



Ethics in Science and Engineering National Clearinghouse (ESENCe)
Beta Site

Final Report
May 1, 2009 through April 30, 2011

www.ethicslibrary.org

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1. Participant Individuals

1.1. Senior Personnel

- 1.1.1. Jane E. Fountain (PI; Professor of Political Science and Public Policy; Adjunct Professor of Computer Science; Director, Science, Technology and Society (STS) Initiative; Director, National Center for Digital Government) brings subject matter expertise and depth of experience and commitment building and managing cross-disciplinary and multi-institutional partnerships. In addition to research on the use of digital technologies to enhance and modernize institutions, she is the PI of the International Dimensions of Ethics Education program (NSF 0734887) and directs the Societal Implications of Nanotechnology Research Group within the Center for Hierarchical Manufacturing, an NSF NSEC (NSF 0531171). As the PI, she oversees the intellectual and practical direction of ESENCE and, in particular, is responsible for incorporating social science research into the ethics beta site.
- 1.1.2. Marilyn S. Billings (co-PI and Scholarly Communication & Special Initiatives Librarian) is the liaison between UMass Amherst and the Berkeley Electronic Press, the contractor responsible for the platform and interface used for the ethics beta site. Billings provides campus-wide leadership and education in alternative scholarly communication strategies. She is frequently an invited speaker at the national level and is an expert on author rights, alternative digital publishing models, and the role of digital repositories in current research and scholarship endeavors.

1.2. Other Personnel

- 1.2.1. Jessica Adamick (Ethics Clearinghouse Librarian) provides primary support for the development of the ethics clearinghouse and the collection of materials. She holds a Master of Library Science and a Digital Libraries Specialization from the School of Library and Information Science at Indiana University Bloomington, and a Bachelor of Arts in Women's Studies from Earlham College.
- 1.2.2. Michelle Sagan Gonçalves (Program Manager) ensures compliance with the project timeline and deliverables, coordinates the overall effort, performs research associate-level writing tasks, and, with Adamick, coordinated the digital clearinghouse workshop. Gonçalves holds a Master of Public Policy and Administration and serves as the program manager for the Science, Technology and Society Initiative and National Center for Digital Government at UMass Amherst, both under the direction of the PI.
- 1.2.3. Alex Lent (Intern) is a graduate student in the Library and Information Sciences program at Simmons College. As an Intern, Lent assisted Adamick in finding and adding material to the clearinghouse from 2009-2010.

1.2.4. Vanessa Krejcir (undergraduate) is an undergraduate communication major at UMass Amherst. Vanessa was a student worker in the library supporting digital communications. Krejcir worked for ESENCE for one day in support of the Ethics Day workshop.

1.2.5. Clement Hsu (undergraduate) is an undergraduate philosophy major at UMass Amherst. Clem was a rapporteur at the ESENCE Redefining Tools and Resources workshop.

2. Partner Organizations

None

3. Other Collaborators

None

4. Activities

4.1. Research and Education

4.1.1. Development of ESENCE Online Resource Beta Site

ESENCE was envisioned as an online resource containing research findings, pedagogical materials, and best practices on the ethical and responsible conduct of research (RCR). It launched on October 2, 2009 and was publicly available at www.ethicslibrary.org until November 2, 2010. The project website is www.umass.edu/sts/digitallibrary/, and materials collected for ESENCE are archived at UMass Amherst's digital repository, Scholarworks (<http://scholarworks.umass.edu/esence/>) and have been made available to the new national ethics resource center.

ESENCE was based on a proprietary platform, Berkeley Electronic Press Digital Commons repository software, which was designed primarily for institutional repositories. It is off-the-shelf software which features both simple and advanced search on the site with multiple browsing facets and ensures records are discoverable by academic search engines such as Google Scholar and the Online Computer Library Center (OCLC) WorldCat. The software provides tools whereby users can utilize Really Simple Syndication (RSS) feeds to be notified of any changes or additions to an author, topic, or specific search. It additionally provides access to published journal articles through full-text links via the user's own library resources. In other words, the software recognizes institutional subscriptions to ensure the greatest access to materials for all users.

The ESENCE developers took advantage of the current web-enabled environment of portable applications to build flexibility and dynamism into a standardized platform designed to disseminate collections. For instance, ESENCE was the first site hosted by Berkeley Electronic Press Digital Commons to explore the implementation of widgets for multiple purposes. Our success was a catalyst for other repository sites within the Berkeley Electronic Press community who looked to ESENCE as an example of widget use.

Specifically, developers created several widgets for ESENCE: a blog feed that brought several news feeds to the front page, an exportable events calendar that highlighted RCR conferences and workshops, and a commenting feature available for each record in the repository. The blog allowed for easy identification of important events, materials, or news. The commenting feature provided an interactive space for users -- an entirely new development that our project pioneered for repositories. These Web 2.0 tools made it possible to analyze interaction within blogs and commenting spaces to understand how the site was being used and how materials were evaluated by users. The growth of data scraping software and other machine learning innovations allowed all parts of the site to be analyzed in dynamic models. ESENCE developers received many email inquiries and participated in listserv discussions on the use of widgets to build flexibility and interactivity into what have been fairly static online resources.

In addition to the widgets described above, ESENCE incorporated several other Web 2.0 features into the site including geocoding, RSS feeds, and dynamic browsing. Use of these Web 2.0 tools challenged the stereotype of a clearinghouse or library as a static collection of materials. The tools helped to merge the repository with the more commonly accepted social media platforms and content management websites in the minds of users. To cite one example, when ESENCE geocoded all materials, it allowed users to visualize the national and international reach of content on the site. Moreover, the use of RSS feeds allowed users to subscribe to RSS feeds on ESENCE to receive regular updates about selected types of material. This prevented the user from having to go to a defined library to search for updates. It was our view that the state of the art in information science made it feasible to build a "site" whose materials find users and their networks. Thus, we moved beyond development of a site that was solely a static destination that must be found by users to one that actively pushes material out to users.

Furthermore, the team developed dynamic "browse" features, which were necessary for a repository to be a highly user-friendly site. To make it easier for users to browse through hundreds of records, we developed a sub-sorting browse feature. The ease of navigation created through dynamic browsing allowed users to find the resources they need quickly. ESENCE continued to push the boundaries of the software in this area.

Finally, ESENCE also used Google Analytics to analyze several dimensions of site use. Such analysis allowed developers to refine and to iteratively redesign the site to optimize its structure for more efficient use.

4.1.2. Broadening the Materials Available for Ethics and RCR

The ESENCE site expanded the common definition of RCR by collecting and disseminating a broadened scope of materials. We discuss two main types of materials here: “grey literature,” or materials that are not indexed and searched on the web, and social science research related to ethics and RCR.

Grey Literature. A central strategy of ESENCE was to make available “grey literature:” high-quality ethics education and research materials that are unpublished and not widely distributed or searchable online. The ESENCE site included unpublished case studies, teaching modules, presentation slides, handbooks, and course syllabi in a way that allows these to be indexed and searchable on the web.

The Science of Ethics and RCR. A critical need in ethics is inclusion of social science theory and research, specifically, behavioral research in the social sciences related to ethics and RCR. The objective in the beta site project was to reduce the gap, for example, that currently exists between normative policies concerning cheating and empirical research that explains why individuals cheat or what factors encourage or predict cheating. Social science research on RCR is currently kept separate from RCR training and education. But ESENCE regards it as imperative for science and engineering to bring the two together. Behavioral and institutional research drawn from psychology, sociology, economics, anthropology, and political science are needed to advance knowledge of ethics in science and engineering.

