author or two. Author C would then be given a contribution of 1/3.

Author order is definitely a legitimate issue. Various reviewers have mentioned that counting a solo-contribution the same as a contribution of many is not fair to the researcher that works alone. Future studies will look into the author order issue.

### 7.6.3 Journal Affiliation Issues

There is also the issue of citation and authorship analysis when studying the work of someone on the editorial board. When one gets on the editorial board of a journal or conference, one starts to gain authorships that are tied to editorial articles published in the venue. While these contributions are worthy of being intellectual contributions, the extent of whether they are equal to a traditional research paper has been brought into question. Often time these editorial papers are short and do not require the rigor of a full research paper. In addition these editorial papers also can garner a high number of citations, especially in special issues where many of the papers in the special issue may refer and cite the editors comments.

Typically these editorial papers are identified as 'Editors Comments'. In order to control for these types of contributions, one can use 'search' tools to identify these editorial papers and tag them as such. Once the editorial papers are tagged there can be some control put on these types of contributions. This is also a possible future area of this research.

## 7.7 The Continuing Research Stream

The current dissertation is the start of a research stream that proposes to use the h-family of bibliometric indices and evaluates IS research. The first of these papers "Assessing Scholarly Influence: Using the Hirsch Indices" looked at IS researcher level rankings using the h-family of indices. This paper was first presented at ICIS in 2008 in Paris. The comments from the reviewers and attendees at the ICIS 2008 conference were used to revise this paper to a JAIS publication in June 2009. Chapter two in this disseration is the JAIS publication.

The natural extention of this research was to take the same methodology and evaluate IS journals and create rankings of these journals. The paper is seen in Chapter 3 titled "The Hirsch family of bibliometric Indices as an improved measure of IS Academic journal impact". The preliminary work was presented at AMCIS 2008 in Toronto. Again the feedback was taken and the paper has been in rework and expansion.

Another extension of this work was to expand on the g and hc indices. The g-index took into account the lifetime of the researcher by summing up the contributions that were counted in the h-index. The hc-index took into account the age of the contribution by using a formula to give newer research papers that were garnering citations more impact. The combination of the two indices had not been proposed. The research paper seen in Chapter 4 titled "Time is Money, More Bang for the Buck: An Introduction of the gc-index for Assessing Research" is the paper that proposes the indices that combines the g and hc-indices methods. This paper was presented at the SAIS 2009 conference in Charleston, SC.

The use of the bibliometric citation indices was a newer approach to evaluate IS research. But the problem with any measurement is that it gives a view using only one lens. To give a more complete view of scholarly influence many measurements should be taken into account. One of these other measurements is the social network. One aspect of this is the collaboration network. While informal collaborations are impossible to measure, formal co-authorships that result in publicly available research papers are manifestations of a collaborative research team. Hence the expansion to include the co-authorship network analysis is a natural extension of this dissertation. The paper in Chapter 5 titled "Evaluating Scholarly Influence Through Social Network Analysis: the Next Step in Evaluating Scholarly Influence" was presented in AMCIS 2010 in Peru. The feedback has been taken and the paper is currently in rework and expansion. Currently we have used the same methodology on Heinz K. Klein (HKK). This HKK paper is in the third review for a special issue at EJIS dedicated to Klein's work.

The use of the h-index has potential outside of the bibliometric area. I feel that any medium where there is knowledge contribution and the ability for people to read to give some form of kudos to the contribution can benefit from the use of the h-index. Areas such as knowledge management, bulletin board systems, or online communities can benefit from the use of the h-index. One area that I have applied the h-index is the online community, which resulted in the paper in Chapter 6 titled "All Contributions are Not Created Equal: Measuring User Relevance in Online Communities with Hirsch Indices and Bibliometric Measures". This paper has been written and is currently being submitted to the ECIS 2011 conference.

### 7.8 Reflections From Research

This research had its genesis in the celebration of Heinz K. Klein and his work. Naturally when presenting the work of a scholar we want to know what their 'influence' is, so the work had morphed into trying to show

Klein's influence on the world. While creating this 'influence' of Klein, work seemed to naturally evolve into how I can operationalize what I did for Klein, to other researchers.

