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In honor of the 75th anniversary of ASIS&T’s founding and the SIG’s materialization from the virtual, SIG/MET has produced a special section on metrics for this issue of the Bulletin with an emphasis on data from our own history. Guest editors Staša Milojević and Cassidy Sugimoto have assembled six outstanding articles that are very informative both about what biblio, web, alt and other kinds of metrics are and about their growing significance in information science (IS) and their role in other disciplines. The authors also discuss the transfer of these ideas and technologies across scholarly boundaries. Cassidy’s interviews with four ASIS&T members who have been distinguished pioneers and scholars in this field conclude the section.

Our feature article also explores an aspect of IS scholarship. Have you looked at a recent program for the Annual Meeting and wondered what the sessions on “metatheoretical snowmen” could possibly be about? Their creator, Jenna Hartel, demystifies them in the feature article “Metatheoretical Snowmen: A Pedagogical Gedankenexperiment in Information Metatheory.” The snowmen are a device to help doctoral students and others more clearly understand the implications of adopting a particular metatheory as the world view for their research, whether bibliometric, constructionist, historical, philosophical or any other of many possibilities and whether in pursuit of a particular research project or as a career-long predilection. In the wake of her discovery, various other metatheoretical creatures, such as flamingos and lions, have also been sighted. Join in the fun at upcoming Annual Meetings and other IS gatherings.
ASIS&T 2012 75TH ANNIVERSARY
Keynote Speaker Named for 75th ASIS&T Annual Meeting

With the 75th anniversary meeting of the American Society for Information Science rapidly approaching, Edward Y. Chang, head of Google Research in China, is packing his bags for a trip to Baltimore as the keynote speaker of the milestone meeting. The 75th ASIS&T Annual Meeting will be October 26-30 in Baltimore, featuring dozens of information science and technology researchers and practitioners from around the world.

Edward Chang has been head of Google Research in China since March 2006. He joined the nation’s leading search firm after an academic career that began after receiving his Ph.D. from Stanford in 1999. He joined the department of electrical and computer engineering at University of California, Santa Barbara, that year and received his tenure in 2003. In 2006, he was promoted to full professor of electrical engineering. His recent research activities are in the areas of distributed data mining and their applications to rich-media data management and social-network collaborative filtering. His team at Google has developed and launched Google Confucius (a Q&A system, VLDB 10) in 68 countries including China, Russia, Thailand, Vietnam, Indonesia, 17 Arabic and 40 Africa nations. Chang also directs Google Mobile 2014 research focused program, which develops novel mobile technologies.

Convening under the theme, Information, Interaction, Innovation: Celebrating the Past, Constructing the Present and Creating the Future, the 2012 ASIS&T Annual Meeting will provide an opportunity to reflect on our past and current research practices, while charting potential pathways for the future. The conference committee, chaired by Shanj L. Chang, National Taiwan University; Crystal Fulton, University College Dublin; and Julia Hersberger, University of North Carolina, is busy preparing the complete program for the meeting. Make your plans now to be a part of the celebration. Check your mailbox for a printed version of the preliminary program, or go online for program updates as they become available.

Balloting Underway for ASIS&T Officers and Directors

As it is every summer, it’s election season for the American Society for Information Science and Technology. Electronic balloting is now underway for the election of a president-elect and two directors-at-large. Voting ends on August 31, 2012, with newly elected officers and directors taking their seats on the Board of Directors at the conclusion of the 75th Annual Meeting of ASIS&T in Baltimore.

Candidates for president elect for 2013 and succession to the presidency in 2014 are Harry Bruce and Dietmar Wolfram. Candidates for two director-at-large seats for three-year terms – 2013-2015 – are Lynn Silipigni Connaway, Sanda Erdelez, June Abbas and Beata Panagopoulos.

Candidates for President-elect

Harry Bruce is a professor and the dean of the Information School of the University of Washington. Before coming to the University of Washington in 1998, Harry was a faculty member in the Department of Information Studies at the University of Technology in Sydney. Harry is a recipient of the ASIS&T Doctoral Dissertation Award. He has served as a member of the JASIST editorial board. His research and scholarship focus on the study of human information behavior. The purpose of this work is to develop a deeper understanding of how people need, seek and use information in
their professional and everyday lives. The new knowledge generated by this research is used to inform the development or enhancement of resources, services and technologies that facilitate information access and use. Harry's research has been funded by the National Science Foundation, the Institute of Museum and Library Services (IMLS), the Washington State Library and the Australian Department of Employment Education and Training.

Dietmar Wolfram is a professor in the School of Information Studies at the University of Wisconsin-Milwaukee, where he also recently served as interim dean. He received his PhD in library and information science, MLIS and bachelor’s degrees from Western University in Canada. He has published widely in the areas of information retrieval and applied informetrics. He currently serves on five editorial boards, including the Journal of Informetrics and Information Research. Dietmar has been a member of ASIS&T since 1988 and has been involved with the society at all levels. He has served as faculty advisor to the UW-Milwaukee student chapter, occupied every officer position of the Wisconsin chapter and served nationally as chair, research symposium organizer and current treasurer. Her contributions to ASIS&T extend to all organizational levels: membership on the program committees and chairing tracks for Annual Meetings, mentoring in the Future ASIS&T Leaders program, regularly reviewing and contributing to JASIST and serving as a faculty co-mentor for the ASIS&T student chapter at MU.

Candidates for Directors-at-large

Lynn Silipigni Connaway, senior research scientist at OCLC Research, has experience in academic, public and school libraries, as well as library and information science education and corporate and non-profit organizations. Prior to joining OCLC Research, she was vice-president of research and library systems at NetLibrary, the director of the Library and Information Services Department at the University of Denver and on the faculty of the library and informational science program at the University of Missouri, Columbia. Connaway received her doctorate in library and information science from the University of Wisconsin-Madison and her MLS from the University of Arizona. She has been a member of ASIS&T since she was a doctoral student and is a member of SIGs/Classification Research; Information Needs, Seeking and Use; and Digital Libraries. She has served on many ASIS&T award and review committees and at regional and national conferences, in addition to serving as co-chair of the 2011 ASIS&T Annual Meeting.

Sanda Erdelez is an associate professor at the School of Information Science & Learning Technologies at University of Missouri (MU). She also serves as associate director for education at MU’s Informatics Institute and is the founder of MU’s Information Experience Laboratory. Her prior academic appointment was at University of Texas at Austin. She holds bachelor and master of law degrees from University of Osijek, Croatia, and as a Fulbright Scholar received a PhD in information transfer from Syracuse University. Her research and teaching focuses on human information behavior and usability evaluation of information systems. She has been actively engaged in SIG/USE as chair, research symposium organizer and current treasurer. Her contributions to ASIS&T extend to all organizational levels: membership on the program committees and chairing tracks for Annual Meetings, mentoring in the Future ASIS&T Leaders program, regularly reviewing and contributing to JASIST and serving as a faculty co-mentor for the ASIS&T student chapter at MU.

June Abbas, associate professor in the School of Library and Information Studies (SLIS) at the University of Oklahoma, Norman campus, obtained her PhD in information science from the University of North Texas in 2001 and taught at the State University of New York in Buffalo before moving to Oklahoma in August 2008. She also held professional positions in public and special libraries. Her research focuses on the development of user-centered digital libraries, institutional repositories and other knowledge organization structures. She conducts research on youth and their use of
technology and the intersection between information behavior, information retrieval and structures for organizing knowledge. She teaches courses related to the organization of information and knowledge resources, cataloging and classification, indexing and abstracting, digital collections and digital information retrieval. She has also served as project manager on eight digital libraries projects and on task forces to develop institutional repositories. Her recently published book, *Structures for Organizing Knowledge: Exploring Taxonomies, Ontologies and Other Schema*, was nominated for ASIS&T Best Information Science Book in 2011.

**Beata Panagopoulos** is assistant director, technical services at the Mildred F. Sawyer Library at Suffolk University in Boston. As part of the management team, she collaborates in the development of library objectives and formulation of policies consistent with them. Previously, she was head of technical services at the Harvard Kennedy School of Government (HKS) library. In 2007 Beata was honored with the Harvard Heroes award for her contributions to the university. Beata has been an active board member of the New England Chapter of ASIS&T since 1994, serving as program chair/chair and membership chair. She serves on the NEASIS&T program committee and conducts the chapter’s annual student travel award competition. In 1998, she won the ASIS&T Chapter Member-of-the-Year award. As chair of SIG/PUB, she organized two panels for ASIS&T Annual Meetings. She has also served on various ASIS&T committees, including nominations and leadership development, and she was elected to two terms as chapter assembly director. She has a B.A. in politics from the University of California, Santa Cruz, M.A. in political science from the University of Massachusetts, Amherst, and M.S. from Simmons GSLIS.

Additional candidate information, including expanded biographical data and position statements, is available at the ASIS&T website: http://asis.org/elections/. All current ASIS&T members are eligible to vote for officers and directors. Links for electronic voting are sent with a special user ID and password (not your normal ASIST ID and password).

**News about ASIS&T Members**

**Tomas A. Lipinski**, currently executive associate dean and professor at Indiana University School of Library and Information Science, will become the new director of the School of Library and Science at Kent State University in January. He will replace associate professor *Don A. Wicks*, who has served as interim director. Lipinski had previously been professor at the School of Information Studies, University of Wisconsin-Milwaukee, where he also was co-director (and founder) of the Center for Information Policy Research (CIPR). In his announcement of the appointment, Stanley T. Wearden, dean of the College of Communication and Information, said, “Dr. Lipinski comes to us with an exceptional record as a scholar and as an administrator. His combination of expertise in library and information science and law will help the college reshape its curriculum in exciting ways.”

**Ryan Shaw**, assistant professor at the University of North Carolina at Chapel Hill’s School of Information and Library Science (SILS), has been awarded a $218,063 Laura Bush 21st Century Librarians Program – Research in Early Careers development grant from the Institute of Museum and Library Services (IMLS) to invent tools for understanding collections of histories through computational text processing techniques. The project, titled “Contours of the Past,” will focus on techniques for identifying individual events and their participants within narrative histories related to the civil rights movement. These events will be used as basic units for building up larger-scale models of narrative structure that can be used to link and compare related histories. The specific histories to be used for this project are 80 scholarly monographs and 350 oral histories.

**News about ASIS&T SIGs**

To celebrate the official launch of ASIS&T SIG/III’s Twitter account (@sig3i), the group conducted a random draw among its Twitter followers. *Isabella Peters* (@Isabella83) from Heinrich-Heine-Universität Duesseldorf in Germany is the winner of a $50 Amazon.com gift card. The SIG undertook the Twitter account to encourage and facilitate international...
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information exchanges among ASIS&T members. The account is managed by a dynamic team of volunteers (http://bit.ly/sig3iTeam) who will work to highlight and promote research done by SIG members and colleagues. The account will also feature news from ASIS&T scholars around the globe as well as job and funding opportunities.

Also from SIG/III are the winners of the 13th International Paper Contest

**First Place Winner:** Muhammad Sajid Mirza and Khalid Mahmood, Pakistan, *Electronic Resources and Services in Pakistani University Libraries: A Survey of Users' Satisfaction.*

**Second Place Winner:** Yahya Ibrahim Harnade, Nigeria, *Authorship Patterns in Engineering Education.*

**Third Place Winner:** Lallaisangzuali, India, *Information Needs and Seeking Behavior of Social Science Post-Graduate Students and Research Scholars of Mizoram University: A Case Study.*

**Fourth Place Winner (1):** Ibrahim Usman Alhaji and Yahya Ibrahim Harnade, Nigeria, *Basic Literature of Diabetes: A Bibliometrics Analysis of Three Countries in Different World Regions.*


The jurors for the 2012 competition included Maqsood Shaheen, chair, Alma Rivera, Fatih Oguz, Xiao Hu and members of the SIG/III Board. The principal authors of all winning papers will be awarded a two-year individual membership to ASIS&T. In addition, the first place winner will be awarded a maximum of $2,000 to attend the 75th ASIS&T Annual Meeting in Baltimore, Maryland, October 26-30, 2012.