4.1.3. Collection and Site Organization Strategy and Methodology

Library and information science provide powerful tools and methods for collection development and organization of materials. Library scientists guided systematic collection of materials for the ESENCE website through: 1.) database searches and 2.) targeted requests to authors of materials. Collection of materials was informed by 1.) a national online survey to university administrators conducted during summer 2009 and 2.) focus groups with university officials, grants and contracts administrators, graduate school representatives, researchers, and librarians. We describe these procedures in later sections of this report.

To focus search results and most effectively populate ESENCE, team members reviewed key government documents and guides on the responsible conduct of research. We then collected materials in the following categories: Human Subjects, Conflict of Interest, Data Management, Mentor and Trainee Development, Collaborative Research, Authorship and Publication, and Peer Review. To build material in these content areas, library scientists identified handbooks created by professional associations, colleges, and universities, and asked for permission to disseminate them. Once materials were identified, librarians used a “chaining” approach on the handbooks to further identify potential new content using the references cited in existing content. They then licensed

the “grey literature” using Creative Commons licenses, which enabled authors to indicate clearly desired usage of materials.

4.1.3.1. Using Information Science to Dynamically Organize and Grow Materials on the Site

ESENCE team members identified academic and scholarly articles through a number of processes. We used the open access database Securing a Hybrid Environment for Research Preservation and Access/Rights Metadata for Open Archiving (SHERPA/RoMEO) to identify publishers with more liberal copyright policies and searched relevant journals for articles on RCR and mentoring. We also used the Directory of Open Access Journals (DOAJ) and Ulrich’s Periodicals Directory as tools to identify possible journals with liberal copyright policies.

Additionally, we identified articles through a comprehensive review of academic and scholarly databases including Academic Search Premier, ERIC, Google Scholar, JSTOR, PsycARTICLES, PsycINFO, Social Sciences Abstracts, Sociological Abstracts, and the Web of Science. ESENCE selected these databases based on their coverage of ethics education. To find specific articles, we used the following search strategy: (“research ethic*” OR “responsible conduct of research” OR “rcr” OR “animal subject*” OR author* OR “collaborative research” OR “conflict of interest” OR “data management*” OR “ethics education” OR “human subject*” OR mentor* OR “peer review*” OR “plagiar*” OR “whistle blow*”). This process returned articles containing these terms in the title, abstract, or descriptors and that were published during the last ten years in peer reviewed journals.

The research team used two additional collection development methods: citation pearl growing, or the process of using a relevant article’s controlled vocabulary to identify other relevant articles, and chaining, as described previously. Additionally, ESENCE conducted citation searches using Google Scholar and Web of Science.

To organize materials, a record encoded in library science metadata standard Dublin Core was attached to each item in the repository. Dublin Core meets the requirements for discoverability through other large academic databases like Google Scholar and OCLC WorldCat. A Dublin Core record is a means to represent important information about the items in a repository, such as title, author, publication date, abstract, citation, rights and usage information, and a unique identifier. All materials also were assigned subject headings using multiple sets of controlled vocabulary. The repository software then used those fields to present information about materials within the repository in user-friendly ways. For example, users could browse materials in the repository by author name, material types, research areas, or RCR topics, and could sort materials further by date, author, and title.

4.1.3.2. Providing Access to User Library Resources

In cases where ESENCE could not upload or publish full-text journal articles and other formally published materials due to restrictive publisher copyright policies, ESENCE provided links to sites from which users could download material directly. ESENCE used OpenURL standards which enabled easier abstracting and indexing of materials. ESENCE created records for relevant copyrighted journal articles, and the repository software's link resolver used those OpenURLs to read relevant metadata and to connect users to their own library's resources, thereby showing them how to gain access.

Although ESENCE was able to identify and catalog these materials, users will experience different levels of access to commercially published materials depending upon their home institution's ability to afford high-cost database and journal subscriptions. It was inefficient and expensive to buy rights from publishers to post single full-text articles. The diversity of access to resources that users experience in an online repository due to intellectual property restrictions and associated costs represents an area to be addressed in future research and development.

4.1.3.3. Making Products of NSF EESE Awards Available

NSF has invested substantial funding to develop ethics education materials through the Ethics Education in Science and Engineering (EESE) program. To leverage this investment, ESENCE contacted NSF ethics education grant recipients to solicit materials. ESENCE identified Principle Investigators through the NSF website's list of EESE and Ethics and Values in Science, Engineering and Technology grantees. We sent 994 emails to PIs to solicit materials. ESENCE received a 28% response rate from the EESE solicitation and collected materials from eight awards.

This one request for materials and the subsequent incorporation of materials into one searchable site was important in terms of reinforcing a norm that NSF funding supports products that should be widely disseminated. It was particularly timely given NSF's new requirement that proposals include clearly articulated data management plans. Currently, NSF invests millions of dollars into ethics education and research, but the products of these grants are rarely posted online or are dispersed across individual research websites where they are difficult to search and locate. By collecting NSF-funded research into a single, searchable repository that also feeds materials to commonly used search engines, ESENCE: 1.) enabled the public to see more clearly the accomplishments of their tax dollars, 2.) enabled researchers to understand better existing ethics research questions, identify gaps, and build upon existing studies, and 3.) enabled instructors to search and quickly identify materials for classroom use.

4.1.3.4. Increasing Transparency to Strengthen Ethics and RCR

The ESENCE research and development team included public comments and citizen input on the NSF request for comments about their RCR proposal on the site. Although public comments were not immediately publicly released, ESENCE incorporated those comments made available through individual organization's public websites. As institutions formalize their RCR training and mentoring plans, having information about the requirements, institutional responses, and the laws themselves in a centralized location will prove valuable to researchers, university administrators, and ethics educators.

4.1.4. Multi-stakeholder Focus Groups

As mentioned, content selections were informed by focus groups and online surveys conducted by the ESENCE team. Between August and September 2009, six hour-long focus groups were conducted with grants and contracts administrators, librarians, researchers, dean-level administrators, and graduate school representatives. The purpose of the focus groups was twofold. First, we sought to gauge knowledge of and preparation for the RCR requirements in the America COMPETES Act provisions related to university research. Second, we sought to gather feedback on user preferences and requirements for an online, centralized resource such as ESENCE. Specifically, we addressed the following questions to focus group participants:

(1) Beginning January 2010, the America COMPETES Act will require “that each institution that applies for financial assistance from the Foundation for science and engineering research or education describe in its grant proposal a plan to provide appropriate training and oversight in the responsible and ethical conduct of research to undergraduate students, graduate students, and postdoctoral researchers participating in the proposed research project” (Section 7009) and “that all grant applications that include funding to support postdoctoral researchers include a description of the mentoring activities that will be provided for such individuals” (Section 7008). Are you doing anything to prepare for the America COMPETES requirement?

(1a) If yes, please describe what you are doing.

(1b) If no, do you plan to address this requirement before January 2009?

(2) Have you received or sought any guidance from NSF or other entities about how to respond to the America COMPETES requirement?

(2a) If yes, please describe.

(3) Is there any discussion in your professional communities about the America COMPETES requirement or other ethics requirements?

(3a) If yes, please describe the discussions and provide the community/association names.

(4) How will you go about developing criteria to assess whether this section of the proposal is adequate or not?

(5) What resources are you using now? What websites do you go to?

(6) What do you think that you need to reach the requirement?

(7) Do you expect your work processes to change as a result of this requirement?

(8) What is your opinion on the creation of this digital library?

(9) Please describe current initiatives related to ethics education in your department/organization.

4.1.5. Exploratory National Survey of Research Administrators

Additionally, ESENCE surveyed administrators at the top twenty research universities in the United States in terms of total federal research awards during the summer of 2009 to explore emerging plans and responses to the new NSF requirements by major research universities. We assumed that these universities would be “first movers” in planning institutional responses to new NSF requirements. Specifically, we asked:

(1) Are you aware of the America COMPETES RCR requirement?

