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RESEARCH

Open Access Status of Nano ELSI Research: Determining Availability of a Core Collection of Research for a Disciplinary Repository

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INTRODUCTION The development and maintenance of a disciplinary repository is a high cost, long-term project; therefore, it is important to investigate the feasibility of the proposed resource. This paper explores whether an emerging discipline can support the development of a disciplinary repository by evaluating the availability of scholarship and scholarly communication trends within the nanotechnology and emerging technology ethical, legal, and societal issues research (Nano ELSI) domain. **METHODS** In this study, journal articles produced through Spring 2013 by two large National Science Foundation Centers for Nanotechnology and Society at the University of California Santa Barbara and Arizona State University are evaluated for both potential and actual availability through open access publishing and author self-archiving. **RESULTS** While only 14% of articles in this collection have been published openly in open access or hybrid open access journals, over two thirds (85%) have been published in journals that support author self-archiving of some version of the manuscript in institutional or disciplinary repositories. The actual full-text open availability of 48% of total articles in the set demonstrates that there is a strong inclination among this community to share research products. **CONCLUSION** The availability of a core collection of materials and an understanding of scholarly communication conventions within the domain support the development of a centralized resource.

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IMPLICATIONS FOR PRACTICE

1. Demonstrate the availability of a core collection of federally-funded research for inclusion in a disciplinary repository;
2. Identify scholarly communication trends among authors within the nano ELSI domain; and
3. Articulate several benefits for establishing a centralized resource for the within this emerging domain.

INTRODUCTION

Disciplinary repositories, or "places where the findings of research in a particular field of study are made accessible" (Erway, 2012), can vary in the systems they use and services they provide, but share the trait that they are centralized resources designed to collect, host, disseminate, and provide access to the research on a specific discipline or topic or for a specific community. Many disciplinary repositories have been developed over the last twenty years (there are nearly 300 listed in *OpenDOAR*, a directory of open access repositories) in response to disciplinary cultures, mandates, community calls, and technological advances. One such response is the *Nanoscience and Emerging Technologies in Society: Sharing Research and Learning Tools (NETS)*, an Institute of Museum and Library Services-funded project to investigate the development of a disciplinary repository for research on ethical, legal, and societal issues (ELSI) related to nanotechnology and emerging technologies. Growing momentum within the research area, a coalescence of a research identity, and the increase in federal research funding have opened discussions about the role and usefulness of a centralized repository for nano and emerging technologies ELSI research.

However, the development and maintenance of a disciplinary repository is a costly endeavor. A long-term host, software development, storage, digital preservation, and active collection, description, and organization of materials are all required (Erway, 2012). Because building and maintaining a disciplinary repository requires a large investment, it is important to investigate the feasibility of the proposed resource for the nano ELSI community. The availability of an initial collection and ongoing scholarship in a domain are important deciding factors in the creation of a disciplinary repository. They represent significant operational concerns for disciplinary repository managers. In addition, the scholarly communication trends within a discipline and the willingness of authors to participate in a centralized resource represent important cultural components of disciplinary repositories that should also be considered. In order to inform the NETS project, this paper explores these questions within the nano and emerging technologies ELSI domain, using a subset of nano and emerging technologies ELSI works to consider whether this emerging discipline can support the development of a disciplinary repository.

LITERATURE REVIEW

Nanotechnology and Emerging Technologies Research

Federal investment in nanotechnology has grown steadily since the 21st Century Nanotechnology Research and Development Act (21st Century Nanotechnology Research and Development Act, 2003), with a $2.1 billion federal budget for the National Nanotechnology Initiative in fiscal year 2012 (National Nanotechnology Initiative, 2012). In 2005, the U.S. National Science Foundation (NSF) announced a set of major grants in nanotechnology in society, including the creation of multi-million dollar Centers for Nanotechnology in Society at Arizona State University (CNS-ASU) and at the University of California, Santa Barbara (CNS-UCSB) to pursue scholarship on and methodological and theoretical approaches to the social studies of nanotechnology. By 2015, scholars across the country affiliated with the two national centers as well as other NSF Nanoscale Science and Engineering Centers (NSECs) conducting social dimensions research (ethical, legal, and societal implications, or ELSI) will have spent ten years collecting qualitative and quantitative data and developing analytic and methodological tools for examining the human dimensions of nanotechnology. While these centers do not represent the whole of the nano and emerging technologies ELSI research community, which has an international scope, they do represent millions of dollars in U.S. federal investment and constitute a considerable portion of this interdisciplinary and international community.