**SIG/MET**, the special interest group for the measurement of information production and use announces the following results of its 2012 student paper contest:

**Sharing first place:** *Research Synthesis: Overview of an Intersection with ILS*, by Laura Sheble, and *The Determinants of Research Citation Impact in Nanoscience and Nanotechnology*, by Fereshteh Didegah

**Runner-up paper:** *Visualizing an Information Society: A Network-Based Perspective of Authors and Editors over 30 years in the Context of a Scholarly Journal*, by Christopher Mascaro

All three authors will be awarded cash prizes, will receive one-year memberships to ASIS&T and are invited to present their papers at the SIG/MET workshop to be held on October 26, 2012, preceding this year’s ASIS&T Annual Meeting in Baltimore. The registration fees for the workshop for all three students will be covered by Elsevier.

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In Memoriam

Jerry D. Saye

Jerry D. Saye, former faculty member at the School of Information and Library Science at the University of North Carolina at Chapel Hill, passed away at his home in June of this year. Jerry was an exceptional teacher, recognized by his own school as well as several professional organizations for his classroom excellence. His primary subject areas included cataloging and classification, history of the book, library history and metadata. Jerry authored, *Manheimer and Saye’s Cataloging and Classification*, 5th edition (New York: Marcel Dekker), and from 1997 to 2002, he edited with Evelyn Daniel, the annual *Library and Information Science Education Statistical Report*. He published many papers, articles and reports, and presented broadly primarily on subjects related to cataloging. He was devoted to his teaching, but he was also a devoted leader at SILS. In 1990, he was appointed assistant dean and in 1994, he was promoted to associate dean of the school.

In addition to a stellar academic career, Jerry served as commander in the U.S. Pacific Fleet in the United States Navy. He spent part of his time at the Pearl Harbor Naval Base Library as a library technical assistant. He later rejoined the U.S. Naval Reserves and retired as a Lt. Commander with 27 years of service.

Jerry’s family has requested that memorial contributions be made in his honor to the School of Information and Library Science at UNC at Chapel Hill, the Orange County Rescue Squad or another charity of your choice. You may leave a memory of Jerry Saye at http://sils.unc.edu/remembrance/jerry-saye.
ASIS&T president Diane Sonnenwald traced her career in information science as guest of honor at the special program celebrating the 75th anniversary of ASIS&T at the Libraries in the Digital Age (LIDA) meeting in June in Zadar. Currently head of school and professor in the School of Information and Library Studies, University College Dublin, Ireland, Sonnenwald credited her early employment at Bell Communications Research, specifically experience in long-range strategic planning, technology transfer and programs to support education in minority universities, as influencing her career. (For a PowerPoint slide presentation of Sonnenwald’s talk, please visit this site: http://www.asis.org/Conferences/Sonnenwald-Talk-career-overview-Jul2012.ppt.)

Several other sessions sponsored by the ASIS&T European Chapter were dedicated to ASIS&T and information science in Europe. In ASIS&T in Europe: Past and Future of ASIS&T, a panel of six speakers highlighted the opportunities and difficulties of maintaining a chapter of an American association in Europe. Tefko Saracevic, Rutgers University, New Jersey, provided an historical perspective that emphasized what American information science owed to European documentation pioneers. Speakers specifically mentioned Paul Otlet and Bozo Tezak. Subsequent talks traced the history and evolution of library and information science in Great Britain, Italy, Austria, Germany, Finland, Norway, Denmark, Sweden, Iceland and Croatia. Panel members included Nicholas Belkin, Rutgers University; David Bawden, City University, London; Isto Huvila, Uppsala University Sweden and Åbo Akademi University, Finland; ASIS&T-EC Chair Fidelia Ibeikwe-SanJuan, University of Lyon, France; and Christian Schloegl, University of Graz, Austria.

ASIS&T panel on Information Science in Europe. From left, Isto Huvila, Fidelia Ibeikwe-SanJuan, Nicholas Belkin, David Bawden, Christian Schloegl and Tefko Saracevic.

ASIS&T European Chapter Participates in LIDA Meeting
by Emil Levine
Presented Papers – Information Science in Europe

Presentations included Schloegl’s Information Science in Europe: A Scientometric Analysis; Lyn Robinson and Bawden, both of City University, London, speaking on So Wide and Varied: The British Origins of Information Science; and Elena Corradini, University of Parma, Italy, discussing the Evolution of Information Science in Italy. Franjo Pehar and Tatjana Aparac-Jelušić, LIDA co-chair, both of the University of Zadar, presented the History and Origin of Information Sciences in Croatia: With a Special Emphasis on Growth of Regional and International Activities. Huvila; Preben Hansen, Swedish Institute of Computer Science; Jeppe Nicolaisen, Royal School of Library and Information Science, Denmark; and Nils Pharo, Akershus University College of Applied Sciences presented Library and Information Science in the Nordic Countries: From the Present to the Future.

Chapter Advisor Emil Levine read a motion passed in the chapter meeting citing the lifelong contribution of Michel Menou to ASIS&T in Europe and worldwide.

“ASIS&T-EC – on the 75th anniversary of ASIS&T – recognizes the lifetime devotion and accomplishments and contributions to international information science by Michel Menou. These include creation of the ASIS&T-EC, capacity building and use of agricultural information and training/education of thousands of persons worldwide in various aspects of information science.”

The 158 participants at LIDA 2012 came from 24 countries and included 19 PhD students. LIDA 2014 will be held in Zadar in June, the preliminary topic being eBooks: Effects, and eBooks: Technology. See the LIDA 2012 full program at http://ozk.unizd.hr/lida/ and the proceedings at http://ozk.unizd.hr/proceedings/index.php/lida2012.
Introduction: Metrics & ASIS&T
by Staša Milojević and Cassidy R. Sugimoto, Guest Editors

EDITORS SUMMARY
Bibliometrics takes center stage for this Bulletin, with a review tracing its historical foundation in the mid-19th century through forecasts of its expanding uses in future research. The scope of bibliometrics has grown from generalized statistical bibliography, the quantitative study of patterns and references in written communication, to an increasing range of identified subfields. SIG/MET, the recently established ASIS&T special interest group (SIG), reflects the growing research focus on metrics in information science. This issue explores bibliometrics within and outside the information science field, the webometrics of the links to the ASIS&T website, an altmetric view of JASIST readership and metrics-based visualizations of co-authorship patterns in the field of bibliometrics itself. Interviews with four distinguished ASIS&T members active in bibliometrics consider where metrics research has come from and where it may be headed.

KEYWORDS
bibliometrics
webometrics
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electronic visualization
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research methods

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This 75th anniversary of ASIS&T presents an opportunity to reflect on the field of information science (IS) and one of its main subfields, bibliometrics. Information science examines the processes, phenomena and institutions that bring people, technology and written records together. It is an adaptable and dynamic field, especially in response to technological innovation. Bibliometrics is one of the rare methods and metatheories used in IS that originated within the field. Joining the traditional methods of bibliometrics are scientometrics, informetrics, webometrics and most recently altmetrics to describe quantitative studies that use scientific information, information phenomena, online data and non-traditional scientific data, respectively, to observe the creation, diffusion and interaction of information.

The coining of the term bibliometrics is frequently credited to Pritchard [1], who proposed it in 1969 to replace the rarely used and somewhat ambiguous term statistical bibliography. Pritchard defined bibliometrics as “the application of mathematical and statistical methods to books and other media of communication” (p. 348). In the same year, Fairthorne [2] widened the scope of bibliometrics to include the “quantitative treatment of the properties of recorded discourse and behaviour appertaining to it” (p. 341). Other definitions include the following:

- White and McCain in 1989 [4] define it as “the quantitative study of literatures as they are reflected in bibliographies. Its task ... is to provide evolutionary models of science, technology, and scholarship” (p. 119).
Tague-Sutcliffe defines it in 1992 as “the study of quantitative aspects of the production, dissemination and use of recorded information” (5, p. 1).

In 2002 Borgman and Furner [6] state that “bibliometrics offers the powerful set of methods and measures for studying the structure and process of scholarly communication” (p.4).

Scientometrics, defined as the quantitative studies of science or, as Hess puts it, the “quantitative study of science, communication in science and science policy” [7, p.75] has its roots in the 1950s and 1960s and stems from the work of the historian of science Derek de Solla Price (for example [8, 9]) in parallel to the development of the citation indexes by Eugene Garfield [10, 11]. Informetrics, defined by Egghe [12, p. 1311] as a research area “comprising all-metrics studies related to information science,” came into use as a term in the late 1980s [13]. Almind and Ingwersen consider webometrics to be “the application of informetrics methods to the World Wide Web” [14, p. 404]. Finally, altmetrics “expand our view of what impact looks like, but also of what’s making the impact” [15] by extending our measurements from citations to information from social media such as storage, links, bookmarks and conversations.

Metrics research continues to be important to the ASIS&T community. In recent years, this role was demonstrated by the transformation of a virtual special interest group (SIG) to a recognized SIG. Within the first year, the newly established SIG/MET organized a highly successful workshop that attracted paper and poster presentations from eight countries and nearly 30 participants. SIG/MET also hosted a paper contribution attracting submissions from an international and talented group of metric neophytes demonstrating the continued growth and interest in metric-related research.

This special issue of the Bulletin is a continuation of the activities of SIG/MET. The goals of this special issue are two-fold. First, we want to provide a history of some aspects of IS and ASIS&T using metric approaches. Second, we want to describe the past, present and future of metrics-related research. As will be shown, these goals overlap in many ways.

The issue begins with a bibliometric article by Vincent Larivière, who provides a brief introduction to bibliometrics and demonstrates the method by examining the place of metric-related research within library and information science (LIS) broadly and the ways in which metrics-related research has been received outside of the field.

Mike Thelwall provides an overview of the history, theory and application of webometrics and demonstrates the use of the tools on the ASIS&T website. This overview provides an introduction to a vibrant and emerging area of IS research.

As mentioned, there is a growing interest in examining scholarly metrics that are not commonly associated with publishing and citing. Judit Bar-Ilan demonstrates how altmetrics can be empirically applied by combining bibliometrics (citation analysis) and altmetric (readership counts) metrics to 10 volumes of the Journal of the American Society for Information Science and Technology (JASIST) (2001-2010).

Angela Zoss applies the latest visualization techniques to the co-authorship patterns of a handful of ASIS&T award winners who have shaped the field of bibliometrics and scholarly communication. This provides not only a historical overview for the perspective of these canonical authors, but also serves to highlight the importance of visualization in metric-related research.

In the final article of the special issue, we give voice to the luminary figures visualized by Zoss. Cassidy Sugimoto interviews Christine Borgman, Blaise Cronin, Katherine McCain and Howard White. Their responses provide a rich encapsulation of the past, present and future of metrics-related research.
Resources Mentioned in the Article

Bibliometric methods are at the heart of library and information science (LIS). It is one of the few – if not the only – method that arose from LIS scholars and that uses one of their main objects – documents and their characteristics – as its unit of analysis. First created by librarians in the mid-19th century to manage collections and used by statisticians such as Lotka in the 1920s, bibliometric methods were democratized in the mid-20th century with the founding by Eugene Garfield of the Institute for Scientific Information (ISI) and the creation of its various citation indexes [1]. Bibliometrics can be defined as the quantitative analysis of the characteristics of documents (articles, conference proceedings and so forth) published by researchers. Although it can theoretically be applied to the measurement of any type of literature – novels, newspapers and scientific journals – it is generally used for the measurement of science and technology and thus applied to scientific documents [2]. As a consequence, terms such as scientometrics or informetrics are often used as synonyms. One of the basic premises of bibliometrics is that new knowledge is incorporated in the scientific literature and that we can understand this process by measuring the characteristics of this literature and measuring certain attributes of knowledge production such as its main producers (authors, institutions, countries), research topics (words, journals) and diffusion and integration patterns (citations).

