AMCIS 2022 Proceedings

SIG SI - Social Inclusion and Socio-Technical Issues

Aug 10th, 12:00 AM

Authorship, Collaboration, and Influence of Women IS Scholars: Using Social Network Analysis

Shimi Zhou
Worcester Polytechnic Institute, szhou7@wpi.edu

Eleanor Loiacono
William & Mary, eloiacono@wm.edu

Sridhar Nerur
University of Texas at Arlington, snerur@uta.edu

Adriane B. Randolph
Kennesaw State University, arandol3@kennesaw.edu

Elizabeth Lingo
Worcester Polytechnic Institute, ellingo@wpi.edu

See next page for additional authors

Follow this and additional works at: https://aisel.aisnet.org/amcis2022

Presenter Information

Shimi Zhou, Eleanor Loiacono, Sridhar Nerur, Adriane B. Randolph, Elizabeth Lingo, Lakshmi Iyer, and Michelle Carter

Authorship, Collaboration, and Influence of Women IS Scholars: Using Social Network Analysis

Emergent Research Forum (ERF)

Shimi Zhou
Worcester Polytechnic Institute
szhou7@wpi.edu

Eleanor T. Loiacono
College of William & Mary
eleanor.loiacono@mason.wm.edu

Sridhar Nerur
University of Texas at Arlington
snerur@exchange.uta.edu

Adriane B. Randolph
Kennesaw State University
arandol3@kennesaw.edu

Elizabeth Long Lingo
Worcester Polytechnic Institute
ellingo@wpi.edu

Lakshmi S. Iyer
Appalachian State University
iyerls@appstate.edu

Michelle Carter
Washington State University
michelle.carter@wsu.edu

Abstract

Research productivity is a critical component of any academic's career progression. Thus, when trying to understand the underrepresentation issues surrounding women in the information systems (IS) field, research networks are a reasonable starting point. This study aims to understand the trends and patterns of IS women academics' citation networks that impact their productivity and promotability. Social network analysis (SNA) techniques that analyze bibliographic data extracted from the IS senior scholar's basket of eight journals between 1990 and 2021 are employed. In addition to this comprehensive article search, author attributes such as gender, affiliation, Ph.D. granting institution, and ethnicity, will be collected. Using these network member attributes, we will analyze the extent of homophily and its influence on forming co-author ties in IS. SNA will help us understand the complexity and potential impacts of authorship and collaboration networks in a diverse and inclusive IS community.

Keywords

Women in IS Academia, Gender, Advancement, Authorship, Collaboration, Social Network Analysis

Introduction

Women faculty remain underrepresented within academia, constituting only 29.3% of the total number of academics in the world in 2016 (UNESCO 2019). In the information systems (IS) area, women scholars are still a significant minority in the U.S., constituting under 30% of the total number of IS academics (Gallivan and Ahuja 2015). The current ratio of women to men academics in the Association for Information Systems (AIS) is very low, and the Senior Scholars' Basket of Journals have a disproportionate number of men (74%) and women (only 26%) on their boards (Beath et al. 2021). Moreover, the lack of citations prevents research by women IS researchers from becoming mainstream (Gorbacheva 2013), which consequently persuades some IS authors to publish their research in more "gender-friendly" non-IS journals (Adam 2002). The lockdown engendered by the pandemic has resulted in a dramatic decrease in the number of submissions.

The number of female first authors during the early lockdown period is 43% lower than the same months of the previous year (Van Osch et al. 2020).

To draw attention to the scholarship of IS women, we need to study how women contribute to and influence IS research (Loiacono et al. 2016). A longitudinal analysis of the citation and co-authorship networks of IS scholars would give us insight into how the scholarship of women in IS has evolved over time. Specifically, social network analysis (SNA) could be used to derive network properties that will allow us to infer a) prominence of women and b) homophilous factors that drive co-authorship, particularly among women scholars. Such an analysis would be invaluable in understanding gender-specific interactions over time as well as in discerning constraints that might impede scholarship of IS women researchers. This, in turn, would enable policymakers to institute interventions, such as provisioning resources, to facilitate both greater participation of and high-impact research by women (Molontay and Nagy 2021).