ELSI of nano and other emerging technologies is a research area with a growing body of work that represents many diverse disciplines, including ethics, sociology and anthropology, public policy, environmental health and safety, and law and government regulation.[1] While nano and emerging technologies ELSI is not expected to develop into a discrete discipline, "it is likely that there will be new interdisciplinary collaborations and exchanges of knowledge across traditional disciplinary boundaries among social scientists and between social scientists and nanotechnology natural scientists and engineers" (Shapira, Youtie, & Porter, 2010). When this body of literature was first emerging, social scientists relied upon the research of natural scientists and engineers, but starting in 2005 following increased support for nano and emerging technologies ELSI research in the United States (Roco, Harthorn, Guston, & Shapira, 2011), there has been increased production of nano and emerging technologies ELSI literature, and the literature has become self-referential (Shapira, Youtie, & Porter, 2010). The outputs of this research domain are intended as much for the public and industry and public policy professionals as for academics (CNS-ASU, 2013; CNS-UCSB, 2013).

[1] http://www.nano.gov/you/ethical-legal-issues

The growing and self-referential nature of literature within this domain is one indicator that nano and emerging technologies ELSI researchers identify as a community. Another is the 2009 formation of an international professional society, the Society for the Study of Nanoscience and Emerging Technologies (S.NET), which "[promotes] open intellectual exchange towards the advancement of knowledge and understanding of nanotechnology in society, including its connections with social and other technological developments" (S.NET, 2013). S.NET is currently an active organization which has held annual conferences with diverse and international representation since its founding. While nano and emerging technologies ELSI is not a formal discipline, it is clear that researchers in this domain are a distinct and self-identifying group.

Disciplinary Repositories

In general, there is little guidance on the development of disciplinary repositories as opposed to institutional repositories—particularly on the subjects of environmental scanning, planning, assessment, and community readiness (Adamick & Reznik-Zellen, 2010). Articles that discuss the history, policies, or technical development of individual disciplinary repositories, while illustrative of project-specific challenges and approaches, can be difficult to generalize (Adamick & Reznik-Zellen, 2010). A recent study of library management of disciplinary repositories demonstrates that the primary reasons for undertaking a disciplinary repository include alleviating access barriers to the literature of the field and a desire, commonly from the disciplinary community itself, to centralize and increase the visibility of its research (Adamick, Lewellen, & Reznik-Zellen, 2013). For example, both arXiv and AgEcon Search began in an effort to utilize the then-young internet to facilitate the distribution of pre-prints and working papers within their communities (Kelly & Letnes, 2010; Kling, Spector, & Fortuna, 2004). Harold Varmus' original idea for a central preprint service for biomedical research, which ultimately became PubMed Central, was inspired by the success of arXiv. Although the original proposal changed significantly before the launch of PubMed Central in 2000, many community members recognized the benefit a single archive for distributed biomedical research would provide (Kling, Spector & Fortuna, 2004). More recently, the founders of a disciplinary repository for economics, Economists Online, acknowledge that obtaining a critical mass of content is essential to the success of a repository (Puplett, 2010b). Each of these subject repositories began with the recognition that an existing body of discipline-specific work would benefit from enhanced access, centralization, or both.

Content availability is not the only determinant of success for a disciplinary repository; disciplinary culture also plays a role. Authors whose communities have a culture of self-archiving will more readily participate in their disciplinary repositories than in other kinds of open access repositories. Patricia Renfro has commented that successful disciplinary

repositories "link tightly to disciplinary practice and culture" (Puplett, 2010b), and Xia's (2008) comparison of author contributions to disciplinary and institutional repositories underscores the influence that community culture can have on author self-archiving practice. A recent study among business faculty at ARL institutions confirms this, finding that researchers would more readily contribute to a disciplinary repository in their own field over an institutional repository (Hahn & Wyatt, 2014). The utility and growth of arXiv, specifically, has been directly tied to the culture within the high energy physics community for sharing preprints prior to publication (Kling, Spector, & Fortuna, 2004). Puplett (2010a) writes that it was important for the Economists Online team to understand the scholarly communication trends within the field to know if their proposed repository would be successful. These findings highlight the importance of cultural behaviors in the success of a disciplinary repository.