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In a previous paper [3], Larivière, Sugimoto and Cronin used bibliometric methods to study the evolution since 1900 of the organizational structure of LIS, its means for diffusing research, patterns of interdisciplinarity and changing research topics. They showed that, despite a growth in the number of papers published, LIS’s market share of all social science and humanities research decreased. They also analyzed interdisciplinary patterns of LIS and provided evidence that LIS scholars now cite and receive citations from
other fields more than from LIS itself. Along the lines of Cronin and Meho [4], they also show that the “intellectual balance of trade” of LIS with other disciplines has been shifting from negative to positive since the 1990s, when LIS began to receive a growing number of citations from journals in computer science and management. This paper goes one step beyond and studies the place of metric-related research inside the LIS literature, as well as the exportation of this research outside LIS. It provides data on the evolution of the top authors cited in LIS papers and then analyzes the use of five different metric-related terms – bibliometri*, scientometri*, info[r]metri*, web[0]metri* and altmetri* – inside and outside the LIS literature.

The next section provides a short primer on bibliometric methods and their limitations and details the specific methods used for the compilation of the data presented in this paper. It is followed by the presentation and discussion of the results and ends with a few concluding paragraphs.

Bibliometric Data and Methods

Bibliometric data are typically compiled using citation indexes such as Thomson Reuters’ (formerly ISI) Web of Science (WoS) or Elsevier’s Scopus. Google Scholar is also increasingly used for compiling bibliometric data at the level of individual researchers, although its use for macro-level data is much more problematic. WoS indexes the articles published in about 11,500 journals; Scopus indexes articles in approximately 17,500 journals. To be indexed in these citation databases, journals have to fulfill several criteria [5], among which citations received is only one of many – although it has historically been the main criteria in the case of the WoS. Despite differences in terms of coverage, the results obtained in terms of numbers of papers published and citations received are very highly correlated at the level of countries [6]. Although these data sources identify several types of documents, only articles, research notes and review articles are generally used in bibliometric studies, because they represent the main channels of scholarly dissemination [7]. An additional strength of these two databases is that they index the addresses of all authors, which allows analysis of the regionalization of scientific production – what countries, institutions or cities are the most active in a specific area – and the analysis of collaboration patterns.

These databases, however, have several limitations in terms of coverage, and the proportion of published literature that they index varies considerably across the spectrum of disciplines. As a consequence, bibliometric indicators are generally considered to be very reliable for the natural sciences, engineering and health sciences, but much less so for the social sciences and humanities. These differences in coverage reflect the diversity of ways in which scholars in the social sciences and humanities (SSH) disseminate new knowledge, compared to scholars in the natural or medical sciences. Several researchers have emphasized the fundamental differences between the communication practices of researchers in those two domains [8]. This divergence is reflected by greater use of monographs and conference proceedings in SSH as well as a lower use of journal articles [9, 10]. Unfortunately, no database covers these other forms of publication as systematically and comprehensively as WoS or Scopus do for journal articles. Another source of limited coverage is the fact that research subjects in SSH are often more local [8, 11], and, consequently, researchers publish more often in their native language and in journals with more limited distribution [12]. Given that these “local” journals are often not indexed in the WoS or Scopus, the coverage of SSH research from non-English-speaking countries is much weaker than for English-speaking countries.

Data presented in this paper are from WoS, which includes the Century of Science and the Century of Social Science for the period 1900-1944, as well as the Science Citation Index Expanded (SCIE), the Social Sciences Citation Index (SSCI) and the Arts and Humanities Citation Index (AHCI) for the period 1945-2011. This database was preferred over Elsevier’s Scopus because of its better historical coverage of LIS. LIS is defined here as all papers indexed in the database to which the field “information science & library science” was assigned in the classification created by the patent board for the Science and Engineering Indicators Series of the National Science Foundation (NSF). Other field groupings used (medical sciences, natural sciences and other SSH) are also drawn from this classification scheme. For the years 1900-2011, the LIS dataset comprises 160 journals and about 320,000 documents, of which slightly less than a third are research articles. However, the analysis of the place of metrics outside LIS uses the full WoS dataset, which comprises approximately 37 million papers and 820 million references.
Results and Discussion

Table 1 presents by decade the top 10 authors that are the most cited in the LIS literature with those who are mostly known for their contribution to LIS-metrics indicated in bold face. It clearly shows the increase of the importance of metrics within LIS: although no metric-related author made it to the top 10 in the 1950s – an obvious reflection of the fact that ISI had yet to release its first version of the Science Citation Index – Eugene Garfield makes it to the top 10 in the 1960s and 1970s, where he is joined by Derek de Solla Price in the 1980s and then by Blaise Cronin and Christine Borgman in the 1990s. The proportion of metric-related researchers among the top 10 most-cited authors increases to five in the 2000s, with Wolfgang Glänzel and Leo Egghe joining the list, but with Derek de Solla Price leaving it. Peter Ingwersen could also be added to the list, as part of his work dealt with metrics.

Although the 2010s are far from complete, these results suggest that this decade might be a decade of metrics. Indeed, for the years 2010 and 2011, nine of the top 10 most cited researchers are mostly known for their contributions to LIS-related metrics. On the whole, this table clearly shows the increasing importance over the last six decades or so of metrics in the LIS citation landscape. The importance of this area is also reflected by the creation of new journals such as Scientometrics in 1978 and the Journal of Informetrics in 2007.

Figure 1 presents the annual number of papers having a metric-related keyword in its title (panel A) or abstract (panel B). One can easily see a steep increase in the use of bibliometri* since 2003. More specifically, while about 40 papers had bibliometri* in the titles in 2000, this number increased by more than three times to 130 in 2011. The increase of the use of bibliometri* is even steeper in abstracts, which increased from 50 to almost 250 papers over the same period. The two panels also show an increase of the use of scientometri* for the same period, although it is not as steep as that of bibliometri*. Interestingly, the use of bibliometri* and scientometri* in titles (panel A) was quite similar in the mid-1990s, which is likely a reflection of their use in other areas of social sciences.

On the other hand, the term info[r]metri*, which emerged in the late 1970s and early 1980s has been much less used by authors throughout the period and actually has decreased since the mid-2000s. This might be due to a more precise use of words by authors, as info[r]metri* can be considered as more generic than scientometri* or bibliometri*. Although web[o]metrics is on the rise and since 2009 is used almost as often as info[r]metrics in the titles and abstracts of papers, no paper was found having the word altmetri* in its title or its abstract. This lack might be due to the novelty of these types of metrics, as well as to the alternative – and perhaps reflexive – approach of its advocates, who seem to prefer diffusing their papers outside of journals.
Figure 2 provides evidence of the use of the metric-related keywords within LIS and in other disciplines – categorized as other SSH (all SSH excluding LIS), medical sciences and natural sciences. Taking all papers having at least one of the five keywords as the denominator, it presents the distribution of the use of metrics terms in the titles (panel A) or abstracts (panel B) of papers across these four groups of disciplines. For a given year, the sum of percentages obtained in each of the four groups of disciplines will be 100%. Unsurprisingly, at the beginning of the 1970s, almost all papers related to metrics were published in LIS journals. After some fluctuations at the beginning of the period, caused by the small number of papers involved, this proportion slowly decreases from 80% in the mid-1980s to about 40% in 2008 and has been stable since then. This percentage is slightly higher for abstracts, which suggests that a larger proportion of metrics papers published in LIS do not incorporate one of the metric-related terms in their title.

The area outside LIS where metrics is most often used today is medicine. Although medical journals accounted for less than 5% of all metrics papers in the mid-1980s, they represent about a third of all papers having metrics terms in their title in 2008. It is worth noting that this increase might be, at least in part, due to LIS-related scholars publishing in these disciplines, such as Eugene Garfield who has published regularly in medical journals since the 1980s. In any case, this analysis clearly shows an increase in the interest in bibliometric measures from researchers in these disciplines, with many discussions surrounding the impact factor, citation analysis and research evaluation in general. Bibliometric methods are also increasingly discussed in the natural sciences – especially in physics – although to a lesser extent than in medical sciences. In 2011 natural sciences journals accounted for about 10% of all papers on the topic.

Within the disciplines included in other SSH, journals assigned to the field broadly defined as social studies of science (STS) were publishing a large proportion of the papers using bibliometric methods at the beginning of the period. The STS field greatly contributed to the legitimacy of citation analysis in the 1970s and 1980s by providing a framework for studying citations and their functions, as well as performing several analyses on the social stratification of science, cumulative advantage and other structuralist analyses of the scientific community, such as those of the Coles [13], Merton [14] and Zuckerman [15]. During this period, bibliometric methods were considered fundamental to the field. Since the 1990s, however, we have observed a change in the preferred methods of STS scholars, which shifted to ethnomethodology and other qualitative research methods that are more adapted to what is now mostly a case study-based literature. As a consequence, the recent handbook of the discipline – the Third Handbook of Science and Technology Studies – does not discuss bibliometrics at all, nor does it contain a single reference to Derek de Solla Price, the editor of the first Handbook [16]. This decrease in the use of LIS-metrics by STS scholars was compensated by an increase in other areas of SSH, mainly economics and policy studies related to research and innovation as well as research evaluation. Hence, the proportion of other SSH within all bibliometric literature is relatively stable throughout the period and represents about 10-20% of all bibliometric papers.

Conclusion

This short paper provides an historical account of the use of bibliometrics and other related metric research inside and outside of LIS. It provides evidence that metrics are increasingly important in LIS literature, as metric-
related authors occupy a growing proportion of top-cited authors. Concurrent with this increase, a larger proportion of metrics-related research is being published outside of LIS, contributing to a leveling of the balance of trade of LIS vis-à-vis other disciplines. Although this paper did not provide any comparison of the export of LIS-metrics to other contributions made by LIS literature, it seems likely that metrics are indeed one of the main exports of LIS. As a social science with deep professional roots, LIS research focused for most of the 20th century on classification, cataloguing and other practical aspects of the profession [3] that are less likely to be of interest to other disciplines. Similarly, most theories developed by scholars of the field are generally quite LIS-focused (information retrieval, information needs and so forth), so it seems unlikely that these theoretical contributions are the cause of the shifting balance of trade observed in the literature.

It is worth noting that for the last five years analyzed (2007-2011) the majority of bibliometric papers were published outside of LIS, with medical journals publishing almost as many as LIS journals. Given the wide interest in one of the main applications of bibliometrics – research evaluation and monitoring – it can be expected that its importance will continue to increase in the medical and natural sciences. In the social sciences, however, the tendency is less clear. Although research on science and innovation policy is still using bibliometric methods, its future for use in domains such as STS is ambiguous. As Bourdieu [17] argued, dominant agents of a discipline determine the legitimacy of its research objects and methods. And that observation is no truer anywhere than it is in SSH, where the appropriateness of a topic is governed by whether an author can persuade the community of its importance. Although the current dominant agents of STS – such as journal editors – are clearly in favor of other research methods, if not against metrics, it is possible that LIS-based quantitative methods will regain popularity in those disciplines, as editorships are not forever. Scientific revolutions sometimes come full circle.

Resources Mentioned in the Article

Resources Mentioned in the Article, cont.