Then it seemed an easy transition to try to use the process to measure the 'influence' of researchers that were up for 'promotion and tenure' decisions. While seeing some P&T committees make decisions at my home institution, there were definite problems associated with the current methodologies that rely heavily on journal ranking lists and whether a researcher had published in the journals identified in these lists. The bibliometric measures seem to have worth in measuring an academic's influence and should be added to a composite set of measures to identify an academic's influence.

These P&T committee decisions are subjective and the use of influence measures is an attempt to gain some objectivity in the process. Similarly to the notion of 'quality' which Locke's secondary definition requires an observer, is also wrought with subjectivity. The current research tries to attempt to move towards a theory of quality using the bibliometric tools.

The question of what drives citations whether it be social connectedness or the information contained in the cited research is debated. Some believe that the citation game is a social construct, while others point to the fact that the cited research has to have some valid contribution for it to be cited. White, Wellman, and Nazer (2004) found their results to be inconclusive whether it is who you know or what you know but they say "who you know pays off only if the people you know have something worth knowing".

Finally I realize that this research delves into a highly political area. As Frantz Rowe commented, "Of course the work is controversial. You're messing with people's lives" when commenting on a paper from this research, he identified the fact that I was working in the area of scholarly influence that if published, is a really controversial area. The status quo is the journal rankings; some researchers and companies (Thomson) have gained from this cottage industry and most researchers have built their academic careers on the measures given by journal rankings. I realize that proposing a different way will have its detractors. But a growing number of scholars see the current focus in publication in a selected few journals as the current methodology is flawed and there are better ways to assess a scholars worth. While there should not be one 'silver bullet' measure for measuring scholarly worth, a composite of measures is the better way to go and definitely will be an improvement on the current methodology. As Habermas (1984) stated how influence can have a carte-blanch validity without knowledge or reason to enter the

discourse, the composite measures should be given a look. In the next step the influence should give evidence to the validity, this dissertation work has given evidence of how composite measures should be part of the discourse of measuring a researchers scholarly influence.

### 7.9 Future Work

The future of this research is going to propose a possible explanation of quality and operationalization of a measure of quality. While that goal is further away there are some areas that need to be addressed in the mean time. There are problems with citations and authorship that need to be address. The target measure and SNA can also be expanded. The database and bibliometric/SNA tool needs to be expanded. The expansion of the toolset to knowledge management systems is also a rich area that can be explored.

With citations, while it is an improvement upon journal ranking studies, there exists various problems. Self-citation and citation swapping need to be controlled for. While I believe the technology is not available to control for citation direction, counting citation can be controlled for. Future technological advances may allow us to start to consider taking into account the direction of the citation, whether positive or negative. Author issues such as author order, author contribution level when multiple authors are present, and editor contributions are also areas of future research.

Currently only the researcher and journal level have been evaluated with the h-family of indices and the SNA of the co-author network has only be applied to the researcher level. Other levels of measurement targets exists, some examples are the level of institution, PhD granting institution, country, and groupings by research methodology.

The SNA that was conducted so far only looked at the co-author network. Other networks exist such as the network of researchers at one institution, co-citation, advisor-PhD student, and informal research teams. The one area that needs focus is the co-citation network. There have been some studies done on co-citation networks and the use of a toolset that includes the h-family of metrics can add to this area of research.

International comparisons are also in the works for the study. The use of datasets that target North American Journals as opposed to other areas such as Europe, Asian, and African can also be used as groups of comparison. Currently a study that looks at North America vs. French journals is in early stages. The differences in the citation behavior and practices between different geographical areas will be interesting to see. Authorship

differences that exist between countries will need to be closely monitored for these studies. For example, in Germany the practice of having long contribution lists is common while in Scandinavian countries the author list is typically put in alphabetical order.

The creation of the database of IS research papers is on the way with over 17,000 authors and 18,000 research papers identified. I envision a web-tool that will be able to provide an IS researcher with the ability to look up the bibliometric and SNA measures described in this dissertation. The database is one of three components of this tool. The other two are the user interface and the data analysis portion.

With the creation of the database we hoped to be able to provide a tool similar to the PoP tool but uses a different dataset. One of the major problems and huge time sink in using the PoP tool has been the need to clean the data once the PoP tool has retrieved the publication list. Many authors share name subsets and there are many wrong or repeated data on Google Scholar (GS). So in collecting data, the majority of time was spent on cleansing the PoP output. The database is pulling data from many bibliometric sources including GS. The data then goes through a data cleansing process, which includes both a program and manual inspection and alteration. This has allowed the creation of a fairly clean database for IS scholars. The tool will use this database as the source of data, which alleviates the need to connect to GS and run a script program on the GS database. The natural advantage with this method is that a query will reveal a fairly robust and clean dataset. The disadvantage is that currently the database is only trying to create an IS researcher database, so the tool will not be universal like PoP.