(2) Have you received any guidance from NSF or other entities/organizations about how to respond?

(3) If you have done anything to prepare for the requirement, please describe your actions.

(4) If you have not done anything to prepare for the requirement, when do you hope to begin preparing?

(5) How will you go about developing criteria to assess the “ethics paragraphs” in the proposals? (Will it be on a case by case basis? Will you seek guidance from anyone? Will you have a committee? If so, who will be on it?)

4.1.6. National Workshop - Ethics in Science and Engineering: Redefining Tools and Resources

The ESENCE research and development team organized a national workshop (<http://www.umass.edu/sts/digitallibrary/workshop>) to build a dialogue between ethics educators, social scientists, and library scientists regarding central challenges and the potential for cyberinfrastructure and digital tools to advance ethics education and to

discuss the role of universities and potential responses to the America COMPETES Act provisions regarding ethics and RCR. The workshop, “Ethics in Science and Engineering: Redefining Tools and Resources,” was held on October 22-23, 2009 at the University of Massachusetts Amherst. All information regarding participants, agenda, background readings, and participant presentations for the workshop is available at <http://www.umass.edu/sts/digitallibrary/workshop>. Information from the workshop report is cited and summarized in the following sections.

4.1.6.1. Objectives

The PI and research team developed the workshop for participants to deliberate on the following questions:

- (1) What *feasible courses of action* might be crafted for institutions that will be required to certify themselves in ethics and responsible conduct of research?
- (2) To what extent might the new NSF requirements be used to encourage *broader approaches* in ethics training and socially responsible conduct of research?
- (3) What do we know about *how researchers and others are actually using digital tools* to promote knowledge sharing in ethics and RCR?
- (4) What *empirical studies* might provide guidance in this domain? What types of studies should be undertaken?
- (5) Among the wide range of tools and applications that come under the Web 2.0 heading, which have the greatest potential to *promote learning and knowledge sharing* in the domain of ethics in science and engineering?
- (6) In what way should we *broaden the definitions of ethics* in science and engineering to encompass greater need for diversity, social justice, globalization, and recognition of changes in the organization and conduct of research?

4.1.6.2. Participants

The PI, co-PI, and project librarian searched extensively to identify innovators and leaders in the relevant areas of library science and ethics education based on demonstrated contributions

(www.umass.edu/sts/digitallibrary/workshop/2009participants.html).

A carefully selected group of invited participants included experts with interdisciplinary knowledge in the social sciences; public policy; science, technology, and society; information sciences; library sciences; human-computer interaction; and ethics.

Library and information science graduate school administrators and instructors offered a broad perspective on the state-of-the-art in information science research related to information sharing and dissemination. This group included Alpha DeLap, Director of Research Services at the University of Washington Information School; Terry Plum, Assistant Dean at the Simmons College Graduate School of Library and Information Science; and John Unsworth, Dean of the Graduate School of Library and Information Science and Director of the Illinois Informatics Institute at the University of Illinois, Urbana-Champaign. These researchers stressed the need to mine research findings—both within library science and beyond—to benchmark development of a national online resource against best practices and the state-of-the-art in information science. In an invited presentation to the workshop participants, Unsworth presented examples of 1.0 and 2.0 clearinghouses and described ongoing research in data and text mining with the potential to strengthen libraries and clearinghouses. He advocated for developers to use research findings concerning the strengths and weaknesses of online versus face-to-face interactions. Library, information, and computer scientists including Jessica Adamick, ESENCE Librarian; James Allan, Professor of Computer Science and co-Director Center for Intelligent Information Retrieval at UMass Amherst; JG Bankier, President of Berkeley Electronic Press; Marilyn Billings, Scholarly Communication Librarian at UMass Amherst; Julia Blixrud, Assistant Executive Director of Scholarly Communication of the Association of Research Libraries; Leslie Button, Associate Director of Collection Services at UMass Amherst; Ann Caldwell, Metadata Specialist at Brown University Library; Mark Leggott, University Librarian at the University of Prince Edward Island and an expert on Internet research and repository software; Think Nguyen, Counsel at Science Commons; Susan Perry, Director of Library, Information and Technology Services at Mount Holyoke College; and Rebecca Reznik-Zellen, Science Librarian for the Center for Hierarchical Manufacturing, a National Science and Engineering Center, and InterNano Project Manager at UMass Amherst provided expertise in digital libraries and scholarly communication. Reznik-Zellen is building InterNano, a nanotechnology subject repository and online resource site that reflects in one domain of research the much broader development opportunities for a national digital ethics library.

Workshop organizers invited a select group of ethics educators with expertise ranging from philosophy to science, technology and society. Anthony Beavers, Professor of Philosophy and Director of the Cognitive Science program at the University of Evansville is the editor of Noesis, a philosophy search engine, and an affiliate of the Indiana Philosophy Ontology Project (InPhO); he is director of the Digital Humanities Library and Executive Director of the International Association for Computing and Philosophy. Michael Bowler, Assistant Professor of Philosophy at Michigan Technological University, is the principal investigator of an NSF Ethics Education in Science and Engineering (EASE) project researching “moral motivation and ethical sensitivity in multinational graduate students.” Gary Comstock, Professor of Philosophy at North Carolina State University and developer of the Open Seminar in Research Ethics, has examined extensively the America COMPETES Act RCR requirements. Matthew Keefer is Associate Professor of Educational Psychology,

Research and Evaluation at the University of Missouri and a specialist in professional ethics and moral development. Lisa Newton, Professor of Philosophy at Fairfield University is an expert on workplace, environmental, and business ethics.

Social science and science, technology and society researchers included Douglas Anderton, Professor of Sociology, Associate Dean for Research, and Director of the Social and Demographic Research Institute at UMass Amherst; Jane Fountain, Professor of Political Science and Public Policy and Director of the Science, Technology and Society Initiative at UMass Amherst; Joseph Herkert, Associate Professor of Ethics and Technology at Arizona State University, who has developed a macro ethics approach to examining ethical dilemmas and teaching ethics education; Deborah Johnson, Chair of the Science, Technology and Society Program and Professor of Applied Ethics at the University of Virginia and a national leader in ethics education at the intersection of ethics, gender, and technology. Maren Klawiter of Yale Law School and Katie Shilton, a researcher at the Center for Embedded Network Sensing at UCLA brought expertise concerning emerging ethical and legal challenges raised by new scientific developments and ubiquitous sensing technologies.

4.1.6.3. Workshop Method

We carefully selected workshop participants to find innovative researchers and scholars and those likely to engage forcefully in discussion and debate. The workshop website provided participants with biographical information, key background papers, and other information to develop shared understanding and research prior to the meeting. Workshop participants met at a dinner held the evening before the workshop for introductions and to reiterate the mission and objectives of the workshop. The workshop itself took place during an eight-hour period and included a combination of presentations, plenary group discussions, and small group sessions. Small groups reported the key points of their discussions in plenary, and we collected key points via PowerPoint slides for thematic analysis of core discussion elements. A group of four graduate and advanced undergraduate rapporteurs recorded the plenary and small group discussions to provide a transcript of the workshop. We used these notes to create a list of key topics and themes raised throughout the workshop and invited participants to “vote” for the high priority themes. These votes were tallied and then the final list of priority topics and challenges was discussed and elaborated during the final plenary session to outline promising future directions and priorities.