Methodology

In this study, we used SNA to perform an analysis of the network of citations among IS scholars in the period 1990 to 2021. Citation networks essentially capture the interchange of knowledge among scholars and thus allow us to assess the importance of authors and their positions and roles in the network. Therefore, the citation network obtained from papers published in the Senior Scholars' Basket of Eight Journals will allow us to evaluate scholarly influence in general (Lowry et al. 2013) and the contribution of women to IS scholarship in particular. In order to get a sense of how scholarship changes over time, we split our data into three time periods, namely, 1990-2000, 2001-2010, and 2011-2021. For each of these time periods, we identified the 50 most influential authors based on in-degree centrality, a measure of the number of authors citing a particular author. Authors with high in-degree centrality are generally accorded more importance. Details of our data and analysis are provided in the next section.

Social Network Analysis (SNA)

SNA, which has its roots in sociology, is a technique that is widely used to analyze patterns and underlying social structures of relationships and interactions between social actors (Biehl et al. 2003; Wasserman and Faust 1994). SNA has become a popular technique to study paper citations and authorship networks in recent years. It provides an understanding of various dynamics of collaboration among researchers and emerging trends within disciplines (Emrouznejad and Marra 2017). A network consists of nodes (authors in our case) and their connections. The connections may be based on citations between the nodes or co-authorship. SNA can be used to analyze such networks to elucidate the interactions among scholars, the dynamics of group formation, and the exchange of resources among the nodes (Haythornthwaite 1996).

Data sources and retrieval

Publication articles have been collected from structured bibliographic databases, to allow systematic cleaning and standardization of data. These databases will be collected based on the following standards:

(1) Include a large number of academic journals and have high representation of IS journals.
(2) Provide bibliographic information on gender, affiliation, Ph.D. institution, regions, ethnicity of the authors, allowing the construction of authors, organizational and regional networks.
(3) Provide the full name of the authors in publications.

Initially, all articles published in the IS senior scholar's basket of eight journals between the years 1990 and 2021 have been retrieved. The articles have been collected from the Web of Science and grouped into three sub-periods according to the time period when they were published. After retrieving the publications from the Web of Science, the bibliographic information of authors will be gathered from two data sources, online search databases and self-reported data. Online search databases such as Google Scholar, Scopus, and institution websites are our main online resources. Self-reported data are authors' CVs, surveys and interviews. We searched authors' bibliographic information such as full names, gender, affiliation, Ph.D. granting institution, ethnicity, etc. basically from these data sources.

Preliminary Data Analysis and Results

This section discusses the analysis and results of our exploratory study. For each time period in our study, we examined the entire network of citations among authors and picked the top 50 authors based on their

in-degree centrality, which is explained in the next section. The network properties were obtained using NetworkX, a tool in Python for SNA. For each author, we also gathered their gender information from online resources and/or their self-reported data. As Table 1 shows, the number of women and men scholars among the leading 50 authors across three periods is significantly disproportionate and has very little change over the three time periods. Moreover, among these leading women scholars, three authors M. Lynne Markus, Wanda Orlikowski, and Sirkka Jarvenpaa are dominantly influential across the three periods.

Time Period	Women	Men
1990-2000	6	44
2001-2010	8	42
2011-2021	9	41

**Table 1. The Number of Women and Men
Scholars in Three Periods**

In Table 2, we list the top three influential authors for each period along with five related measures of each author. These five measures are indegree, normalized indegree and outdegree, PageRank, and authorities. The unnormalized Indegree shows the number of authors citing a particular author.