The information science field of webometrics is “the study of the quantitative aspects of the construction and use of information resources, structures and technologies on the web drawing on bibliometric and informetric approaches” [1] or, more generally, “the study of web-based content with primarily quantitative methods for social science research goals using techniques that are not specific to one field of study”[2]. While the former definition emphasizes the informetric heritage of many bibliometric methods, the latter focuses on the value that webometrics could provide to the wider social sciences, reflecting a shift in webometrics over time from more theoretical studies to more applied studies, though retaining an emphasis on methods development. Webometrics currently provides a range of methods and software for various kinds of quantitative analyses of the web, and, despite initial concerns that web data would always be easily manipulated because they are not quality-controlled, the advocates of webometrics claim that it is useful both for studies of aspects of the web itself, such as hyperlinking among academic websites, and studies of offline phenomena that might be reflected online, such as political attitudes reflected in blogs.

The term webometrics was coined in 1997 by Tomas Almind and Peter Ingwersen in recognition that informetric analyses could be applied to the web [3; see also 4]. The field really took off, however, with the introduction of the Web Impact Factor (WIF) metric to assess the impact of a website or other area of the web based upon the number of hyperlinks pointing to it [5]. WIFs seemed to make sense because more useful or important areas of the web would presumably attract more hyperlinks than average. The logic of this metric was derived from the importance of citations in journal impact factors, but WIFs had the advantage that they could be easily calculated...
using the new advanced search queries introduced by AltaVista, a leading commercial search engine at the time. Webometrics subsequently rose to become a large coherent field within information science, at least from a bibliometric perspective [6, 7], encompassing link analysis, web citation analysis and a range of other web-based quantitative techniques. In addition, webometrics became useful in various applied contexts, such as to construct the world webometrics ranking of universities [8, 9] and for scientometric evaluations or investigations of bodies of research or research areas [10]. This article reviews a few key areas of webometrics and summarizes its contribution to information science research.

**Link Analysis: Impact Measurements and Networks**

Link analysis drove early webometrics research, primarily through a combination of the development of improved methods and applications to a range of different contexts. Two types of studies emerged, link impact analyses and link network analyses. Link impact studies essentially compare the numbers of hyperlinks pointing to each website within a pre-defined set, such as all universities in a country or all departments within a discipline in a country. Links to university websites and, in some cases departmental websites, were found to correlate significantly with measures of research productivity or prestige, giving evidence of the validity of using link impact metrics as research-related indicator [10, 11, 12]. They have been used in this role to provide an indication of the most important organizations or websites within specific groups. In addition, a breakdown of the sources of links used in the calculations has been used to identify the sources of the impact, such as the country and organization types that host most of the links.

Link network research created network diagrams of the links among specified collections of websites in order to identify connectivity patterns. In addition to networks based upon direct links between pairs of sites, co-inlinks have also been used to indicate connections between pairs of sites. A co-inlink to a pair of websites A and B is a third website C that contains a hyperlink to both A and B [4]. This relation is similar to co-citation in bibliometrics and is particularly useful when investigating websites that are similar but do not necessarily hyperlink to each other. Figure 1 is an example of a co-inlink network diagram for ASIS&T. A direct link network diagram would be likely to exclude links between pairs of sites that were similar in some way but were not directly related to each other.

The nodes in the network are the websites most highly linked to from a set of 741 pages reported by Bing as containing a URL citation to “asis.org.”
Lines between websites indicate co-inlinks between them from the 741 pages. All the organizations represented should be in some way related to ASIS&T. Green nodes are general international sites and pink nodes are university sites in the United States.

Two important components of link analysis are the software and methods to extract link data. Researchers were for many years able to gather hyperlink information from commercial search engines like Bing, AltaVista and Yahoo! via their advanced link search commands, but these tools were all eventually withdrawn. Link data can still be obtained by the use of specialist link analysis web crawlers, including free programs like SocSciBot (http://socscibot.wlv.ac.uk) and IssueCrawler (www.issuecrawler.net) as well as a range of other crawlers developed by individual researchers. The IssueCrawler initiative from sociology [13] seems to have been particularly successful at spreading link analysis methods to the wider areas of social sciences and the humanities. Within information science, hyperlink-based network diagrams have been used to investigate the interconnections between large groups of organizations, such as universities in Europe [14, 15] and organizations within a specific knowledge sector [16, 17].

Some link analysis research has focused on the links themselves, investigating why they are created and why some sites or pages attract more links than others. These studies seem to have focused exclusively on links in academic contexts. Content analyses have shown that links between academic websites tend to be created for scholarly or educational reasons [18], a partial similarity with citation analysis. Statistical tests have also been used to see which attributes of the website owners (other than research productivity or production, which was already a known factor) tend to associate with higher inlink counts, for example finding that research group website owner gender is unimportant [19]. A recent quite comprehensive study used the most advanced statistical modeling approach yet on a large dataset to gain significant insights into the factors behind academic website interlinking in Europe. Among the findings were that country, region, domain specialism and level (whether awarding doctoral degrees or not) were the most important factors predicting hyperlinks, while reputation was the key factor for the top universities [20].

From Web Citation Analysis to Altmetrics

The second type of webometrics to become popular was web citation analysis: counting online citations to published academic documents like refereed journal articles. The rationale behind early research was to assess whether the web could replace traditional citation databases to assess the impact of articles in open access online journals [21] and subsequently also for all journals [22]. This early research found that although counts of web citations correlated with citation counts from traditional databases, many of the web citations derived from non-academic sources, such as online library catalogues. As a result, the web appeared to be an inferior source of citation impact evidence for journals or individual journal articles.

This strand of webometric research gave way to more specialized investigations into particular types of web citations to academic publications, such as citations from PowerPoint presentations [23], online syllabi [24] and Google Books [25] on the basis that within these restricted domains, web-based citation counts could reveal different types of impact from the scholarly impact reflected by traditional citation counts. For example, online syllabus citations could reflect the education impact or value of articles. This line of research was subsequently overtaken by the altmetrics initiative, discussed elsewhere in this issue.

A promising but relatively little studied type of webometrics is the analysis of mentions of keywords or phrases – not necessarily citations. This type of analysis was started by an investigation into the context of online mentions of academics [26], but the keyword approach has also been used to map concepts online [27] and interactions between concepts online by tracking co-words in web pages [28].

Theoretical Perspectives and Information-Centered Research

Webometrics has been a methods-centered field, developing methods to gather and analyze data from the web. Perhaps as a result of this focus, the theoretical component of most webometric studies has typically been drawn from citation analysis rather than being created specifically for web data. For example, many early studies assessed whether web citation counts or web link counts correlated with traditional citation counts, drawing upon
Robert Merton’s theoretical discussion of citation norms in science. Hence, such studies assessed to some extent how well web data fitted Merton’s theory. The lack of development of specialist theory for the most developed area of webometrics, link analysis, reflects the web being a far more varied and complex space than academic journal databases, with theory development in the latter being recognized as problematic and controversial [29].

One partial exception to the lack of native theory for webometrics is information-centered research [30], a style of research theorized to be particularly appropriate to webometrics. An information-centered research study focuses on a new information source, such as a type of web data, and attempts to identify the social science research problems that the data is most suited to address rather than using a priori intuitions to match the data with a research problem and then to assess the value of the data for the problem. This theory was used to justify the development of a range of different methods to analyze web data and to match the methods to a variety of social science problem areas.

Web Data Analysis as a Service for the Social Sciences

Webometrics research has expanded from general or academic web analyses to investigations of social websites, often by automatically downloading data from those websites either through a web crawler or through data requests sent through permitted routes (application programming interfaces). For example, exploiting the information-centered research approach, blogs and RSS feeds have been analyzed to detect public fears about science while social network sites have been investigated to detect friendship patterns and language use. Twitter has been analyzed for the sentiment of public reactions to major media events and YouTube for the factors associated with discussions attached to online videos. In all cases, the methods of the research have been webometrics – large scale data gathering and analysis for social science purposes – but the findings of the research have been targeted at disciplines outside information science, such as media studies [31], politics [32, 33, 34] and science communication [35]. Many of the programs used are now publicly available in the free software Webometric Analyst.

Summary

The field of webometrics has now developed a range of different strands of research, from link analysis to social web analysis, and is used in mainstream information science applications such as research evaluation in addition to applications in the wider social sciences. Its outputs are methods-based, including free software and a range of analysis methods.

Perhaps one advantage of webometrics that has been insufficiently exploited within information science education is that webometric software supports the quick gathering of data targeted to a topic of interest – whether defined by a specific set of websites or a set of keywords. This speed is useful for student projects since it allows students to devote more time to data analysis and research design rather than data collection. It also allows projects to be more targeted to student interests, including almost anything that is discussed significantly online. The data quality issues discussed above are even a positive advantage for student projects since they give them scope for an extensive and intelligent discussion of validity issues.

Resources Mentioned in the Article


Resources continued on next page
Resources Mentioned in the Article, cont.


Resources continued on next page
Resources Mentioned in the Article, cont.


JASIST 2001-2010
by Judit Bar-Ilan

EDITOR’S SUMMARY
The Journal of the American Society for Information Science and Technology (JASIST) started in 2001 after being published since 1950 under two other titles. Prior bibliometric analyses of JASIS focused on author and article characteristics and trends and on geographic and keyword distributions. The current study examines article citations from 2001 through 2010, drawing on three major citation databases and readership counts. Of 1,459 articles, 14 were cited at the top of at least one database, and seven were among both the top-cited papers and those with the highest readership counts. The top-cited papers focused on the web, informetrics, link analysis, theory and knowledge management. The most often read were on the web as a topic, theory, link analysis, informetrics and databases. Though not used in this research, alternative metrics such as mention counts in social media, Slideshare, Wikipedia and ReaderMeter can complement traditional citation analysis.

KEYWORDS
citation analysis
information science history
bibliometrics
World Wide Web
link analysis
altmetrics

JASIS, the Journal of the American Society for Information Science, changed its name to JASIST, the Journal of the American Society for Information Science and Technology, beginning in 2001 with volume 52. This was the second time the journal changed its name. It started out as American Documentation in 1950 and changed its name to the Journal of the American Society for Information Science in 1970, starting with volume 21.

In this article we will provide a short bibliometric characterization of the first 10 JASIST volumes – volumes 52 to 61 for the years 2001 to 2010. This characterization includes the list of most highly cited articles published in JASIST as well as citation counts that will be compared to “readership counts” retrieved from Mendeley, an online reference manager (www.mendeley.com).

Bibliometric analyses of JASIS have been conducted before, where the main emphasis was on analyzing different characteristics of authors. In an article published in 1999 Lipetz [1] studied JASIS authorship during the first five decades of JASIS (and American Documentation) by selecting one volume from each decade. His paper appeared in a special issue of JASIS for the 50th anniversary of the journal. Another paper studying the characteristics of JASIS authors between 1970 and 1996 was published by Al-Ghamdi et al. in 1998 [2]. Different trends in the first 50 volumes of JASIS were analyzed by Koehler et al. [3] in a study published in 2000 that included article characteristics such as number and type of references, length of paper and title in addition to author characteristics. More recently, Chua and Yang [4] studied author, co-authorship and keyword distributions for two 10-year periods of JASIST publications.

He and Spink [5] analyzed the geographic distribution of JASIST and
Journal of Documentation authors during a 50-year period, between 1950 and 1999, while Wormell [6] studied geographical distribution of both authors and readers (based on subscriptions) in the mid-1990s, and JASIS was among the analyzed journals.

Only a few studies emphasized citations: Nisonger [7] analyzed the position of JASIS in various LIS journal rankings in 1999 and found that one of the most frequently employed criteria for ranking journals in the field was citation data. Earlier Harter and Hooten [8] carried out a study of nine volumes of JASIS that included citation data as well. In a study published in 1999 Cronin and Shaw [9] analyzed citation rates and uncitedness of four LIS journals, including JASIST, while in a recent work, Sin [10] studied the effects of international co-authorship in six LIS journals on citation counts.