4.1.7. Regional Workshop – Ethics Day: Engaging Librarians in the Responsible Conduct of Research

Training in ethics and RCR received increased attention from administrators, scientists, engineers, and ethics education experts as a result of the America COMPETES ethics certification requirements for NSF proposals. In this new regulatory environment, universities will benefit if university librarians develop a fundamental understanding of

research ethics and RCR. They should further play a role in campus-level development and support of ethics training and education. This workshop was designed to advance knowledge and practice for ethics among library and information scientists. The workshop program and speaker biographies are available at <http://guides.library.umass.edu/ethicsday>

4.1.7.1. Objectives

“Ethics Day: Engaging Librarians in the Responsible Conduct of Research,” was held on October 8, 2010 at UMass Amherst. The workshop was an extension of the national workshop “Ethics in Science and Engineering: Redefining Tools and Resources” (described elsewhere in this report) which demonstrated a clear need to incorporate library and information science in the development of cyberinfrastructure and tools for responsible ethics training. Ethics Day was designed to provide librarians with new knowledge about research ethics and to demonstrate possible roles for librarians in ethics -- either in the field of librarianship or in science and engineering disciplines.

4.1.7.2. Participants

A diverse group of faculty, administrators, and librarians gave presentations on issues in research ethics and ethics in librarianship. The first three sessions provided an overview of some of the central issues in research ethics training and education so that all attendees could better understand the issues that their campuses are facing. Two sessions gave concrete examples of the ways in which librarians can directly advocate for ethical research and ethical dissemination of research, and two sessions explored professional ethics in librarianship. A keynote address explored the “landscape of ethics collaboration” to situate ethics and the responsible conduct of research (RCR) training in a larger, international context. The presentations are explored in more detail in the Findings section of this report.

4.1.8. Transition to a Permanent Online Resource Site

As one of two beta sites funded to explore the potential for cyberinfrastructure to support ethics education, research, and practice, ESENCE had a responsibility to ensure a smooth transition of material to the permanent online site identified by NSF. In preparation for such a transition, ESENCE librarians created copyright agreements which licensed materials to appear in ESENCE as well as the future, permanent site at the University of Illinois. This action prevented new librarians from having to request copyright permissions in order to post ESENCE-collected materials in their library. Moreover, all ESENCE materials were meta-tagged to ensure an easy export to a new site. ESENCE spent considerable time thinking through their collection and development strategy knowing the development of a new site at University of Illinois would only overlap with the funding for ESENCE librarians for a short period and, once the Illinois site was announced, made themselves available for questions or other interaction.

It is ESENCE developers' expectations that findings from ESENCE workshops will be incorporated into the development of a new site. Specifically, we have worked to disseminate the urgency to incorporate social science research into ethics education and training and the necessity to explore ethical dilemmas from a macro and international perspective. PI Fountain will serve on the Illinois steering committee in an effort to reinforce these findings.

5. Major Findings

5.1. Open Access for Ethics and RCR Materials

Collecting published materials for the repository is a time-intensive and expensive task. Full collection requires publishers and authors to give ESENCE a non-exclusive right to disseminate their work. However, if an author has signed a copyright transfer agreement, which is typical in most publishing outlets, publishers do not readily grant this right without payment of substantial fees. Requesting permission on a case-by-case basis is inefficient and ineffective. NSF has invested hundreds of millions of dollars on ethics education research and development, yet the public does not have open access to the materials produced as a result of these awards. The Association of American Universities *Report and Recommendations from the Scholarly Publishing Roundtable* (2010) states as its core finding that: "Each federal research funding agency should expeditiously but carefully develop and implement an explicit public access policy that brings about free public access to the results of the research that it funds as soon as possible after those results have been published in a peer reviewed journal." If NSF mandates that all NSF-funded research be deposited into open access repositories, researchers, administrators, and the public will have access to the research they need, for which they have already paid.

5.2. Analysis of Site Usage Statistics

ESENCE incorporated Google Analytics into the Berkeley Electronic Press platform in order to understand usage of the site and its materials. Google Analytics allowed us to gather information concerning individual users without revealing their identity. We could drill down to the country, state, and city of use; record the amount of time spent on the site; track the materials most frequently downloaded; and identify keywords used to find ESENCE and to find materials within ESENCE. Results from the Analytics tools indicated which categories of materials were more frequently searched and allowed us to tailor the homepage to make those materials and themes more easily accessible.

ESENCE users came from 102 countries, and ESENCE received more than 27,500 page views. When compared to similarly sized "educational resources" websites, as defined by Google Analytics, ESENCE traffic ranked favorably. In fact, the number of visits to ESENCE was 638% higher than average for "educational resources," and visitors to ESENCE spent 754.73% more time on the site per visit. The site was launched in October 2009 and closed November 2010, so these results are merely suggestive, and use is emergent without clear or stable patterns for analysis. Yet the inclusion of fine-grained indicators of use is critical if developers and educators are to understand and improve the use of such online resources. We

included a set of figures in the appendix of this report to illustrate some of the key usage statistics gathered.

5.3. Focus Group Findings

We conducted six focus groups with a total of 18 participants. As a beta site working rapidly to build a prototype system, our objective was simply to gather key administrators and researchers to query these users in order to broaden our understanding of preferences and interests in an online resource for ethics and RCR. Thus, the responses reported here are merely suggestive and do not reflect the results of sampling or any statistically significant group of respondents. We sought to explore initial impressions of those tasked with developing and monitoring responses to the America COMPETES Act provisions related to ethics and RCR on the University of Massachusetts Amherst campus, classified by the Carnegie Foundation as a “Very High Research Activity” (RU/VH) institution. This exploratory data gathering effort should be supplemented with systematic, national data gathering efforts in order to understand early responses to new NSF requirements and to detect patterns across universities.

We sought information from key higher education administrators and researchers representing multiple stakeholder views. Focus group participants provided detailed information concerning their expectations for an online resource center and the needs of their offices or units.

In general, administrators wanted to understand how “quality control” would be maintained in an online resource environment and what the legal exposure of an entity hosting such a site would entail. Administrators expressed enthusiasm at the incorporation of social networking and other Web 2.0 tools and reacted positively to possibilities for engaging lively discussion of materials in ethics and RCR. The key challenge, they reported, was creating “a site that looks academic and peer reviewed, as well as being accessible and lively and entertaining.” They were willing to engage with an online clearinghouse, but stressed that materials needed to be easy to find and clearly labeled. In terms of new NSF and other federal requirements, they asked for clear guidance from U.S. federal agencies, and specifically from the National Science Foundation, regarding implementation and review of compliance. In part because that guidance does not exist, administrators are interested in benchmarking against peer institutions and their implementation of the relevant America COMPETES requirements.

Faculty and researchers, by contrast, expressed little interest in ever visiting an online resource for ethics and RCR. If they were planning to submit a proposal to NSF, they wanted boilerplate language that could be used to fulfill the RCR requirements. They voiced concern over adding additional, time-consuming requirements to research protocols. As they reported, this did not mean that they felt ethics and RCR training are unimportant; they emphasized the time pressures related to balancing research and teaching, and a new anticipated requirement that they review a broad array of ethics trainings or materials to find the best fit for their lab or classroom. They suggested that an RCR resource site be designed with two levels of engagement: a first level would include boiler-plate language for compliance while a second

level would provide a rich collection of materials for those with more interest and responsibility to explore.

A common concern raised in most focus groups, except those involving faculty, was the lack of requirements for faculty ethics and RCR training. Indeed, the current RCR requirements at NSF focus squarely on students and postdoctoral researchers. Non-faculty focus group participants reported a view that ethics training should be required of all researchers, including faculty.

5.4. Exploratory National Survey Findings

During summer 2009, we surveyed senior research administrators in offices of grants and contracts, research affairs, or research compliance at the top 20 federally funded research universities in the United States. Surveys were sent to directors or associate directors of research administration offices. Fifty percent of schools responded, which is a surprisingly high response rate for survey research. The objective was not to conduct a broad-based scientific study, but to gain an early and exploratory sense of responses by the nation's top research universities. Responses from ESENCE's survey of administrators at federal grant-getting universities revealed early preparation for implementing programs that institutions thought would meet NSF's standards. Research administrators reported that they sought guidance from third party organizations and peer institutions. Two institutions cited involvement with the Council of Graduate Schools as a way to remain apprised of the state of affairs. Another noted conference calls with peer campuses on "the most effective approach[es] for being in compliance." A third convened "a committee comprised of representatives from academic units with a history of receiving funding from NSF to develop a plan for providing the needed RCR training." Others have examined the state of ethics and RCR training across their campuses, especially in light of existing National Institutes of Health requirements.