Author	Gender	Indegree	Normalized Indegree	Normalized Outdegree	Page Rank	Authorities
1990-2000						
Peter G. W. Keen	Man	302	0.2141844	0.004255319	0.01082671	0.01456503
Blake Ives	Man	277	0.1964539	0.026950355	0.01191725	0.01395786
M. Lynne Markus	Woman	267	0.1893617	0.046808511	0.01077286	0.01336806
2001-2010						
Wanda Orlikowski	Woman	729	0.27676538	0.017463933	0.00881481	0.00897228
M. Lynne Markus	Woman	620	0.23538345	0.036066819	0.0076502	0.00812226
Fred D. Davis	Man	544	0.20652999	0.027714503	0.00767832	0.00723647
2011-2021						
Wanda Orlikowski	Woman	1052	0.28181088	0.011786767	0.00569649	0.0044384
Viswanath Venkatesh	Man	989	0.26493437	0.160192874	0.00446387	0.00494838
M. Lynne Markus	Woman	858	0.22984195	0.026252344	0.0044771	0.00409664

Table 2. Top 3 Influential Authors

Degree, indegree and outdegree centrality

In this study, we used centrality measures as the main predictors of reputation, scholarly influence, and productivity of scholars from the IS Basket of Eight Journals. Degree centrality is generally considered the

most intuitive form of centrality. It is seen as a measure for an actor's level of involvement or activity in the network (Prell 2012). Indegree centrality is the number of ties received by an actor from others, and outdegree centrality is the number of ties given by that actor to others. In the citation network, indegree centrality refers to citations that the author received from other authors and is suggestive of prestige or popularity. An author who cites a number of other scholars would have a high outdegree, which may be construed as the breadth of knowledge that one borrows. As discussed earlier, we selected the top 50 authors according to their indegree centrality. In the 1990-2000 period, the author Peter G. W. Keen is the most influential, while Wanda Orlikowski and M. Lynne Markus are the top 2 influential IS scholars in the subsequent period. In the 2010-2021's period, Wanda Orlikowski and Viswanath Venkatesh are the top 2 influential IS scholars.

PageRank

The importance of authors in a citation network may be assessed using a measure called PageRank, an algorithm that was pioneered by Google for ranking web pages returned by its search engine (Page et al. 1999). The PageRank algorithm calculates an importance score or "weight" for a node (i.e., author) based on both the number of authors citing the node and the importance of those authors (Krapivin et al. 2009). In the context of our study, authors with high PageRank are considered to be authorities, as they have a relatively large number of links to those who themselves have high PageRank. As can be seen, authors with high in-degree tend to have high PageRank as well.

Authorities

Authority is originally from a ranking algorithm called the Hypertext Induced Topic Selection (HITS), which refers to a valuable and informative webpage being pointed to by a large number of hyperlinks (Kleinberg 1999). In our study, articles that provide links to seminal works are useful knowledge resources and are referred to as hubs. For example, good review papers are likely to be prominent hubs. In the context of citation networks, such hubs which cite many original ("authoritative") papers tend to have large outdegree centrality. An authority is a seminal paper that is cited by many hubs, and therefore has a large indegree (Ding et al. 2004). In 1990-2000's period, the author Peter G. W. Keen has the highest authority and indegree scores, but for the subsequent periods, Wanda Orlikowski and Viswanath Venkatesh have the highest authority score.

Conclusion

This study aimed to provide insight into the participation and influence of women in IS scholarship. Although they are underrepresented in the limited sample (i.e., the 50 most influential scholars), women have had considerable influence in shaping the scholarly landscape of IS. Our study found that two of them (namely, Orlikowski and Markus) have been dominant in all three time periods. Once we have all the attributes (e.g., gender, affiliations, PhD granting institution, and country of origin), we will be able to apply our techniques to deepen our understanding of small but growing influence of women in IS scholarship.

Limitation

This research will perform the analysis based on a very large number of publications and authors, so the limitations exist in the process of data collection. Since the cited references only include the names of first authors, non-lead authors' citations are underrepresented. Additionally, in SNA studies, it is critical that the spelling of authors' names are correct. The same author may have different names on records because of abbreviations, omissions, name changes, aliases and spelling errors, while different authors may have the same name (homonyms) (Wang et al. 2012). In our data sets, two authors who share the same last name and their first names starting with the same letter are hard to distinguish, so we also organized the authors' full names to eliminate the ambiguities. Some attributes of authors, such as ethnicity, region of origin, rank, and affiliation transition, are difficult to clarify especially for authors who already have left academia or provide very limited personal information online. Authors identify on a broad spectrum of gender identities, including male, female, non-binary, and more. However, in this research, author gender was categorized as

male or female based on authors' online resources and this information will be estimated in future self-identified surveys. These difficulties and limitations do not affect the contributions of the research in a major way, albeit arising from the data collection process.