METHOD

Understanding a research domain's corpus is important early work when establishing a new repository. Scanning a domain's corpus can determine the percentage of work available to archive with respect to the overall research produced in the discipline and give disciplinary repository managers an idea of the potential comprehensiveness of their resource, and therefore both goals and metrics for assessment. It can also help identify scholarly communication trends (e.g. current self-archiving practices) within the field that might support the new resource, and it can enable repository managers to proactively collect content. To understand the body of work in the nano and emerging technologies ELSI domain, this study analyzes a set of bibliographic data for published nano and emerging technologies ELSI papers.

Journal article references were collected from publication lists on CNS-ASU and CNS-UCSB's websites between January 2013 and April 2013.[2] Both research centers are funded from 2005-2015, meaning that the results of this study do not represent the full research output of the two CNSs. Publications were collected using Zotero, an openly-available browser-based citation management system. Bibliographic data were exported to Excel and appended with articles' author self-archiving designations and open access statuses from SHERPA/RoMEO, a searchable database of publishers' policies and open access

[2] Since there are resources for verifying the archiving policies of periodicals, and since there are no tools for the mass identification of archiving statuses of datasets, grey literature, and other research products, this study focuses on journal articles. Publication in peer-reviewed journals is the standard for dissemination and recognition throughout the academic research environment (Creaser et al., 2010). Emerging fields are no exception. Shapira et al.'s (2010) analysis of the nano and emerging technologies ELSI community through its literature confirm that this form of scholarly communication is of primary importance across disciplines that conduct nano and emerging technologies ELSI research.

business models (SHERPA/RoMEO, 2013). SHERPA/RoMEO's author self-archiving color designations represent the degree to which a publisher will support the deposit of an author's preprint, postprint, or the publisher's version of their manuscript into an institutional repository or personal or departmental website. Green journals are the most liberal and will allow the self-archiving of pre- and postprints or publisher's PDF of author manuscripts. Blue journals allow the archiving of the postprint or publisher's PDF; yellow, only the preprint. White journals are the most restrictive and do not formally permit the archiving of any version of the manuscript. Open access statuses refer to journals that are published as open access, providing authors with immediate open publication, usually for a fee; hybrid open access, providing authors with the option to publish open access for additional article processing fees; or traditional subscription access, offering no open access option to authors. The evaluation of articles' open access statuses and author self-archiving designations articulates the extent to which the publishing environment enables the broader dissemination of research—how much content *could* be made openly available. In addition, actual availability of published nano and emerging technologies ELSI research in the set was established using Google Scholar to search for the full-text of the articles. Full-text availability and cost information were appended to the bibliographic data. Findings were analyzed using Excel.

RESULTS

Of 469 total research products produced by CNS-ASU and CNS-UCSB at the time of collection, 227 were identified as journal articles (48%). Other research outputs include books (28 items) and book sections (75), dissertations/theses (23), web pages (18), video/DVDs (12), conference proceedings (8), magazine articles (7), sound recordings (5), newspaper articles (4), reports (4), motion pictures (3), personal communications (1), and generic items which include highlights for newsletters and other ephemera (54).

The 227 journal articles were published in 115 academic journals between 2004 and 2013, the most productive year between the two research centers being 2011 with 62 articles. Compared to all literature in this domain as indexed by Scopus,[3] this set of nano and emerging technologies ELSI publications comprises 24% of the total output between 2004 and 2013 (942 total articles). In 2011, CNS-funded output was close to 50% of total output in this domain. See Figure 1 (following page).

[3] The query for this Scopus search was conducted in February 2015: ((TITLE-ABS-KEY(nano*) AND TITLE-ABS-KEY(ethics) OR TITLE-ABS-KEY(law) OR TITLE-ABS-KEY(society)) AND DOCTYPE(ar) AND SUBJAREA(MULT OR ARTS OR BUSI OR DECI OR ECON OR PSYC OR SOCI)).