5.5. National Workshop Findings

ESENCE produced a workshop report describing findings from the national ethics in science and engineering workshop (http://www.umass.edu/sts/digitallibrary/pubspress/goncalvesetal_workshopreport.pdf). Many of the key points are also reported here.

The workshop contributed to building a multi-disciplinary network of scholars and administrators interested in deepening and broadening ethics and RCR research and education. It provided for cross-fertilization of ideas through deliberation among experts from the social sciences; public policy; science, technology and society; information sciences; library sciences; and ethics.

We identified four themes that recurred throughout the workshop discussions: 1) the need to broaden the ethics and RCR community to include greater multi-disciplinarity as a means to

foster knowledge creation and dissemination; 2) the critical need to incorporate social science research and other areas of expertise in order to strengthen the knowledge base and to bring to bear empirical research methods and results; 3) the current gap between available knowledge in the information and library sciences, specifically regarding digital platforms and tools, and the use of this knowledge for online resources in ethics and RCR; and 4) the importance of ensuring easy and open access to materials.

5.5.1. Develop a Networked, Multi-disciplinary Community of Practice

A recurring theme throughout the workshop was a call for an ethics and RCR “community” that would extend across the disciplines of science and engineering. Although individual disciplines have professional societies with codes of conduct or other standards in place, few resources or meeting points currently exist for interdisciplinary or multi-institutional work. This multi- and interdisciplinary community is particularly difficult to develop because researchers who extend their research programs or other activities to include ethics and RCR are expected to identify with an interest in ethics and RCR within their discipline. Thus, experts, materials, and research findings are fragmented and difficult to find.

No map exists that clearly outlines the networks of researchers in this field or that defines what research is being conducted, which subsequently limits how information is shared and used. This lack of a defined community may be one contributing reason for the numerous existing ethics education and ethics clearinghouses. The absence of a single, centralized resource to outline and define the growing community has encouraged a proliferation of websites and inward-looking programming.

A permanent, centralized, online resource center must resonate with an identifiable community and help bring together disparate resources. This cataloging and sorting of information will be most effective if it extends beyond merely collecting the results of online searching capabilities. Instead, the resource should reach out to existing institutions and programs to encourage them to build from each other’s strengths. Indeed, the development of both internal and cross-institutional communities is critical.

If an online resource center is to answer the call for improved ethics and RCR training, it must be a destination as well as a living community. It should be aesthetically pleasing, easy to navigate, and incorporate a number of information sharing tools so that all target demographics perceive the site as addressing their needs. Authors who submit work should be able to make updates to items under review. Researchers should be able easily to share records with colleagues and to give input and feedback on resources.

5.5.2. Include Social Science Research in Ethics and RCR

Ethics and RCR will benefit from incorporating social science research expertise into existing theory and practice. A broader base of theory, research, and practice will reflect

actual challenges faced by scientists, engineers, and their institutions in the public, private, and non-profit sectors. Two areas for growth were emphasized by workshop participants: First, there is a critical need to extend the boundaries of ethics and RCR in science and engineering to include relevant social and behavioral science research. Second, the field requires greater inclusion of library and information science research concerning search, retrieval, and knowledge discovery.

Enduring theory and research at the levels of individual, social, and institutional behavior provide illuminating frameworks and insights into, for example, the conditions under which individuals or groups tend to deviate from professional norms; how norms are developed and sustained; and how institutions such as government agencies and universities encode and enforce norms. Research on innovation in groups, on stress and its effects on performance, on cross-cultural understanding and socialization, on the relationship of management structures and practices to performance and much more offer an empirical knowledge base to bring ethics and RCR into alignment with current institutions and practice. While normative theories are central, a range of behavioral research has been missing from ethics and RCR. This gap in knowledge is unacceptable and detrimental to national competitiveness. Within the social and behavioral sciences, a rich trove of empirical research on subjects central to the conduct and organization of science and engineering holds promise to broaden how ethics and RCR are defined, understood, taught, and measured.

This extension of the ethics and RCR knowledge base will complement and extend knowledge and conceptual frameworks currently in use. Integrating social and behavioral science research into the ethics and RCR community—and extending the community to encompass more social scientists—will extend the materials to be captured or developed for an online resource center. For example, social science research that explores the conditions under which decisions are made and the underlying behavioral tendencies of researchers who fabricate data should not be separated from articles, case studies, and other materials that outline examples of data fabrication. National and institutional statistics about ethics violations will become more useful if they are supported by research that explores the conditions under which ethical violations are likely to occur. Current ethics education lacks a macro ethics perspective, thereby ignoring important cultural, institutional, and international dimensions of science and engineering—even as globalization of science and the global movement of scientists and engineers proceed rapidly. Thus, an integrated framework for ethics education must be created.

Social and behavioral science integration will encourage a broadening of the definition of “ethics” in science and engineering. For example, the challenges of diversity in science and engineering form central questions of ethics, such as why is participation of women and under-represented minorities so weak in many areas of science and engineering? There has been growth in recognition of social justice and its role in science and engineering education, but this is rarely connected explicitly to ethics. Yet the unequal benefits of science and engineering in societies and an array of social justice issues are of obvious significance to ethics. The international dimensions of ethics and RCR demand much greater research as science and engineering have globalized and as flows of

scientists and engineers increasingly cross national borders and cultures. The transformative effects of cyberinfrastructure on the conduct of scientific investigation and engineering research require systematic inquiry in order to understand and exploit potential to increase innovation, scientific discovery and downstream benefits of science and engineering. All of the above are examples of significant developments that call out for a more expansive definition of ethics and RCR. To address all these 21st century dimensions of the scientific enterprise, a new definition of ethics must draw upon the full range of knowledge and research available.

The role of library and information science also was made clear at the workshop, specifically with respect to information search, retrieval, classification, and organization—the critical elements for an online resource. Participants noted that the central role played by university libraries, which serve all disciplines, makes them a potentially powerful locus for cross-disciplinary knowledge platforms and systems. Information and library science have been at the forefront of use, display, and organization of multiple media including interactive, visual, and other creative approaches. For example, videos, simulations, graphical, and mapping resources emphasize visual display of information and invite interaction and exploration. By drawing ethics examples from contemporary culture using current media, information might be made more engaging to students.

5.5.3. Use Information and Library Sciences to Improve Information Discovery

Computational research and tools that currently enhance visibility of collaborative scientific research have a strong potential to advance the delivery of ethics and RCR knowledge. Using these tools and research findings to deliver trainings and other materials directly to scientists has the potential to markedly increase their value and usability. Utilizing existing computational resources, for instance, would enable a repository to embed ethics education across disciplines in a way that conforms to the actual work and research practices of scientists and engineers.

In order to encourage resource discovery, information from an online resource site should be pushed out to users through a number of methods. Users should not be expected to know about the site, and so it should not be constructed *solely* as a destination but as a resource that can “find” those who need the information when they need it and in the form that it is needed.

To further extend its reach, the developers of an online resource should use social networks as well as software and tools to seek to build relationships among records, collections, repositories, clearinghouses, and other related websites. A consortium of site supporters and contributors is critical not only to ensure discovery, but also to facilitate use. Creating semantic metadata for resources will allow users to benefit from information that is pushed out to other databases. Currently, users have to visit multiple sites to find and access the data they need, especially when searching for multi-disciplinary scholarly resources. With semantic metadata, specifically Resource Description Framework (RDF), materials from the repository could appear in meaningful

and contextualized ways outside of the repository site. All of these efforts will make information discovery easier.