Future Research

The researchers are continuing their analyses of authors' attributes for deeper understanding and quantitative analysis of IS authors' networks through comparisons of network growth over time. In future research, the citation network will be further extended to larger networks within IS academia, and co-authorship networks will be developed based on authors' bibliographic data. Individual actor attributes, such as gender, ethnicity, origin of region, and rank will be analyzed for estimating how individual attributes can make meaningful contributions to the complete social network of IS scholars. We will conduct homophily analysis (Gallivan and Ahuja 2015), combined with other analysis approaches, to evaluate the impact of shared attributes on women IS scholars within different cliques and clusters. Beyond this scope, we will also evaluate the co-authorship of supervisors and their authors, which represent unique aspects of IS community. Moreover, the collaboration and promotion patterns will be identified and investigated in future studies.

REFERENCES

Adam, A. 2002. "Exploring the Gender Question in Critical Information Systems," *Journal of Information Technology* (17:2), pp. 59-67.

Beath, C., Chan, Y., Davison, R.M., Dennis, A.R., and Recker, J.C. 2021. "Editorial Board Diversity at the Basket of Eight Journals: A Report to the College of Senior Scholars," *Communications of the Association for Information Systems: CAIS* (48).

Biehl, M., Kim, H., and Wade, M. 2003. "Relations among the Business Management Disciplines: A Citation Analysis Using the Financial Times Journals," *OMEGA: The International Journal of Management Science*.

Ding, C.H., Zha, H., He, X., Husbands, P., and Simon, H.D. 2004. "Link Analysis: Hubs and Authorities on the World Wide Web," *SIAM Review* (46:2), pp. 256-268.

Emrouznejad, A., and Marra, M. 2017. "The State of the Art Development of Ahp (1979–2017): A Literature Review with a Social Network Analysis," *International Journal of Production Research* (55:22), pp. 6653-6675.

Gallivan, M., and Ahuja, M. 2015. "Co-Authorship, Homophily, and Scholarly Influence in Information Systems Research," *Journal of the Association for Information Systems* (16:12), p. 2.

Gorbacheva, E. 2013. "Evolution of the Gender Research Agenda in the Senior Scholars Basket of Journals. A Literature Review,".

Haythornthwaite, C. 1996. "Social Network Analysis: An Approach and Technique for the Study of Information Exchange," *Library & information science research* (18:4), pp. 323-342.

Kleinberg, J.M. 1999. "Authoritative Sources in a Hyperlinked Environment," *Journal of the ACM (JACM)* (46:5), pp. 604-632.

Loiacono, E., Iyer, L.S., Armstrong, D.J., Beekhuyzen, J., and Craig, A. 2016. "Ais Women's Network: Advancing Women in Is Academia," *Communications of the Association for Information Systems* (38:1), p. 38.

Molontay, R., and Nagy, M. 2021. "Twenty Years of Network Science: A Bibliographic and Co-Authorship Network Analysis," in *Big Data and Social Media Analytics*. Springer, pp. 1-24.

Prell, C. 2012. *Social Network Analysis: History, Theory and Methodology*. Sage.

UNESCO. 2019. "Women in Science."

Van Osch, W., Leidner, D.E., and Beath, C.M. 2020. "Does a Societal Lockdown Treat Gender the Same? Submission and Reviewing Patterns at Jais During Spring 2020," *Journal of the Association for Information Systems* (21:6), p. 11.

Wang, D.J., Shi, X., McFarland, D.A., and Leskovec, J. 2012. "Measurement Error in Network Data: A Re-Classification," *Social Networks* (34:4), pp. 396-409.

Wasserman, S., and Faust, K. 1994. "Social Network Analysis: Methods and Applications,".