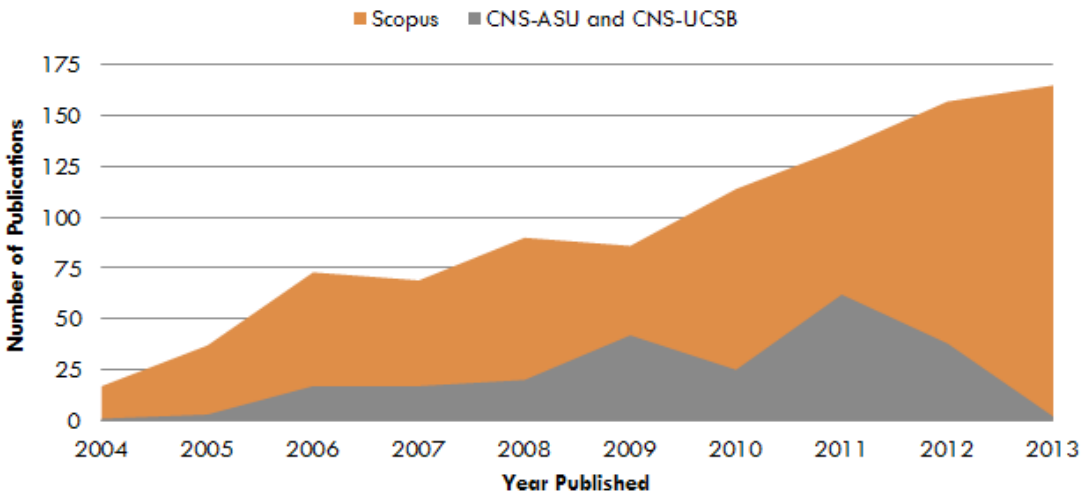

Figure 1. *Total Nano and emerging technologies ELSI Publication Counts 2004-2013.* Publication counts from CNS-ASU and CNS-UCSB and Scopus for 2004-2013 show increased scholarly output in this domain over time. The decrease in CNS output is explained by the timeframe during which citations were collected (Spring 2013).

Of the 227 journal articles identified, 10 are published in open access journals; 150 are published in journals with a paid open access option; 16 are in subscription access journals; and the remaining 51 are in journals that are either unlisted or ungraded by SHERPA/RoMEO or for which SHERPA/RoMEO does not have data on the journal's business model.[4] In addition, of the 227 journal articles identified, 127 were published in journals with a SHERPA/RoMEO green designation; 3 in blue; 64 in yellow; 14 in white; and the remaining 19 are published in journals that are either unlisted or ungraded by SHERPA/RoMEO.

The journals that most commonly publish CNS-funded research are the *Journal of Nanoparticle Research* (16), *Science and Engineering Ethics* (14), *Scientometrics* (11), *Public Understanding of Science* (9), *Science and Public Policy* (8), *The Journal of Technology Transfer* (8), *NanoEthics* (7), *Nature Nanotechnology* (7), *Minerva* (5), *Science* (4), and *Technology and Culture* (4). All of these journals, with the exception of *Nature Nanotechnology*, *Science*, and *Technology and Culture*, offer a paid open access option to their authors. With regard to author self-archiving, all of these journals but *Science and Public Policy* (yellow) and *Nature Nanotechnology* (yellow) are RoMEO green.

[4] The SHERPA/RoMEO journal data for this study was collected in 2013.

When searched in Google Scholar, the full-text of 110 subscription and open access CNS-funded articles was found to be openly available.[5] This represents 48% of all articles in the set. While Research Gate was the most common platform for hosting full-text (22), the remaining full-text articles were dispersed over 55 different sites that include institutional repositories, various disciplinary and national repositories, publishers' websites, and unaffiliated research repositories. CNS-ASU and CNS-UCSB together made the full-text of only 5 articles available through their websites.

Comparing potential open availability of full-text to actual open availability of full-text is challenging because a journal can both offer an open access option to authors and maintain liberal author self-archiving policies, thereby giving authors a choice for making their work available. For instance, by looking at the total number of papers that were published in hybrid open access journals (150) and the total number of full text articles in this subset that were found openly available online (76), it would appear that half of the authors who publish in hybrid open access journals elect to make their papers open access (51%). However, the location of the full-text informs how an article was made accessible. Within the subset of papers that were published in hybrid open access journals, 27 full-text articles were found openly available on publishers' websites. Of those, 23 were explicitly labelled open access content, while 4 had no indication of the open access status of the article. Therefore, authors paid for only 23 of 150 papers in this set to be published open access (15%). Only half of the 10 articles that were published in open access journals were found openly available directly on publishers' websites (5); 4 were found openly available at repositories, and one was not found at all. Of 16 articles that were published in subscription only journals, 4 were found openly available online. See Figure 2 (following page).