5.5.4. Ensure Open Access to Materials

Research should be available to the public to ensure maximum benefit to society and to increase innovation and knowledge development. Open access to articles and teaching materials will ensure broad dissemination which will enable more institutions and organizations to incorporate high-quality materials into trainings, classrooms, and other meetings. The National Science Foundation has taken a proactive stance in encouraging open access to materials. NSF should require all materials produced through programs like EESE to be deposited into a single, centralized resource for digital, free, and immediate access. Additionally, researchers funded through NSF might be required to keep their copyright when publishing and to grant a non-exclusive right to the single, centralized resource identified by NSF to disseminate their work.

Such standardized dissemination is best accomplished through an open access repository that uses the Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH). OAI-PMH repositories make their metadata shareable so that it can be harvested and searchable via engines such as Google Scholar, WorldCat.org, and WorldCat Local. These first two institutionalized search engines are free and gaining momentum

Finally, authors should be encouraged to disseminate “gray literature,” such as works-in-progress, reports, syllabi, case studies, presentation slides, videos, teaching modules, and other material types which are not traditionally formally published. These are the very materials that may be built upon and reused in a classroom or lab setting for ethics and RCR education. Thus, the availability—and searchability—of these types of materials is critical.

5.6. Regional Workshop Findings

ESENCE produced a workshop report describing findings from the regional Ethics Day workshop (http://www.umass.edu/sts/digitallibrary/pubspres/adamick_ethicsday.pdf). Many of the key themes are also reported here.

5.6.1. Central Issues in RCR and Ethics Training

New ethics policies from funders have prompted many institutions to review and reassess existing ethics trainings, certifications, or requirements. Serving as links to multiple disciplines and centralized resources for a range of university affiliates -- from undergraduate to graduate students, and from lecturers to full professors -- librarians and libraries must understand the current political and cultural climate for RCR.

Jennifer Donais, associate director of the University of Massachusetts Amherst Office of Grant & Contract Administration, outlined a history of ethics requirements of NSF and

NIH. As a foundation, librarians should be aware of the nine Office of Research Integrity Core Areas of RCR: research misconduct, protection of human subjects, animal use and welfare, conflicts of interest, data management practices, mentor and trainee responsibilities, collaborative research, authorship and publication, and peer review. When librarians understand the legal justifications for new requirements, as well as background information for the processes and procedures implemented at various institutions, they become catalysts ushering in a new climate for new research ethics and can more effectively help researchers to frame research questions, prepare grant proposals, or manage existing or unforeseen ethical dilemmas. Moreover, scholarly communication librarians work on a daily basis with issues of collaborative research, authorship and publication, and peer review, so it is important for them to be cognizant of the ethical complications of these issues that researchers may be facing.

Elizabeth Buchanan, director of the Center for Applied Ethics at the University of Wisconsin-Stout, introduced attendees to complexities inherent in Internet Research Ethics (IRE). As principal investigator for the Internet Research Ethics Digital Library, Resource Center, and Commons, Buchanan advocated for a transformation of traditional models of research ethics. Moreover, as a PhD- and MLIS-prepared researcher, Buchanan was a critical bridge between librarians and the field of research ethics. Buchanan outlined a new framework for ethics, methodologies, and rules for e-research and posited that currently well-defined issues such as human subjects, intentionality, and cultural, disciplinary, and institutional differences must be re-assessed when conducting and reviewing e-research. Indeed, a new discourse on ethics is necessary for responsible e-research; such transformation is noticeable in how institutional review boards are approaching Internet research. Regardless of the language used to discuss ethics or the processes and policies in place, IRE involvement should be a natural extension of day-to-day work for many librarians, given their familiarity with Internet resources, trends, and research.

5.6.2. Role of the Librarian

Roles for librarians in research ethics have not been widely documented or recognized. Two Ethics Day sessions gave concrete examples of the ways in which librarians can directly advocate for ethical research and ethical dissemination of research. Nancy Harger and Judy Nordberg (both Education and Clinical Services Librarians at the University of Massachusetts Medical School Lamar Soutter Library) spoke about their experiences serving on the University of Massachusetts Medical School's IRB, a position foreign to most academic librarians. Nancy Pontika (adjunct faculty at the Graduate School of Library and Information Science at Simmons College), on the other hand, presented on a role more familiar to library scientists: open access promoter.

As IRB members, Harger and Nordberg supported protocol reviewers, primarily performing original searches for each protocol to supplement the work of the principal investigators. To fill an existing gap in the review process, they mentioned that librarians could also preform literature searches for principal investigators before a protocol was reviewed. Not only did serving on an IRB introduce Harger and Nordberg to a new

dimension of research, but it supported the library's mission of outreach, enabled networking across campus, refined search skills, and contributed to an understanding of the clinical trial approval process. IRB participation supports the service mission of many college and university libraries, and directly inserts librarians into the faculty research process.

Although Pontika's presentation topic was a familiar one to most librarians, considering the ethics of open access added a distinctive dimension to the open access debate. Pontika's presentation situated the state of scholarly communications and the open access movement squarely in line with the evolving ethics and RCR-awareness at many academic institutions. In addition, moral arguments in favor of open access were presented, including author control, empowering free flow of scientific information, and enabling taxpayer access to publicly funded research. Pontika also advocated for librarians to train faculty members, administrators, university presses, and scholarly communication staff on open access issues due to their expertise on journal evaluation, publisher practices, copyright and licensing, and ability to find other resources. Educating on open access issues and understanding ethical arguments in favor of open access relates to the work involved with serving as a resource on issues of collaborative research, authorship and publication, and peer review, and understanding the ethical complexities of those issues.

5.6.3. Ethics in Librarianship

The last two sessions focused on ethics in librarianship. The increasing emphasis on research ethics at funder and institutional levels provides librarians with the opportunity to brush up on professional ethics. John DeSantis, Cataloging and Metadata Services Librarian at Dartmouth College, outlined the American Librarian Association's (ALA) Library Bill of Rights and Codes of Ethics, drawing from his experience serving on the ALA Committee on Professional Ethics. Citing the literature, he pointed out that confidentiality and privacy, integrity, equal access to information, and professional development were the most frequently identified principals in library codes of ethics. While ethics trainings are not generally required of librarians, they can seek out ethics education opportunities in order to develop professionally and to be able to relate to the various ethics trainings and education taking place in academia.

In science, technology, engineering, and mathematics fields (STEM) fields, mentorship is often discussed in relation to ethics education as a form of modeling scholarly integrity. Hongjie Wang, Head of the Information and Education Services Department at Lyman Maynard Stowe Medical Library at the University of Connecticut Health Center, discussed the benefits of implementing a mentoring program for librarians. As an author of articles on academic mentorship in libraries and a member of mentoring programs at the University of Connecticut Health Center, Wang made a case for mentorship as a part of professional development, especially given that many aspects of librarianship are often learned on the job. Indeed, on-the-job training is particularly relevant for science librarians who often find themselves learning disciplinary matter based on their professional appointment. Because most libraries do not explicitly focus on professional

ethics, a mentoring relationship could be a crucial tool for safely resolving moral dilemmas in the workplace.

5.6.4. Landscape of Ethics Collaboration

Sheila Bonde, professor of history of art and architecture and professor of archaeology at Brown University, gave a keynote lecture on the current institutional ethics environment. While scholarly integrity has been long recognized as a pressing issue within academic communities, few scholars have examined how the cultural context in which ethical decision making occurs influences outcomes or action. Bonde, however, who has led ethics training for graduate students as the Dean of the Graduate School at Brown for numerous years, has examined these issues as principal investigator of an NSF-funded project investigating the cross-cultural challenges of ethical decisions and developing new contextually-focused ethics training programs.