The aim of the current study is to analyze the citations received by JASIST articles published between 2001 and 2010. It is well known that citation counts are dependent on the citation database used for data collection, even if all the data were collected at the same time [11, 12]; thus in this study we collected data from three major citation databases: Thomson-Reuters’ Web of Science (WoS), Elsevier’s Scopus and from Google Scholar (GS).

Citations reflect only one aspect of the use of scholarly articles. Not all the articles we read appear in the reference lists of the works we publish, even though they might be influential. This of course is especially true of readers who are not writers, such as students, librarians, information professionals and other people interested in information science. Thus it is of interest to explore the readership of scientific articles. In the past, this exploration can be done by analyzing download statistics [15] or data was gathered through library usage studies, for example [13, 14]), but today this exploration can be done by analyzing download statistics [15] or by consulting reference managers [16, 17, 18]. In this study we collected readership counts from the reference manager Mendeley and compared the readership counts with citation counts retrieved from WoS, Scopus and GS.

Mendeley readership counts are just one example of a set of alternative metrics that can be derived from the web and from Web 2.0 applications [19]. Other examples include citations or mentions of peer-reviewed journal articles on Twitter [20] or in blogs [21, 22]. In addition, mentions in CiteULike, Facebook, Delicious and Wikipedia and views and downloads on Slideshare can also be tracked through the total-impact website (http://total-impact.org). Other tools that allow easy production of altmetric measures include ReaderMeter (http://readermeter.org). Publishers are also interested in alternative measures, for example PLoS reports readership counts for Mendeley and CiteULike for all articles it publishes, besides the download and view counts that are sometimes reported by other publishers as well. One of the reasons for the growing interest in alternative metrics is that they can be calculated almost immediately after publication, thus providing almost immediate feedback on interest in the specific article, whereas citation in a peer-reviewed publication takes much longer.

Eysenbach [20] has shown that the number of early tweets might be able to predict whether an article will be highly cited later on. Correlation with citations is interesting, but the value of alternative metrics is that they provide information on “impact” in different senses that compliment citations. As noted above, reading an article and thinking highly of it does not necessarily mean that the reader will actually cite it in a journal paper.

Data Collection and Analysis

Data were collected from the three citation databases, WoS, Scopus and GS, in April 2012. In WoS, articles, reviews and proceedings papers were selected (editorials, book reviews, letters, biographical items and bibliographies were excluded); similarly in Scopus, articles, reviews and conference papers were selected. An extensive search and data cleansing were conducted in GS, using Publish or Perish in order to identify relevant JASIST articles and record their citation counts. This process resulted in the identification of 1459 items: 12 were not indexed by Scopus, and one was not indexed by Google Scholar. For each item the basic bibliographic information and citation counts were recorded.

As noted above, we used the online reference manager Mendeley to collect readership information. For an article, the retrieved information includes the number of readers, that is, the number of system users who bookmarked the specific item and included it in their virtual library.
Figure 1 is a screenshot from Mendeley showing that multiple Mendeley records can be associated with a single item, in which case readership counts are combined. Out of the 1459 items, 1422 (97.5%) were bookmarked on Mendeley. This finding is very meaningful because it is a result of an effort by the crowd or the community and not a centralized process like in the citation databases.

**Results**

Table 1 displays the top cited papers according to WoS, Scopus, and GS. For each citation database we tabulated the top 10 items. Because of the differences in the citation counts among the databases, this process resulted in a total of 14 papers that were top-cited in at least one of the three citation databases. The rankings based on WoS and Scopus are highly similar, while the GS-based ranking differs somewhat. The number of GS citations is consistently higher than the number of citations reported by WoS or Scopus. An interesting outlier is the paper “Twitter power” that accrued 233 citations in GS, but only 18 in WoS. These top-cited papers can be categorized as web-related (5 papers), informetrics (5), link analysis (2), theory (1) and knowledge management (1).

**TABLE 1. Top-cited JASIST articles**

<table>
<thead>
<tr>
<th>Authors</th>
<th>Title</th>
<th>Pub year</th>
<th>WOS cits</th>
<th>WOS Rank</th>
<th>Scopus cits</th>
<th>Scopus Rank</th>
<th>GS cits</th>
<th>GS Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spink, A; Wolfram, D; Jansen, MBJ; Saracevic, T</td>
<td>Searching the Web: The public and their queries</td>
<td>2001</td>
<td>289</td>
<td>1</td>
<td>398</td>
<td>1</td>
<td>778</td>
<td>1</td>
</tr>
<tr>
<td>Jansen, BJ; Pooch, U</td>
<td>A review of web searching studies and a framework for future research</td>
<td>2001</td>
<td>177</td>
<td>2</td>
<td>210</td>
<td>2</td>
<td>338</td>
<td>4</td>
</tr>
<tr>
<td>Meho, LI; Yang, K</td>
<td>Impact of data sources on citation counts and rankings of LIS faculty: Web of Science versus Scopus and Google Scholar</td>
<td>2007</td>
<td>145</td>
<td>3</td>
<td>162</td>
<td>4</td>
<td>230</td>
<td>9</td>
</tr>
<tr>
<td>Ahlgren, P; Jarmeving, B; Rousseau, R</td>
<td>Requirements for a co-citation similarity measure, with special reference to Pearson’s correlation coefficient</td>
<td>2003</td>
<td>119</td>
<td>4</td>
<td>129</td>
<td>7</td>
<td>215</td>
<td>11</td>
</tr>
<tr>
<td>Chen, CM</td>
<td>CiteSpace II: Detecting and visualizing emerging trends and transient patterns in scientific literature</td>
<td>2006</td>
<td>117</td>
<td>5</td>
<td>144</td>
<td>5</td>
<td>343</td>
<td>3</td>
</tr>
<tr>
<td>Cronin, B; Meho, L</td>
<td>Using the h-index to rank influential information scientists</td>
<td>2006</td>
<td>114</td>
<td>6</td>
<td>118</td>
<td>9</td>
<td>179</td>
<td>20</td>
</tr>
<tr>
<td>Rieh, SY</td>
<td>Judgment of information quality and cognitive authority in the web</td>
<td>2002</td>
<td>110</td>
<td>7</td>
<td>144</td>
<td>6</td>
<td>327</td>
<td>5</td>
</tr>
<tr>
<td>Bornmann, L; Daniel, HD</td>
<td>What do we know about the h index?</td>
<td>2007</td>
<td>107</td>
<td>8</td>
<td>123</td>
<td>8</td>
<td>192</td>
<td>13</td>
</tr>
<tr>
<td>Borlund, P</td>
<td>The concept of relevance in IR</td>
<td>2003</td>
<td>98</td>
<td>9</td>
<td>114</td>
<td>11</td>
<td>235</td>
<td>10</td>
</tr>
<tr>
<td>Thelwall, M</td>
<td>Extracting macroscopic information from web links</td>
<td>2001</td>
<td>93</td>
<td>10</td>
<td>99</td>
<td>12</td>
<td>186</td>
<td>15</td>
</tr>
<tr>
<td>Liben-Nowell, D; Kleinberg, J</td>
<td>The link-prediction problem for social networks</td>
<td>2007</td>
<td>73</td>
<td>18</td>
<td>162</td>
<td>3</td>
<td>783</td>
<td>2</td>
</tr>
<tr>
<td>Wathen, CN; Burkell, J</td>
<td>Believe it or not: Factors influencing credibility on the web</td>
<td>2002</td>
<td>86</td>
<td>12</td>
<td>116</td>
<td>10</td>
<td>238</td>
<td>7</td>
</tr>
<tr>
<td>Alavi, M; Tiwana, A</td>
<td>Knowledge integration in virtual teams: The potential role of KMS</td>
<td>2002</td>
<td>68</td>
<td>22</td>
<td>84</td>
<td>19</td>
<td>263</td>
<td>6</td>
</tr>
<tr>
<td>Jansen, BJ; Zhang, MM; Sobel, K; Chowdury, A</td>
<td>Twitter power: Tweets as electronic word of mouth</td>
<td>2009</td>
<td>18</td>
<td>243</td>
<td>88</td>
<td>17</td>
<td>233</td>
<td>8</td>
</tr>
</tbody>
</table>
Table 2 displays the 15 *JASIST* articles with the highest readership counts. Only seven articles appear in both tables. A striking difference between the two lists is in the topics covered. Whereas informetric topics had considerable representation in the citation-based list, except for the paper *CiteSpace II*, there are no other papers in this category on the readership-counts-based list. On the other hand, theory is represented much more strongly in the readership-based list than in the citation-count-based list. The topics of the top-read papers can be categorized as: web-related (7 papers), theory (5), link analysis (1), informetrics (1) and databases (1).

### Conclusion

In this paper we studied the first decade of articles published in *JASIST*—after the journal changed its name from *JASIS* to *JASIST*. Articles were ranked in terms of both the number of citations they received and the number of readers who bookmarked the articles using the online reference manager, Mendeley. Remarkably, almost all of the *JASIST* articles were bookmarked by at least one reader. Although there are significant correlations between the Mendeley readership counts and the citation counts, the correlations are only around 0.5, indicating that reading and citing are two different scientific activities. An additional point is that we do not actually know why users bookmark articles and whether they actually read them. These issues, as well as the reliability of information retrieval from reference managers, should be further explored.
Resources Mentioned in the Article


Seeding a Field: The Growth of Bibliometrics Through Co-authorship Ties
by Angela Zoss

EDITOR’S SUMMARY
A series of bibliometrics-based visualizations illustrate the contributions of five preeminent researchers in information science. With data drawn from the Web of Science, the views reflect a total of 1,993 publications by Christine Borgman, Blaise Cronin, Eugene Garfield, Katherine McCain and Howard White spread across seven time periods between 1955 and 2012. Contributions by the authors rose over time as they became active in the field and collaborated with others. The visualizations reveal the temporary nature of some co-authorship linkages while others were reinforced over time. Trends in the strength of author citations varied. The later time slices show the dynamic connections among the five authors studied, revealing the prominent and influential role played by Garfield and his collaborators through the years.

KEYWORDS
joint authorship
coauthorship
bibliometrics
electronic visualization
time series data

Bibliometrics and related techniques provide an opportunity for researchers to turn their analytical focus inward, using the traces of scholarly communication to validate or challenge internal impressions of the process. The traces available for studying research are rapidly increasing in quantity, coverage and diversity. One of the foundational sources for exploring and describing research, however, is authorship data. This brief look at some of the dominant researchers in the field of bibliometrics uses authorship to explore evolving relationships and publication patterns.

Analyzing authorship patterns gives us a glimpse into the communities that construct scholarship, the complex social environment that contextualizes research and the scientific system more broadly. The following series of visualizations show direct authorship links among five eminent bibliometrics researchers: Christine Borgman, Blaise Cronin, Eugene Garfield, Katherine McCain and Howard White.

The metadata for publications of these five researchers was collected based on author name searches of the Web of Science (WoS). Each researcher’s last name and first initial were used to obtain publication records from WoS. In the case of Howard White, additional subject criteria were added to limit the results to a more manageable number. The results were then examined manually to identify only the publications by the researcher of interest. While the limitations of using a single data source are well documented, and while it is certain that the dataset excludes many monographs, conference proceedings and other publications outside the WoS index, the data obtained nonetheless show considerable overlap in collaboration among the researchers and hint at the broader history of the field.
Figure 1 below shows the number of papers used for the analysis over a period of over 50 years. The 1,993 publications obtained have been divided into seven time slices to examine changes in authorship over time. For consistency, all but the first and last slice cover five-year time intervals. The penultimate time slice covers a small number of papers, but it also represents a period with increasing diversity of authorship.

Table 1 shows the number of publications located for each of the five researchers. Publications were not limited to any particular genre or format and thus include articles, letters, editorial material, etc.