Similarly, when looking at author self-archiving, a journal's policy does not necessarily determine an author's actions. In this set of CNS-funded papers, 11 of 14 articles with a white SHERPA/RoMEO designation were found openly available online (79%); 18 of 44 articles with a yellow designation were found openly available (40%); and 3 of 3 articles with a blue designation were found openly available (100%). Conversely, only 66 of 127 articles with a green SHERPA/RoMEO designation were found openly available (52%). See Figure 3 (following page).

[5] For these results, "found openly available" indicates that the full text of the article was located and accessed by searching either the DOI or the article title in Google Scholar. These searches were limited to Google Scholar; if a link to an article's full text did not appear in these results, the full text would have been considered not found or unavailable.

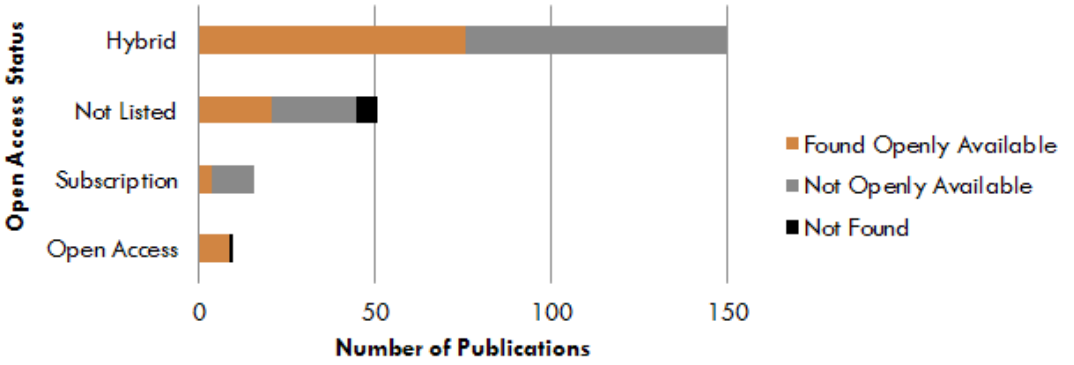

Figure 2. *Availability and Open Access Status.* Full-text for half of the set of CNS-funded papers has been found openly available across all access categories.

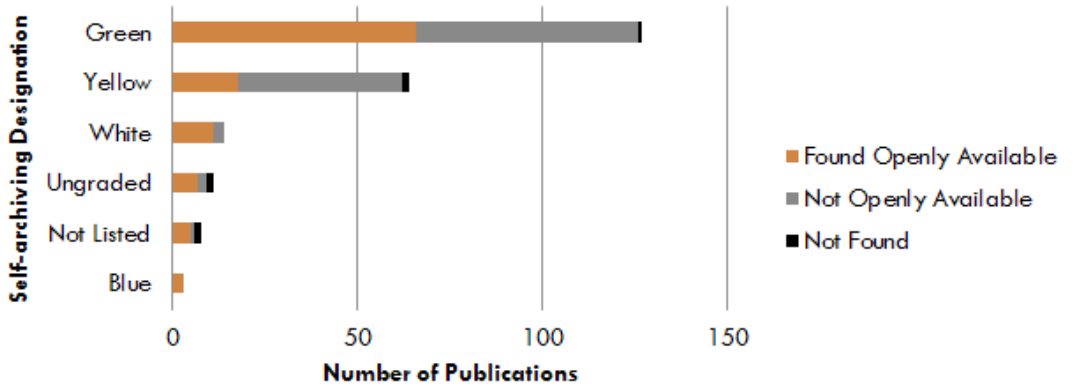

Figure 3. *Availability and Author Self-archiving Designation.* Full-text for half of the CNS-funded papers has been found openly available across all self-archiving designations.

The total cost of access to the set of 227 CNS-funded research articles is $6,122.45, across access models. Costs for a single article range from $0 (including open access and paid hybrid open access articles) up to $113 dollars (for subscription articles), the most common charge for access being $39.95. The open availability of the full text of 110 articles, either through open access or paid hybrid open access publishing or self-archiving, offsets $2,375.50 of the potential cost to readers.