Bonde's address highlighted the necessity to view ethical dilemmas from both a micro and macro perspective. While ethics and scholarly integrity are valued on an international level, ethical decision-making takes place at both an individual and institutional level and always within different cultural contexts. It is impossible to fully understand any dimension of ethics without examining the context in which it is situated. Thus, legal, political, and social variations across cultures must be taken into consideration when implementing ethics education programs.

Moreover, science is increasingly globalized and takes place at an international scale. Technology has enabled immediate collaboration across borders and rapid dissemination of information. This internationalization of science has the potential to dramatically impact ethics education and training because it greatly expands ethical dimensions for research. Ultimately, Bonde asked if the "international character of research [would] bring about a uniform, international ethical standard for research or will these be limited and defined by cultural differences in ethical decision-making?"

Regardless of how globalization may affect ethics, librarians remain well prepared to interpret and disseminate new findings, policies, and standards. Librarians are well aware of the global impact of online research related to dissemination of and access to information, and Bonde inspired the audience to think even more broadly about an increasingly global research and development environment.

5.6.5. Roles and Future Directions for Librarians in Research Ethics

Raising awareness about ethics education and training and RCR amongst librarians is critical. Librarians work to support research and learning and are in excellent positions to play important roles in support of research ethics. Continued emphasis on the development of online resources in support of research ethics is a crucial first step. Several examples currently exist which may act as models for development. EthicShare is a research and collaboration website for ethics developed at the University of Minnesota that includes several librarians on the project team. Another example is the Ethics

Education Library (EEL) developed by the Center for the Study of Ethics in the Professions at the Illinois Institute of Technology. EEL has partnered with the National Academy of Engineering's Online Ethics Center and is managed by a librarian. Finally, the National Center for Professional and Research Ethics under development at the University of Illinois at Urbana-Champaign includes a librarian as one of the co-principal investigators.³ Liaison librarians should become aware of these resources and their discipline's domain-specific ethics issues, as many faculty will need to provide or participate in the training of students and postdocs, and may seek resource referrals from their librarians on these topics. For example, the librarian who manages EEL makes materials referrals for NSF Research Experiences for Undergraduates (REUs).

Another documented role that librarians can take to support research ethics is serving on an IRB (Cheek & Bradigan, 2008; Frumento & Keating, 2007; Robinson & Lipscomb, 2005; Wessel, Tannery, & Epstein, 2006). Several workshop attendees reported participation on Institutional Care and Animal Use Committees (IACUC), very similar work. Most of the literature on librarians serving on IRBs describes experiences of health sciences or hospital librarians, but there is also a role for librarians who serve STEM fields. Responsible Literature Searching for Research: A Self-Paced Interactive Educational Program is an excellent tutorial for both librarians and researchers on literature searching for IRBs. It is authored by Charles Wessel, a Health Sciences Library System Reference Librarian at Health Sciences Library System at the University of Pittsburgh.

Librarian advocacy for open access is well-established (Albert, 2006; Chan, Kwok, & Yip, 2005; Palmer, Dill, & Christie, 2009), as are the ethical justifications for open access (Covey 2009; Harnad, 2007). The ethics of open access are related to the broader topics of ethics in scholarly communication discussed above: publishing and authorship, peer review, and collaborative research. This advocacy is a third role that librarians can take in support of research ethics. Libraries are just beginning to partner with research administrators and offices of grants and contracts to deliver services to researchers such as data management plan consulting and the hosting and dissemination of grant-funded research outputs. More partnerships regarding the ethics of scholarly communication are possible, particularly for research-intensive institutions. For example, libraries could develop systems that support collaborative work on a technical level or they could provide researchers with material dissemination options.

Resource development and referral work, IRB, and IACUC involvement, and ethics in scholarly communication are well documented on their own, but rarely exist in the broader context of librarian involvement with research ethics. This report outlines these roles for librarians in research ethics. Librarians who serve science and engineering disciplines should understand core and discipline-specific issues in research ethics and be able to provide services or make referrals to appropriate resources. Given the growing emphasis on research ethics at funder and institutional levels, librarians should become familiar with ethics in our own field. Ethics Day strove to engage librarians with these issues and could serve as a model for low-cost, consciousness raising programs that will

more formally document and develop the role of librarians in science and engineering ethics.

6. Training, Development, and Mentoring

6.1. Training and Development

ESENCE contributed to the development of research and teaching skills for project team members in several ways. Most importantly, it provided a multi-disciplinary arena in which disciplinary knowledge could easily flow between researchers. ESENCE provided an opportunity for researchers and librarians to explore and better understand existing metadata and taxonomies for ethics, as well as the importance of social science research for ethics education and training. ESENCE was an opportunity to create – in a very limited timeframe – a complex digital library and to test the boundaries of existing repository software and Web 2.0 techniques. Moreover, ESENCE provided networking, teaching, and knowledge sharing opportunities for graduate and undergraduate students through two workshops.

6.2. Outreach Activities

As described above, ESENCE team members conducted a national survey of the top 20 research universities during summer 2009, organized focus groups and informal meetings with grant and contract administrators, graduate school administrators, and faculty at the University of Massachusetts Amherst throughout the Fall 2009 semester to publicize the clearinghouse and gain feedback about the needs and interests of the clearinghouse's potential user base, and have been in contact widely with researchers and administrators to solicit materials and to answer questions about the potential use of materials in ESENCE to respond to America COMPETES Act requirements. The ESENCE research group has tracked email and telephone inquiries, which have been numerous as institutions form responses to new NSF requirements.

The ESENCE library scientists have spent considerable time exploring the best methodologies for gaining visibility and marketing this educational resource. Because the materials in ESENCE are configured to be available through Google Scholar and OCLC's WorldCat in addition to the standard search engines, the site's reach is much further than that of a traditional website. Statistics gathered from Google Analytics demonstrate that ESENCE is being accessed internationally and widely used throughout the United States. When compared to other “educational resources” sites, ESENCE ranks very highly in terms of the amount of time spent on the site, pages accessed per visit, and total page views. In sum, we have precise indicators and statistics regarding who is using the site and how they are using it. This type of information may be used to improve and refine the design of such resources.

The two workshops, described in detail above, were major outreach contributions for this project.

Finally, conference presentations by team members, outlined below, have increased the visibility of ESENCE's materials and resources throughout the globe and have provided opportunities for discussion and feedback regarding how best to develop the beta site based on user needs and institutional constraints.

6.2.1. Presentations

All presentation slides and posters are available at
<http://www.umass.edu/sts/digitallibrary/pubs.html>

- Adamick, J. (2010, December). Marketing a Small-Scale Subject Repository Through Collection Development. Poster session, 6th International Digital Curation Conference. Chicago, IL.
- Adamick, J. (2010, November). Active and Targeted Collection Development Strategies for Small-Scale Subject Repositories. Poster session, SPARC Digital Repositories Meeting. Baltimore, MD. [poster] [slide]
- Adamick, J. (2010, October). Subject Repository Development as an Act of Virtual Community Creation. Poster session, LITA 2010 National Forum, Atlanta, GA.
- Adamick, J. (2010, October 20). Report on 'Ethics Day: Engaging Librarians in the Responsible Conduct of Research.' Research Libraries Council Meeting. Invited presentation. University of Massachusetts Amherst, Amherst, MA.
- Adamick, J. (2010, June 26). Subject Repositories as Virtual Communities. American Library Association Annual Conference. Poster session, American Library Association, Washington, D.C.
- Adamick, J. (2010, March 26). The Ethics in Science and Engineering National Clearinghouse Beta Site: Building a Resource for a Research Community. Western Massachusetts Health Information Consortium Meeting. Invited presentation. Holyoke, MA.
- Adamick, J. (2010, March 23). Making Teaching Visible: Using Repositories to Disseminate Grey Literature. Exploring New Options in Digital Publishing. NorthEast Regional Computing Program (NERCOMP), Amherst, MA.
- Adamick, J. (2009, October 28). Introduction to the Ethics Clearinghouse Project. Senior Management Group Meeting. Invited presentation. University of Massachusetts Amherst, Amherst, MA.
- Adamick, J., & Reznik-Zellen, R. (2010, May 21). Subject Repository Trends. Scholarly Communication Brownbag Series. University of Massachusetts Amherst, Amherst, MA.