The publications were grouped by zipcode using research/reprint addresses to give a better view of where the research has been produced (Figure 2). The dominance of Philadelphia is not surprising, given that three of the five researchers work there.

The following visualizations tell a story of how the five researchers entered the field of bibliometrics/informetrics research, as well as how their collaborations connected over time. The position of each individual stays constant over each of the seven time slices. The size and color of the nodes and edges was calculated anew for each time slice, however. Instead of showing the
accumulation of citations (size of node), numbers of papers (width of edge) and betweenness centrality (color of node) over the entire 57-year period, the recalculations make it easier to see changes in the collaboration patterns.

Co-authorship patterns that are not renewed fade into the background because of the inclusion of less opaque versions of previous time slices. Nodes are allowed to grow and shrink as the authors produce more- and less-highly cited papers. Though precise values for betweenness centrality are artifacts of the algorithm and difficult to interpret, the color gradation allows us to see changes in brokerage over time in a more relative manner.

The first time slice (Figure 3) covers only publications by Garfield. The number of co-authors over those 20 years is high, but only a few co-authors appear on multiple papers. Several of the papers are extremely well-cited, though it is also expected that older time slices will have more citations because of the extended period of time over which the publication has garnered citations. Because of the nature of egocentric networks, or network datasets that are focused on a single researcher, the researcher of focus will typically dominate in terms of degree, citations and number of publications.

The other nodes are represented by only a small subset of their total publications.

The next five years introduce both Borgman and White to the dataset (Figure 4). Garfield obtains several new collaborators, and the placement of two of them foreshadows their future connections to Borgman and her associates.

In the third time slice (Figure 5), all five researchers have appeared and have co-authored with other researchers. By and large, the connections from the first two slices have faded into the background and have not been reinforced.

In the fourth time slice (Figure 6) there is a burst of activity connecting Borgman to many new researchers as well as to Garfield’s former collaborators. White and McCain have co-authored. Cronin and Garfield have established new connections.
In the fifth time slice (Figure 7), Cronin shows the largest increase in number of collaborators. Everyone has stayed active, but the number of overall publications has started to decline.

Though the number of publications in the sixth time slice is limited (Figure 8), the number of collaborators has increased for Garfield and stayed high for Cronin. Garfield and Cronin now have a shared collaborator, as do Cronin and Borgman.

The final time slice (Figure 9) spans 12 years but only 209 publications. Nonetheless, the connections between the five researchers have crystallized, and almost all are connected by publications within this time period. Though each researcher has experienced periods of varying activity over the full course of the dataset, many of the early collaborators do return in later time slices, and each of the researchers has been able to extend his or her community to new individuals throughout long and productive careers. By the final time slice we also see sharing of brokerage roles and more evenly distributed citations.

This admittedly constrained overview of the overlapping communities of five pre-eminent bibliometrics researchers gives an idea of how the field has evolved over time and how much work has been done by these five researchers to support and be supported by other scholars doing related work. The unity suggested by the aggregated networks speaks to a thriving area of research with active knowledge sharing. The smaller, more interconnected clusters may indicate specialties or invisible colleges, but even five-year times slices show how fluid the researchers are and how eager they are to explore new territory.
Taking the Measure of Metrics: Interviews with Four ASIS&T Members

by Cassidy R. Sugimoto

EDITOR'S SUMMARY

A series of interviews with four ASIS&T members, all outstanding scholars in metric-related research, provides insights into their interests, motivations and views on research in the area. Christine L. Borgman recalls being intrigued as a student when hearing about the history of bibliometrics, and she sees expanding metrics research methods as one of the most significant recent advances in the field. Blaise Cronin speaks of reading, meeting and corresponding with leaders in the field from early in his own career. He is impressed by the rise of journals other than JASIST covering informetrics, reflecting expanding interest in the field. Katherine W. McCain was drawn to the field when she was recognized for a citation analysis and collection assessment carried out while she served as a biology librarian. Among the challenges McCain identifies are more meaningful analysis of huge datasets, research funding and gaining understanding through the different perspectives of boundary spanners. Howard White recalls how a friendly conversation led to special access to a proprietary data gathering tool, resulting in the first author co-citation map and his co-authoring a highly acclaimed article. He notes significant advances in the mathematical foundations of bibliometrics and a rise in importance of bibliometrics for assessing national research programs. All four researchers are pleased to see the rise of altmetrics and data visualization capabilities, though they share concerns about the validity and reliability of metrics-based research and trustworthiness of platforms and data sets.

KEYWORDS

interviews informetrics co-citation analysis
scholars research methods cross disciplinary fertilization
career development data analysis

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METRICS & ASIS&T

Metric-related research (for instance, bibliometric, scientometric and informetric) has played a prominent part in ASIS&T meetings and products. Research in this area is presented at the Annual Meeting, has appeared in numerous Annual Review of Information Science and Technology (ARIST) review chapters and is regularly seen in the pages of the Journal of the American Society for Information Science and Technology (JASIST) and other ASIS&T publications. Many active ASIS&T members are also highly lauded scholars in this area. In this article, we ask four such individuals to provide narratives of their introduction to the area and their assessment of the landscape for current and future research and to reflect upon the role of ASIS&T in the past, present and future of metrics-related research.

Christine L. Borgman

Presidential Chair and professor of information studies
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What is your earliest memory of metrics-related research at ASIS&T or in JASIST? Were there any particular articles, presentations or lectures that made a distinct impression upon you? What was memorable about these?

My memories of metrics-related research at ASIS&T/JASIST go back to my earliest student days. One memorable moment was the Research Award speech by Henry Small, who built the metrics capacity of ISI and who published extensively from those data. Henry is a bibliometrician and an historian of science extraordinaire. His acceptance speech was a rich and lively tour of how we got to where we were.
What do you think are the most significant advances that have been made in metrics-related research in the last 25 years? Five years? Last year?

The most significant advances are twofold: (1) altmetrics, generally anything not based on references and citations per se, and (2) research methods.

The MESUR project of Johan Bollen, Herbert van de Sompel and Marco Rodriguez moved the field along by mining a vast corpus of metrics and comparing them. The webometrics work first begun independently by Peter Ingwersen, Denmark, and Alastair Smith, New Zealand, was extended greatly by Mike Thelwall, United Kingdom, and his colleagues. Together, they applied known metrics to even messier data from web sources and then extended those metrics.

What do you think are the most pressing current challenges and opportunities in metrics-related research? How might ASIS&T be positioned to address these challenges and opportunities?

The most pressing challenges are methodological. We are flooded with data that can be used for information metrics, but identifying the origins of those data, their provenance and their context can be impossible. Research results are only as good as the evidence on which they are based and on the quality of the methods used to make inferences. Data, we've got. We're in a crisis of confidence in data.

What do you anticipate for the future of metrics-related research? What role do you envision the ASIS&T community playing in this future?

I anticipate more data, more players and not necessarily better evidence. The ability to standardize scholarly units such as authors through ORCID, funders through FundRef and similar developments may lead to cleaner data and more trustworthy results.

ASIS&T can play a role in promoting expertise in research methods and as a platform for publication and presentation of quality results – and critiques of the questionable results that plague us.

What is your earliest memory of metrics-related research at ASIS&T or in JASIS(T)? Were there any particular articles, presentations or lectures that made a distinct impression upon you? What was memorable about these?

My interest in metrics dates from the late 1970s, quite some years before I came to the United States or became involved with ASIS&T. Back then I was an avid reader of JASIS (and its precursor American Documentation) as well as ARIST, so I was not unaware of the early contributions to research in citation analysis being made by people such as Henry Small, then at ISI in Philadelphia, and the brothers Stephen and Jonathan Cole at Columbia University. Henry continues to be one of the most innovative scholars working in the field today and, along with Howard White and Kate McCain, one of the most elegant authors on the subject of metrics.

In the early 80s, while working at the Aslib Research & Development Department in London, I had the pleasure of meeting both the late Belver Griffith, a delightful polymath, and Eugene Garfield (a future president of ASIS&T). Belver stopped by my office, and from there we repaired to a local hostelry for a most congenial lunch discussing his work on scholarly communication. Around about the same time I happened to spot Gene in the Reading Room of the British Museum, went up to him and introduced myself. I had read his book Citation Indexing as well as his Essays of an Information Scientist and was thrilled to meet the man who launched the Science Citation Index and so much more. He said he’d just been reading my little book, The Citation Process, while taking a cruise up the Thames. I was well chuffed, to use a Britishism.

Two others who fueled my interest in metrics were the historian of science Derek de Solla Price and the sociologist Robert Merton. Sadly, I never got to meet either, though I did have a lengthy correspondence with Merton, who, just before his death, contributed a chapter to the Festschrift...
that Helen Atkins and I edited for Garfield’s 70th birthday. More than 30 years later I am still (re-)reading the works of all of these individuals, without whom I could not have had the career I did and without whom this field would not be what it is.

**What do you think are the most significant advances that have been made in metrics-related research in the last 25 years? Five years? Last year?**

Unquestionably, the most significant advances of late have to do with the widespread availability of large-scale, digital datasets (Web of Science, Scopus, Google Scholar), which can be used either to model the dynamics of scholarly communication and/or evaluate research performance and productivity. I am one of those who grew up with the printed volumes of the SCI, SSCI and A&HCI. First generation data gathering and analysis was a slow, painful business, if one couldn’t afford online access; my eyesight has never recovered. Despite all the long-standing caveats to do with the validity and reliability of biblio/scientometric indicators, the easy availability of usage metrics of all kinds makes them almost irresistible to journal publishers, science policy makers, educational administrators, research councils, foundations and, indeed, scientists and scholars themselves, not least those of a narcissistic disposition. Of course, to quote Einstein, “Not everything that counts can be counted and not everything that can be counted counts.” Reading the ballooning literature on metrics (bibliometrics, scientometrics, informetrics, influmetrics, webometrics, cybermetrics, digimetrics) it is hard not to feel that the Great Man’s adage is sometimes given regrettably short shift.

One of the most interesting recent developments has been the emergence of alt(ernative) metrics, and here I take my hat off to Jason Priem, a doctoral student in information science at UNC, Chapel Hill, whose youthful energy and enthusiasm have done much to propel early experimentation and debate in this area. Today, there are many new and emerging forms of scholarly communication, ranging from tweets through blogs to web-based open peer-reviewed journals. Increasingly, scholars share ideas, data and resources using a variety of social media (for example, Mendeley, Facebook, ResearchGate, CiteULike) and the tools and platforms exist to show how researchers’ opinions, data and insights diffuse throughout the wider scientific community and the kinds of downstream impact they have. Citations are now but one among many competing (or complementary) indicators of scholarly interaction and impact. It remains to be seen how many of the new entrants will achieve the longevity of the citation and how they might be factored into performance evaluation and research assessment exercises.

**What do you think are the most pressing current challenges and opportunities in metrics-related research? How might ASIS&T be positioned to address these challenges and opportunities?**

There are several major challenges facing metrics-based research. First, there exist persistent and warranted concerns regarding validity and reliability. What exactly do traditional citations and alternative indicators measure: quality, impact, influence, visibility, value, reputation…? Second, how transparent and trustworthy are the platforms and datasets upon which distributions, visualizations and comparative evaluations are based? Third, are all citations/acknowledgments/invocations/recommendations equal, or is differential weighting required? Further, how do we establish equivalence between, say, a citation from a Nobel laureate, six glowing mentions on Twitter and a high rating on Faculty of 1000? The idea of a symbolic capital currency convertor may not be all that far-fetched. Fourth, there are justified concerns that in a metrics-conscious age some scholars and researchers will find ways to game the system. To be sure, performativity is not a novel issue – it has been raised repeatedly by anti-citationists – but it is likely to take center stage as the number of indicators increases and evaluators’ reliance on these indicators, singly or conjointly, grows. So, for me, the big question is this: Will the availability of digital metrics and the concomitant ability to track and evaluate individuals and groups lead to the development of a cybernetically controlled system antipathetic to the traditional value system of the academy?