Work on the interface has already started with a C# program being created for user interface. Two of the capabilities of the system that is new to this type of tool are the addition the SNA measures and the ability to set your data analysis source set. The database includes co-authorship information. By using this information, creating the co-authorship network and making the centrality calculations are now possible. So the tool will be able to return measures of both ideational influence and social influence.

Another set of data that is being updated on the database is the authors' affiliation and PhD granting institution of the authors. Given this data, it will be possible to run data on not just the researchers, but the publication venue (journal or conference), institutions level, or PhD granting institution level.

There has been a movement to create program that can mine the data in this database and be able to calculate the bibliometric measures as well as the SNA measures.

Finally the movement to use the toolset to knowledge management systems has begun with the use of the h-index on an online community. Knowledge management is a vast area of past IS research and the contribution to this area of research to identify key contributors to the knowledge management system is an undertaking that can benefit both academia and industry.

### 7.10 Conclusion

The whole of this dissertation has been discussing the controversial yet relevant idea of "scholarly Influence." The seeds of this research began with my initial research primarily focusing on the work of Heinz K. Klein. My work with Klein eventually led to the creation of a social co-authorship network. Through that work, I was able to question why scholarly influence was so important in the fields of academia, specifically focusing on IS, and how that influence was measured. By asking these two key questions, this dissertation was born.

In this work, I have identified two main areas of scholarly influence: ideational influence or the publication of ideas and the uptake or influence of said ideas. In this dissertation my research has focused on the ideational influence of ideas through the use of bibliometric measures, though I by no means discard the value of social influence. I am simply reserving that study for future research.

This dissertation used bibliometric measures, specifically citation analysis tools in the form of the Hirsch metric. The use of citation analysis measures allowed me to use a methodology that relied on the uptake of ideas rather than the subjective notion of journal rankings. This also allowed me to operationalize the data collection, data analysis, and measure calculation in a systematic manner. This allowed the use of databases and IS tools that were publically available, allowing transparency and replicability of my dissertation.

While my work has focused in on the ideational influence through the use of bibliometric measures, the social influence is a large area of future research. With the understanding of 'influence' the current dissertation has looked at the possibility to move towards a theory of 'scholarly quality'. While the 'theory of quality' is in no means close to being possible, the current P&T committee's are using journal-ranking studies as a surrogate to measure a researcher's quality. I feel that the use of citation analysis measures are a more true measure of the uptake of ideas by the field as a whole and would be a better measure of 'quality'.

The use of the ideational and social influence methods can also be expanded to other areas in IS research. The most obvious area of research would be the knowledge management area. But any area that has a system that

includes contributions by the users and some way to measure uptake by the population of the system would be an area that can benefit from ideation and social influence methods described in this dissertation. The current research has started to look into this area with the use of the ideational influence tools on an online college sports fan community.

While working on the ideational influence area of this dissertation, there was an obvious need to try to streamline the data collection process. The output of this need was to build a database of our own leading to an important artifact of this dissertation. The database of IS research now houses more than 17,000 IS researchers and 18,000 IS research papers. This database is the first part to a three-part tool. The other parts are the user interface and the data analysis engine of the tool. The tool will allow us to measure ideational and social influence of an IS researcher quickly and more accurately for our future research.

While I realize the text of this dissertation is an improvement of how 'influence' and 'quality' are measured today, this is by no means a replacement of the current methodologies of using journal-ranking lists. Any single tool that tries to measure 'influence' or 'quality' will be rendered inadequate compared to a set of measures. The current system of assessing 'influence' or 'quality' of an academic provides a limited view at best. By using multiple tools such as the one proposed here a more accurate view of a scholars 'influence' or 'quality' can be assessed. I argue that a basket of measures need to be adopted to fully understand 'influence' and 'quality'. I understand that the current research is merely a stepping-stone to a basket set of measures that will allow us to see the whole of a researcher's scholarly contribution. I propose these measures as a subset of measures that should be used simultaneously and hope that future research will continue to improve upon the basket of measures used to assess scholarly influence.

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