DISCUSSION

The subset of CNS-funded nano and emerging technologies ELSI publications represents a quarter of all publications in this domain. However, given that the overall numbers in this domain are fairly small (less than 1000 for the 2004-2013 timeframe), the set comprises a significant collection. There is also an upward trend in number of publications between 2004 and 2013, both for CNS-funded articles and for all articles, which indicates continued growth of the scholarship in this area.

There is strong potential for open dissemination of nano and emerging technologies ELSI research in this collection and, given that the full-text of almost half of the articles in this set can be found openly online, this potential is being actualized by nano and emerging technologies ELSI community members. However, when comparing potential availability to actual availability, some scholarly communication trends within this group become clear.

With respect to open access publishing, a majority of the articles are published in journals with business models that give authors the option to publish openly, with 150 (54%) published in hybrid open access journals. Hybrid open access is an increasingly common business model across disciplines, with more and more publishers offering authors the option to publish openly. However, only 33 articles in the complete set of CNS-funded papers (14%) have actually been published open access, 10 in open access journals and only 23 through hybrid open access journals. This suggests that authors do not choose to publish in open access journals and that, when they publish in hybrid open access journals, they do not choose to pay the fees for open access publishing. Placing financial responsibility for providing open access on the author, author's institution, or author's sponsored research funder places a major obstacle to publishing open access, as there are few systematized ways for authors fund this option.

The relative infrequency of open access publishing in this set indicates that author self-archiving is the most common mechanism for making full-text available. In this set overall, 194 articles (85%) were published under publisher policies that support the archiving of some version of the manuscript (RoMEO green, yellow, and blue), and the journals that most commonly publish CNS-funded research (*Journal of Nanoparticle Research*, *Science and Engineering Ethics*, and *Scientometrics*) predominantly support it. The publishing environment for this domain enables the open dissemination of research, which is consistent with publishing trends across disciplines, where 62% of publishers support author self-archiving via policy (Laasko, 2013). Of the complete set of CNS-funded papers, 77 articles were self-archived (34%), more than doubling the number of those that were published open access. Within the subset of available articles, 70% (77/110) of authors chose to self-archive.

The challenge of self-archiving is that it puts the responsibility of providing open access on the authors themselves, who may not always be fully aware of the nuances of publishers' self-archiving policies. For example, of 127 articles that have green author self-archiving policies, policies that allow self-archiving of the pre- or post-prints and in some cases the publishers' versions of their articles, only 66 were found online, about 52%. At the same time, of 14 articles that have white author self-archiving policies, policies that prohibit self-archiving, 11 were found online (79%). This apparent disregard for policy underscores Antelman's (2006) study of self-archiving practice, which found that disciplinary norms drive author self-archiving behavior to a far greater extent than journal policies. While a 34% self-archiving rate is a positive indicator of members' willingness to make their works openly available, there remains a significant gap between that rate and the 85% of articles in the set that *could* be archived. Education and outreach could correct some irreverent self-archiving behavior and encourage even more authors to participate in publisher-supported self-archiving. Singeh, Abrizah, and Karim (2013) stress that author awareness of and participation in OA processes such as self-archiving are critical to the successful adoption of new technology-based communication systems.

Author awareness and willingness to self-archive may not be enough, however; authors' time and attention for self-archiving is limited, and mediated deposit may be necessary to improve archiving rates. Even institutions with successful Open Access policies provide mediation services in some way to place content into their repositories (Brand, 2012). Spezi, Fry, Creaser, Probets, and White (2013) found that 75% of researchers who report that they have archived papers have had their articles placed in a repository by someone else on their behalf. Planners of a nano ELSI disciplinary repository should anticipate this type of author service in order to facilitate collection development.

While the inclination to self-archive exists within this community, there is clearly no single place for authors—or their intermediaries—to do this. There are 55 different websites used as platforms to host nano and emerging technologies ELSI research papers. Research Gate has the largest concentration, with 22 papers, but this comprises only 20% of available full-text and only 10% of the whole set. A centralized repository would solve a significant problem for community members who want to make their papers available through self-archiving as well as for stakeholders who want to find and use nano and emerging technologies ELSI research products. Further, the open availability of this body of work would save stakeholders seeking to access this research thousands of dollars in access fees as well as the inconvenience of paying twice for publicly-funded research. The price for a single download or individual access for a 24-hour period for the set of CNS-funded research is $6,122.45. While the currently available full-text articles will save an individual $2375.50, savings would scale considerably within a community of stakeholders and with increased openly available content. For example, for all nano and emerging technologies ELSI literature for

2004-2013, there are 158 unique authors. Using that figure as an estimate for community size and multiplying it by the most common charge per article ($39.95), there is potential savings of $6,312 for a single article. If you extend that to the entire set of CNS-funded research, there is potential savings of $1,432,846. This exceeds all the listed annual costs for administering a disciplinary repository found by Adamick, Lewellen, and Reznik-Zellen (2013), which range from $102,000 (AgEcon) to $800,000 (tDAR).