Information science may be the ancestral home of metrics-related research, but we don’t own the subject nor can we regulate the ways in and reasons for which bibliometric techniques are used. I seriously doubt that
any academic or professional body would attempt to require that researchers be certified in the theory and application of bibliometrics. Pandora’s box has been opened. What ASIS&T can do, however, is provide an agora for informed debate on the theoretical underpinnings and sociological significance of metrics-based evaluation of academic performance and through its conferences and publications ensure that the strengths and limitations of different types of metrics are properly understood. I would also encourage the Society to cooperate with other groups and organizations worldwide with an interest in developing, testing, validating and refining metrics of one kind or another.

What do you anticipate for the future of metrics-related research? What role do you envision the ASIS&T community playing in this future?

_JASIST_ continues to be a major publisher of research, both theoretical and applied, relating to metrics, but the Journal certainly does not have a monopoly on the subject. _Scientometrics_ continues to enlarge its already Yeti-like footprint, and it has been joined by the fast-growing _Journal of Informetrics_. There exists a vast, scattered literature on bibliometrics and allied areas, and it continues to expand at a quite remarkable rate; the field has moved from being a cottage industry to a robust academic specialty in its own right with, I’d wager, thousands of adherents, dedicated and transient, worldwide.

I have some familiarity with the multi-faceted literature on metrics and I derive considerable satisfaction from the fact that individuals such as Howard White and Henry Small, two eminences of information science, continue to undertake research and publish on the subject with an authority and depth of understanding that few newcomers can match. That said, it is often the contributions of outsiders – think of Jorge Hirsch, a physicist, and his h-index – that revitalize the field and help push it in new directions. The future will be neither dull nor predictable. Let us hope that it does not degenerate into numerology.

What is your earliest memory of metrics-related research at ASIS&T or in _JASIS(T)_? Were there any particular articles, presentations or lectures that made a distinct impression upon you? What was memorable about these?

Actually, my earliest memory of metrics-related research goes back to 1978, when Henry Small came to the weekly seminar of the biology department at Temple University in Philadelphia (where I ran the biology library) and talked about his collagen research. I thought it was interesting but my heart was still in marine biology. My next memory of metrics-related research was actually my own. Jim Bobick, the science librarian at Temple, heard a paper about using citation analysis to do collection assessment. So he set all of the departmental library managers to do citation analyses for their departments. My study got published in _JASIS_ (McCain & Bobick, 1980) and also got me into the Ph.D. program, thanks to Belver Griffith and Carl Drott. I remember sitting in Belver’s office and talking about the citation distribution, going home and asking my husband (the economist) how one really demonstrates the long tail of a highly skewed distribution. I went back to Belver’s office a couple of days later with a Lorenz curve plot and a calculated Gini coefficient. Then I saw the maps that Howard White and Belver Griffith had started to do – author co-citation analysis – and decided that’s what I wanted to do – and I have, for the subsequent 30+ years.

What do you think are the most significant advances that have been made in metrics-related research in the last 25 years? Five years? Last year?

Twenty-five years? Visualization of citation and other networked data-mapping. Five years? The increased deployment of social network analysis tools into metrics-related research and related freeware like Pajek and HistCite. (OK – I’m shading it a bit – that’s 10 years.) Last year? The emergence of alt-metrics as an active and vibrant research area that focuses on the new data sources coming from social media.
What do you think are the most pressing current challenges and opportunities in metrics-related research? How might ASIS&T be positioned to address these challenges and opportunities?

Challenges – finding ways to mine really large metrics datasets and do more with them than just report network stats and related quantitative results. The real challenge, IMHO, has always been to connect the metrics data with the folks who produce and use the information resources, make the references/citations, etc. It’s partly an issue of scale (the really big vs. the in-depth case study) but also an issue of access to the scholars who are writing and citing. But then I’m a natural historian who likes to look under rocks and haul up old rubber tires at marinas to see what’s there. Another challenge is, at least for academics, to find ways to get funded to support work. How might ASIS&T be positioned? We’ve got boundary spanners – continue to find ways to bring in some of the communities that share interests but have different perspectives and toolkits. Howard White is a good example of this, if you look at his writings on the psychological approach to relevance, the intersection of discourse analysis and citation analysis, the intersection of social network analysis and ASIS&T-style metrics.

What do you anticipate for the future of metrics-related research? What role do you envision the ASIS&T community playing in this future?

I’m not much of a prognosticator – I’ll leave this to younger folks.

What is your earliest memory of metrics-related research at ASIS&T or in JASIS(&T)? Were there any particular articles, presentations or lectures that made a distinct impression upon you? What was memorable about these?

An early influence was the session on the mapping of science convened by Derek Price at the ASIS&T conference in Minneapolis in 1979. He presented, as did B. C. Brookes and Daniel Sullivan. (Henry Small was also scheduled to present, but yielded his time to allow Brookes to speak longer.) Gerard Salton attended, and as I recall, said something derogatory about the whole science-mapping project – perhaps just to be provocative. The most significant event in Minneapolis for me, however, was that, in a private conversation, I explained my budding research on author co-citation to Charles Bourne, whom I knew from UC Berkeley and who was then a researcher at Dialog; he told me about an in-house Dialog command called Intersect that would let me obtain co-citation counts for seven or eight author pairs at a time, rather than one pair at a time. That greatly sped up the data-gathering for the first author co-citation map – the one of information scientists that initially appeared in the 1980 book *Key Papers in Information Science*, edited by Belver Griffith, and then in the 1981 White-Griffith paper in *JASIS* that launched author co-citation as a research method. Belver, my colleague on the Drexel faculty, was a close friend of Derek Price and sent him a pre-publication draft of the White-Griffith paper. To my delight, Derek said that it was the best paper he had seen in a long time. At Drexel we got several more published articles out of the Intersect command before Dialog shut it down – on the grounds that outsiders’ use of it was degrading search performance for the Dialog system!

What do you think are the most significant advances that have been made in metrics-related research in the last 25 years? Five years? Last year?

Last 25 years: the steady improvement in our ability to visualize bibliometric data. Also the strides made by bibliometricians such as Leo
Egghe, Ronald Rousseau and Wolfgang Glänzel in providing mathematical foundations for the field. Last five years: the explosion of interest in the h-index and related measures for assessing personal and group achievements through publication and citation counts. Also, the gradual political gains bibliometrics has made as a complement to peer review in national assessments of research programs. Last year: the heightened visibility of bibliometric research through the appearance of Katy Börner’s *Atlas of Science: Visualizing What We Know*. We have our own coffee-table book!

What do you think are the most pressing current challenges and opportunities in metrics-related research? How might ASIS&T be positioned to address these challenges and opportunities?

The ready availability of large-scale bibliometric visualization packages such as Pajek and VOS affords ample opportunity for new metrics-related research. At the same time, I believe we need to look more critically, in the style of Edward Tufte, at what bibliometric maps are good at conveying. There has been a great proliferation of such maps, and some of the most striking and beautiful also seem to me quite bad at revealing anything useful about the scientific fields or activities they purport to clarify. Terrible though it may be to contemplate, a few passages of old-fashioned text might actually do a better job. So I would like to see ASIS&T sponsor some sort of forum in which the aesthetics and utilities of bibliometric mapping could be candidly discussed.

What do you anticipate for the future of metrics-related research? What role do you envision the ASIS&T community playing in this future?

A major gain would be really rapid production of genuinely useful bibliometric intelligence to individuals on demand. This would involve bigger databases (e.g., integrations of citation data from books and proceedings as well as journals), cleaner data (e.g., proper disambiguation of author homonyms) and software well-tested for value by users. ASIS&T will surely offer opportunities to discuss and publish research on this broad topic as one of the most central to information science.
Metatheoretical Snowmen: A Pedagogical Gedankenexperiment in Information Metatheory
by Jenna Hartel

Editor’s Summary
Metatheory is the highest level conceptual device used in social scientific research and determines a way of thinking and speaking about reality and its information phenomena. Today, numerous metatheories exist in information science and create a dynamic climate. There is also widespread confusion about metatheory because it is a relatively new, abstract and elusive concept for students, practitioners and scholars alike. The article introduces metatheory in information science and its ontological, methodological, social and personal implications. Then “Metatheoretical Snowmen,” a novel pedagogical strategy, is described. Metatheoretical Snowmen demystifies information metatheory through a gedankenexperiment, that is, a thought experiment. In Metatheoretical Snowmen, participants apply the characteristics of a variety of information metatheories to the life and information experience of an ordinary and affable persona: a snowman. The renderings of the snowman and its information world bring the special features of each metatheory into clear view. This approach has been implemented to positive effect as a panel presentation at international conferences in information science, including two recent Annual Meetings of the American Society for Information Science and Technology (ASIS&T).

Keywords
metatheories
epistemology
analytic models
concepts
education

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Bates has defined metatheory as “the philosophy behind the theory, the fundamental set of ideas about how phenomena of interest in a field should be thought about and researched” [1, p. 2]. Elsewhere, metatheories are characterized as “the often unarticulated premises upon which empirical research and theorization is based…broader and less specific than theories, they are orientation strategies to the world” [2, p. 272]. There are several near synonyms to metatheory. In some instances a metatheory could also be referred to as a theoretical framework, paradigm, sensibility, worldview, approach or perspective, although these terms are less precise.

Certain academic fields operate with a single dominant metatheory. For example, the natural sciences adhere to evolution as an overarching perspective on life. Differently, as an interdisciplinary domain, information science has always had many metatheories in play. Almost a century ago, the first textbook of library science (a tap root for contemporary information science), devoted separate chapters to the sociological, psychological, historical and practical (or technological) problems of information access [3]. More recently, the term metatheory gained prevalence in the writings of Finnish theorists Sanna Talja, Kimmo Tuominen and Reijo Savolainen [4] who analyze three “isms” of information science: constructivism, collectivism and constructionism.

According to Bates [1], there are 13 major metatheories in information science that are shown in alphabetical order in Table 1. Most of the metatheories in Table 1 have been imported from other disciplines, whether history (historical metatheory), philosophy (philosophical-analytic

Table 1. Bates’ 13 metatheories in information science [1]

<table>
<thead>
<tr>
<th>Bibliometric</th>
<th>Cognitive</th>
<th>Constructivist</th>
<th>Critical Theory</th>
<th>Constructivism</th>
<th>Collectivism</th>
<th>Constructionism</th>
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<tr>
<td>Engineering</td>
<td>Evolutionary</td>
<td>Ethnographic</td>
<td>Historical</td>
<td>Philosophical-analytic</td>
<td>Physical</td>
<td>Socio-cognitive</td>
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</table>
metatheory), cognitive science (cognitive metatheory) or anthropology (ethnographic metatheory). There is only one metatheory that information science can claim as its own: bibliometrics. The metatheories named by Bates exist in dynamic relationship to each other. Socio-cognitivism (a socially-oriented approach) emerged as a response to cognitivism, which was critiqued as overly individualistic. Some pairs of metatheories are complementary. There is an affinity between critical theory and an historical approach, as well as between ethnography and socio-cognitivism. Table 1 is neither comprehensive nor stable, for metatheories come in and out of fashion. On a regular basis, scholars propose new metatheories, such as activity theory [5], phenomenography [6], neo-pragmatism [7] or phenomenology [8], to name just a few.

Metatheory impacts research in information science in ways that are ontological, methodological, social and personal. The ontology, or nature, of information takes form differently across metatheories. In socio-cognitivism, information is an artifact, often a document. In constructionism, information is language in the form of discourse. Importantly, there is not one definition of information in information science, but rather multiple definitions exist, depending on the metatheory.

There are methodological implications to metatheory, as well. It serves as a reservoir of tenets that cascade through a research design, shaping the implementation of a research project. To illustrate, a study based in a cognitive metatheory leads to an experiment; whereas an investigation grounded in an historical metatheory involves reading original documents. The cascading quality of metatheory is a matter that doctoral students wrestle with in the theoretical framework section of a dissertation.

Metatheory is also a social force. Metatheoretically like-minded scholars tend to affiliate on account of a shared worldview and practices. Research areas, invisible colleges, special interest groups, networks and collaborators all rally around different metatheories. Some of the metatheories in Table 1 harbor large and well-established research communities within information science, namely user-centered design and cognitivism. In contrast, the evolutionary approach is embraced by a small circle of enthusiastic researchers. Metatheory is propagated by academics each time an article, scholar, concept or method is recommended to advisees or students.

Finally, metatheories are personal. They express how we each see the world and its information phenomena. A reflective reader of this article might ask, “What’s my metatheory?” But first, it should be noted that there are two possible ways to answer the question. A metatheory may be a permanent and innate orientation based upon deeply set values, beliefs and cognitive styles. This orientation is akin to being born under a constellation; one simply has and always will have a certain metatheoretical sensibility that remains stable over a lifetime and career. Or, alternatively, perhaps a metatheory is one tool in a toolkit that is picked up for use in a particular problem or project and then replaced by another in different circumstances. In the latter case, a lifetime and academic career can feature many metatheories.

**Metatheoretical Snowmen?**

What does any of this have to do with snowmen? During my second year as a doctoral student in the Department of Information Studies at the University of California, Los Angeles, Student Services had an art contest during the winter holiday season. All were challenged to decorate their office doors with a snowman craft, which would be judged and could win an award. Around this time, I was wrestling with metatheory and its implications for my dissertation research design. I wanted to make a snowman craft and felt strongly that my snowman must be bearing information. I wondered, “What is information for a snowman?” I realized the answer to this question depends on my own (or the snowman’s) information metatheory.

From this insight, I created a poster for the 2005 conference of the Association for Library and Information Science Education (ALISE), entitled Metatheoretical Snowmen [9]. The poster displayed snowmen from the perspective of four different information metatheories, their information reality and the type of information research produced there. To illustrate, a section of the original poster on the metatheory of cognitivism contained a thinking snowman and Brookes’ fundamental equation of information science, a cognitive conception. The poster also displayed a well-known cognitive study about young girls and their understanding of heroin [10]. The ALISE poster session is a heated competition. Alas, Metatheoretical Snowmen did...
not win an award, but fellow students agreed that my contribution contained the best title to ever grace a poster in information studies.

The strategy of using an imaginary situation (such as a snowman) to increase understanding is called a thought experiment, or, in German, *gedankenexperiment*. Thought experiments have been used in a variety of fields since classical antiquity and are common in the work of scientists such as Galileo and Einstein. Einstein’s most famous thought experiment involved imagining what it was like to chase a beam of light, leading to his theory of special relativity. (For the record, in German, a thought experiment based upon a snowman would be *das schneemannsgedankenexperiment*.)

Later in my academic career, as an assistant professor at the Faculty of Information, University of Toronto, I utilized the Metatheoretical Snowmen conceit in lectures. Students reported that the playful device captured their imagination and made an abstruse concept more accessible.

For the 2009 ASIS&T Annual Meeting in Vancouver, British Columbia, I turned the *gedankenexperiment* into a panel [11]. The session began with a brief introduction to metatheory. Then, five thought leaders each provided a succinct (five-minute) overview of the metatheory s/he champions and employs. The presenters were required to explain his/her metatheory in the context of a snowman. To enable comparison and contrast, all presenters addressed three fundamental questions from the perspective of their metatheory:

1) What does the snowman’s reality look like?
2) What constitutes information for the snowman?
3) How is information research conducted in this world?

To motivate the panelists, the event was staged as a competition. At the beginning of the session, a jury of three judges was drawn from the audience, composed of a senior academic, a junior academic and a student. In real time, the jury ranked each presentation on a scale of 1 (“incomprehensible!”) to 10 (“eureka!”). The presenter with the highest score was awarded the Snowman Trophy. At the conclusion, a discussant provided synthesizing observations and hosted a question and discussion period with the audience. The panel has since been repeated at the 2010 Conceptions of Library and Information Science conference in London, England [12] and again at the 2011 ASIS&T Annual Meeting in New Orleans, Louisiana, as Metatheoretical Snowmen II [13]. A few scholars who witnessed the panel have implemented spin-offs at their campuses. It is not possible, due to space limitations, to recount every snowman presentation, but a summary report and select examples are provided next. The definitions of metatheories that follow come from Bates’ previously noted analysis [1].

**Metatheoretical Snowmen at the 2009 ASIS&T Annual Meeting**

Understandably, the first participants in the Metatheoretical Snowmen session had some reservations, since ASIS&T panels are typically marked by gravitas. The five presenters were accomplished information scientists with substantial legacies within their favored metatheory. Howard D. White (Drexel University) represented *bibliometrics*, a metatheory in which the analysis of the statistical properties of information is seen to provide understanding of value for both the design of information provision and the theoretical understanding of social processes around information, including historical processes. Pamela McKenzie (University of Western Ontario) addressed *constructionism* (also called *discourse analysis*), an approach in which it is assumed that the discourse of a society predominately conditions the responses of individuals within that society, including the social understanding of information. Jens-Erik Mai (Royal School of Library and Information Science, Copenhagen) presented *socio-cognitivism* (also called *domain analysis*), a position in which both the individual’s thinking and the social and documentary domain in which the individual operates are seen to influence the use of information. Paul Solomon (University of South Carolina) interpreted *sense-making*, a set of metatheoretic assumptions for understanding how people overcome discontinuity. Siobhan Stevenson (University of Toronto) championed *critical theory*, an approach in which the hidden power relations and pattern of domination within a society are revealed and debunked. Marcia J. Bates (UCLA emerita) served as a discussant and offered concluding remarks.

The presentation on critical theory at the 2009 ASIS&T Annual Meeting is an example of how the *gedankenexperiment* works. Stevenson first clarified her focus on a form of Marxist critical theory known as political economy [14].
1) *What does the snowman’s reality look like?* Cast in terms of capitalist society and forces such as mass production and mass consumption, this snowman is the fetishized invention known as “Frosty” and a special type of commodity: *intellectual property*. Frosty is the product of legions of invisible creative laborers; has proliferated across various technologies and cross-promotions (see Figure 1); reproduces a host of social inequalities and stereotypes; and is licensed by select capitalists for millions of dollars.

2) *What constitutes information for the snowman?* As a form of content, Frosty is information that is shaped by intellectual property policy, regulatory trends and technological developments in the telecommunications sector.

3) *How is information research conducted in this world?* As a methodology for information science, political economy aims to uncover Frosty’s role in the successful reproduction of capitalism as an inequitable economic regime. This research examines the economic, technological, social and cultural history related to information. Further, inquiry into this tradition attempts to be a moral compass, revealing the inequalities that underlie intellectual property such as Frosty and articulating alternative futures.

All the Metatheoretical Snowmen presentations at the 2009 ASIS&T Annual Meeting were ground-breaking. The judges awarded Pamela McKenzie the prize for her presentation on constructionism, which edged out a compelling talk on socio-cognitivism by Jens-Erik Mai, the runner-up. Based upon applause and a palpable enthusiasm in the room, Siobhan Stevenson’s statement, described above, appeared to be an audience favorite.

**Metatheoretical Snowmen II at the 2011 ASIS&T Annual Meeting**

Metatheoretical Snowmen returned to the 2011 ASIS&T Annual Meeting in New Orleans, Louisiana, with a different lineup of scholars and metatheories. Jonathan Furner (UCLA) presented the *philosophical-analytic* approach, in which the classical techniques of the discipline of philosophy are brought to bear on information-related matters. Soo Young Rieh (University of Michigan) championed *user-centered design*, wherein the development and human testing of information systems is seen as a path to both scientific understanding and improved information access. Michael Olsson (University of Technology, Sydney) represented *critical studies*, an approach in which the hidden power relations and patterns of documentation within society are revealed and debunked. Marcia Bates (UCLA) addressed an *evolutionary* stance: the insights of biology and evolutionary psychology are brought to bear on information-related phenomena. Finally, Nick Belkin (Rutgers University) represented *cognitivism*, a perspective arising out of cognitive science in which the thinking of the individual person operating in the world is the dominating focus of research on information seeking, retrieval and use. Andrew Dillon (University of Texas) was the discussant who provided summarizing observations and hosted a question and answer period.

Another example of a snowman, drawn from this panel, was Soo Young Rieh’s user-centered-design snowman. To begin, Rieh [15] described user-centered design as a philosophy and set of research methods that aim to involve users in the design of information systems.

1) *What does the snowman’s reality look like?* In this metatheory, the snowman is an information system (see Figure 2). It is incomplete without two human stakeholders: users and information system builders.

2) *What constitutes information for the snowman?* In user-centered design, the snowman itself (as an information system) contains information in a variety of multimedia formats. This information helps people achieve goals and complete tasks in everyday life.
3) How is information research conducted in this world? Rieh critically reports that a tense bifurcation exists between two research specialties devoted to improving the snowman’s contribution to society. On the one hand, there are information behavior scholars who take a broad interest in all the information behaviors performed by people who encounter the snowman. On the other hand, information system designers place a narrower focus on the user’s direct engagement with the snowman and strive to improve these experiences. Each research specialty has a distinct set of methods and would benefit by closer integration with and appreciation of the other.

Although the format was identical to the 2009 event, Metatheoretical Snowmen II included new panelists, addressed a fresh set of metatheories and had its own exuberant spirit. Michael Olsson was victorious with a sharp explication on critical theory. Jonathan Furner’s contribution on the philosophical-analytical approach resembled performance art; an audio version of this memorable disquisition can be heard at www.jennahartel.com/metatheoretical-snowmen.html.

Spin-Offs

This approach to understanding metatheory has generated novel adaptations. The College of Communication and Information of Florida State University presented Metatheoretical Flamingos [16], an appropriate means to analyze information metatheory in a tropical setting. Organized by Adam Worrall, the session featured Worrall and fellow doctoral students presenting semiotic, cognitive, social and physical metatheories followed by a fishbowl discussion. The School of Information and Library Science at Pratt Institute offered the panel [meta]Theoretical Lions in its annual research showcase. At Pratt the lion is a symbol of patience and fortitude and is a campus landmark. Spearheaded by Debbie Rabina, the session at Pratt featured faculty presentations on existentialism, evolutionary theories, empiricism, political economy and feminism [17].

A Critique

All pedagogical strategies should be subject to critique and a public discussion of their merit. One information scholar has remarked that this playful treatment of metatheory makes it difficult for other scholars and their students to engage the topic with the sobriety it deserves; put another way, Metatheoretical Snowmen has rendered information metatheory a joke. Also, a reviewer of the original panel proposal asserted that academic work should not be conducted as a competition for a trophy, for the outcome of new insight is reward and motivation enough. As the originator, I acknowledge that the five-minute statements by the presenters require that they transmit simplified understandings of metatheories that are truly complex idea systems. (For this reason, a bibliography of selective articles on metatheory is provided at the panel events and is available at the link below).

The Future

Going forward, given the preponderance of positive feedback, Metatheoretical Snowmen will likely reappear at upcoming annual meetings of ASIS&T, other international conferences and special events or classes within information studies programs. In general this approach may encourage more creative pedagogical techniques across the field. Additional background and a collection of PowerPoint slides from past renditions are available at www.jennahartel.com/metatheoretical-snowmen.html. Those interested in participating on a Metatheoretical Snowmen panel or in applying the idea in their own communities are invited to contact the author for assistance.
# Resources Mentioned in the Article