In evaluating the set of CNS-funded research, a substantial and growing body of interdisciplinary work has been identified and analyzed. The venues in which nano and emerging technologies ELSI researchers publish support the broad dissemination of this work, primarily through liberal self-archiving policies. Further, as evidenced by open access publishing and author self-archiving behavior, the communication trends among nano and emerging technologies ELSI researchers demonstrate that community members are willing to share their research and to participate in activities that increase access to their research beyond traditional publishing channels.

CONCLUSION

The journal articles from the Centers for Nanotechnology and Society at UCSB and ASU comprise a significant collection of research in the nano and emerging technologies ELSI domain. By evaluating this set of publications, scholarly communication trends have been articulated—such as the continued growth of scholarship and the inclination among authors to archive research products. In addition, some benefits of establishing a disciplinary repository have been identified. Specifically, a disciplinary repository for nano and emerging technologies ELSI research would help to capture previous and forthcoming scholarship in the domain; provide a centralized discovery and access point for distributed research; leverage community members' inclination to archive their research products; streamline archiving procedures and facilitate author awareness of publisher policies; and provide cost savings for the nano and emerging technologies ELSI stakeholders. Furthermore, there is an international community of social scientists who work in the field of nano and emerging technologies. Access to a significant portion of this work through a repository could help to expand the reach of research outputs to potential collaborators and generate a critical mass of research products that would perpetuate value and interest in both the field and the repository.

Both CNS-ASU and CNS-UCSB have goals of broad public outreach, and centralizing research and removing financial barriers would contribute to reaching those goals. It would make sense for one or both of these research centers to undertake the development of a disciplinary repository, since they fund at least a quarter of the research in this domain and have the networking capacity to bring researchers from different disciplines together.

However, they are also nearing the end of their funding cycles, which means an appropriate group must be identified to take ownership of a project to centralize and archive nano and emerging technologies ELSI research. Libraries are one possibility, as they can be successful partners with disciplinary communities in the construction and management of disciplinary repositories. The challenge will be to galvanize a distributed community membership to identify with a resource that is managed by a library, or take ownership of a resource that is managed by the community. As we know from arXiv, the greater the ability of the repository to fit the community and its scholarly communication conventions, the more successful it will be.

Whether a library or other community group, the successors of the CNSs should only use the findings of this study as a starting point: the paradigm of publishing and disseminating research through peer-reviewed journal articles is applicable to only half of the output of the CNSs. There is substantial additional content that also needs to be supported and included in any disciplinary repository, such as magazine articles, web pages, and videos, in addition to presentation slides and qualitative and quantitative data. Often, magazine articles, web pages, videos, and presentation slides are more comprehensible content types to the general public, so would be an important component to make available. Data are an important research output, and could be used to leverage invested federal funding. All of these materials may be more easily compiled (with the exception of magazine articles) into a centralized resource, due to the lack of a third party publisher with restrictive copyright policies, and their collection would further consolidate a distributed body of work. A repository that collects, provides access to, and preserves both these diverse outputs and the journal literature would provide a great service to the nano and emerging technologies ELSI community and the researchers that inhabit this domain.

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REFERENCES

Adamick, J., & Reznik-Zellen, R. (2010). Representation and recognition of subject repositories. *D-Lib Magazine*, *16*(9/10). http://dx.doi.org/10.1045/september2010-adamick

Adamick, J., Lewellen, R., & Reznik-Zellen, R. (2013). SPEC Kit 338: Library management of disciplinary tepositories. Washington, D.C.: Association of Research Libraries. Retrieved from http://publications.arl.org/Library-Management-Disciplinary-Repositories-SPEC-Kit-338/

Antelman, K. (2006). Self-archiving practice and the influence of publisher policies in the social sciences. *Learned Publishing*, *19*(2), 85-95. Retrieved from http://eprints.rclis.org/7420/1/antelman_self-archiving.pdf

Brand, A. (2012). Beyond mandate and repository, toward sustainable faculty self-archiving. *Learned Publishing*, *25*(1), 29-34. http://dx.doi.org/10.1087/20120105

CNS-ASU. (2013). About. Retrieved from http://cns.asu.edu/about

CNS-UCSB. (2013). About CNS-UCSB. Retrieved from http://www.cns.ucsb.edu/about

Creaser, C., Fry, J., Greenwood, H., Oppenheim, C., Probets, S., Spezi, V., & White, S. (2010). Author's awareness and attitudes toward open access repositories. *New Review of Academic Librarianship*, *16*(S1), 145-161. http://dx.doi.org/10.1080/13614533.2010.518851

Erway, R. (2012). Lasting impact: Sustainability of disciplinary repositories. Dublin, Ohio: OCLC Research. Retrieved from http://www.oclc.org/content/dam/research/publications/library/2012/2012-03.pdf

Hahn, S. E., & Wyatt, A. 2014. Business faculty's attitudes: Open access, disciplinary repositries, and institutional repositories. *Journal of Business & Finance Librarianship*, *19*(2), 93-113. http://dx.doi.org/10.1080/08963568.2014.883875

Kelly, J., & Letnes, L. (2010). AgEcon Search: A case study on the differences between operating a subject repository and an institutional repository. *Journal of Digital Information*, *11*(1). Retrieved from https://journals.tdl.org/jodi/index.php/jodi/article/view/733/639

Kling, R., Spector, L. B., & Fortuna J. (2004). The real stakes of virtual publishing: The transformation of E-Biomed into PubMed Central. *Journal of the American Society for Information Science and Technology*, *55*(2), 127-148. http://dx.doi.org/10.1002/asi.10352

Laasko, M. (2013). Green open access policies of scholarly journal publishers: a study of what, when, and where self-archiving is allowed. *Scientometrics*, *99*(2), 475-494. http://dx.doi.org/10.1007/s11192-013-1205-3

Puplett, D. (2010a). The Economists Online subject repository: Using institutional repositories as the foundation for international open access growth. *New Review of Academic Librarianship*, *16*(1), 65-76. http://dx.doi.org/10.1080/13614533.2010.509490

Puplett, D. (2010b). Subject repositories: European collaboration in the international context. *Ariadne*, *62*. Retrieved from http://www.ariadne.ac.uk/issue62/bl-subject-repos-rpt

Roco, M. C., Harthorn, B., Guston, D., & Shapira, P. (2011). Innovative and responsible governance of nanotechnology for societal development. *Journal of Nanoparticle Research*, *13*(9), 3357-3590. http://dx.doi.org/10.1007/s11051-011-0454-4

Shapira, P., Youtie, J., & Porter, A. (2010). The emergence of social science research on nanotechnology. *Scientometrics*, *85*, 595-611. http://dx.doi.org/10.1007/s11192-010-0204-x

SHERPA/RoMEO. (2013). FAQ. Retrieved from http://www.sherpa.ac.uk/romeo/faq.php?la=en&fIDnum=|&mode=simple#about

Sherpa Services Blog. (2011). Retrieved from http://romeo.jiscinvolve.org/wp/2011/11/24/60-of-journals-allow-immediate-archiving-of-peer-reviewed-articles-but-it-gets-much-much-better/comment-page-1/

Singeh, F. W., Abrizah, A., & Karim, N. H. A. (2013). What inhibits authors to self-archive in open access repositories? A Malaysian case. *Information Development*, *29*(1), 24-35. http://dx.doi.org/10.1177/0266666912450450

S.NET. (2013). The society. Retrieved from http://www.thesnet.net/TheSociety.html

Spezi, V., Fry, J., Creaser, C., Probets, S., & White, S. (2013). Researchers' green open access practice: A cross-disciplinary analysis. *Journal of Documentation*, *69*(3), 334-359. http://dx.doi.org/10.1108/JD-01-2012-0008

Xia, J. (2008). A comparison of subject and institutional repositories in self-archiving practice. *The Journal of Academic Librarianship*, *34*(6), 489-495. http://dx.doi.org/10.1016/j.acalib.2008.09.016