- Adamick, J., & Reznik-Zellen, R. (2010, April 12). Generalizing the Subject Repository: An Investigation into Potential Best Practices. Spring 2010 Membership Meeting. Coalition for Networked Information, Baltimore, MD.
- Billings, M. (2009, July 23). Evolving Models of Scholarly and Scientific Publishing. Association of College and Research Libraries, New England Chapter (ACRL NEC) Scholarly Communication SIG Workshop, Dartmouth College.
- Billings, M. (2009, October 2). ESENCE: The Ethics Clearinghouse, an Example of Partnering with Faculty on Externally Funded Grants, American Library Association, Library Information Technology Association Conference, Salt Lake City, UT.
- Fountain, J. (2009, June 23). International Dimensions of Ethics in Science & Engineering. Invited presentation for the panel, Ethics in the International Context. NSF Civil, Mechanical and Manufacturing Innovation (CMMI) Research and Innovation Conference: Research in a Flat World, Honolulu, HI.
- Fountain, J. (2009, September 11). ESENCE and NSF Requirements. Invited presentation to the University of Massachusetts Amherst Research Council, Amherst.
- Fountain, J. (2009, September 24). Creating Access to Knowledge: Ethics in Science & Engineering. Invited lecture. Fourth Annual Digital Quadrangle Series, UMass Amherst.
- Fountain, J. (2010, February 19). Expanding Ethics in Science and Engineering. Panel presentation. National Science Foundation and Ethics Education in Science and Engineering Workshop. American Association for the Advancement of Science (AAAS) 2010 Annual Meeting, San Diego, CA.
- Fountain, J. (2011, February 28). Ethics in Science and Engineering National Clearinghouse Beta Site. EESE PI Meeting, National Science Foundation, Arlington, VA.

6.3. Products

6.3.1. Publications

- Adamick, J. (in preparation). Subject Repositories as Virtual Communities.
- Adamick, J. (2010). Workshop Report: Ethics Day: Engaging Librarians in the Responsible Conduct of Research.
http://www.umass.edu/sts/digitallibrary/pubspress/adamick_ethicsday.pdf

- Adamick, J. (2009). Literature Review as Call to Action: Addressing the Need for Evaluations of Subject Repositories. White paper prepared for Ethics in Science and Engineering: Redefining Tools and Resources workshop. Available online: <http://www.umass.edu/sts/digitallibrary/workshop/adamicklitt.pdf>
- Adamick, J., & Reznik-Zellen, R. (2010). Trends in Large-Scale Subject Repositories. D-Lib Magazine 16 (11/12). <http://www.dlib.org/dlib/november10/adamick/11adamick.html>
- Adamick, J., & Reznik-Zellen, R. (2010). Representation and Recognition of Subject Repositories. D-Lib, 16(9/10). <http://www.dlib.org/dlib/september10/adamick/09adamick.html>
- Adamick, J., Buchannan, E., Fountain, J., Gonçalves, M. S., & Proferes, N. (2010). Responsible Conduct of Research and Research Ethics. White paper submitted to the National Science Foundation Social, Behavioral & Economic Sciences 2020 Project. http://www.umass.edu/sts/digitallibrary/pubspres/adamicketal_white.pdf
- Gonçalves, M. S., Fountain, J. E., Adamick, J., & Billings, M. (2010). Workshop Report. Ethics in Science and Engineering: Redefining Tools and Resources. Amherst, MA: Ethics in Science and Engineering National Clearinghouse. http://www.umass.edu/sts/digitallibrary/pubspres/goncalvesetal_workshopreport.pdf

6.3.2. Web site or other Internet sites

- www.ethicslibrary.org ESENCE home
- <http://scholarworks.umass.edu/esence/> Scholarworks archive
- <http://guides.library.umass.edu/ethicsday> Ethics Day workshop website
- www.umass.edu/sts/digitallibrary/workshop Ethics in Science and Engineering workshop website

7. Contributions

7.1. To the Principle Disciplines of the Project

As a central resource in science and engineering, ESENCE focused across all the disciplines and fields of science and engineering that were supported through the National Science Foundation. Its principal contribution was to broaden and deepen the definitions and knowledge base for ethics and RCR in science and engineering by extending current definitions to include social and behavioral sciences research. To note one example, the globalization of science and engineering – including transnational movement of science and engineering students – is poorly captured in research and education. The international dimensions explored in most science and engineering courses are minimal by contrast to a rapidly globalizing workplace and the increasingly transnational production of scientific and

engineering knowledge. To note another example, the discipline of psychology includes rich streams of research on mentoring, learning, influence, deception and several other behavioral dimensions underlying scientific and engineering practice.

The project contributed to the “principle discipline” – ethics and RCR (which are, of course, not disciplines) by extending and deepening the theoretical constructs and empirical research streams brought to bear on these domains of inquiry. The development of ESENCE increased incentives for social scientists to study ethics and RCR in science and engineering through the disciplines of psychology, sociology, political science, economics, and related applied fields.

As a subject repository, ESENCE contributed to the fields of information and library sciences with relevance to many of the NSF CISE programs. Research on subject repositories has not nearly reached maturity, and there is a lack of information related to the design, development, and management of subject repositories. For example, although subject and institutional repositories have different audiences, delivery, and discovery needs, existing repository software options reflect the needs of institutional rather than subject repositories. Subject repositories, as destination sites, would benefit from complex browsing capabilities, a conveyance of turnover of information, and aesthetically pleasing interfaces. ESENCE expanded the boundaries of its software platform, Berkeley Electronic Press’ Digital Commons. Although some improvements were made to Digital Commons to accommodate the unique functionality of subject repositories, repository software across the board should be more fully developed. With several articles and presentations on this topic, ESENCE will play a major role in the development of this research and applications area of information science. “Literature Review as Call to Action: Addressing the Need for Evaluations of Subject Repositories,” a white paper written by one of ESENCE’s librarians, described the current gaps in library science understanding of repositories. In general, the field needs research and writing on subject repositories to help repository managers better design and manage projects and to examine and develop best practices. Members of the ESENCE team are currently preparing several articles that will form important contributions to this virtually unexplored topic.

7.2. Other Disciplines of Science and Engineering

ESENCE provided a critical resource for faculty, administrators, researchers, and students in a wide range of science and engineering disciplines. The materials compiled and archived in the ESENCE databases was used to educate and train a science and engineering workforce to make them more prepared for the complexities of research and work in contemporary universities and professional science and engineering. The ESENCE online resource provided content and infrastructure for research and training.

7.3. The Development of Human Resources

As a response to the America COMPETES Act, ESENCE was a primary resource for education, mentoring, and training materials that were critical for the development of human resources throughout the university and professional career cycles. Our vision was for faculty, researchers, and administrators to use, re-use, and remix a wide variety of the published and unpublished materials archived on ESENCE that were gathered from university workshops, orientations, and the classroom. As described throughout, the project was meant to provide resources to enable institutions to build a more responsible and ethically-aware workforce.

7.4. The Physical, Institutional, or Information Resources that Form the Infrastructure for Research and Education

As an online resource and clearinghouse, infrastructure provision was one of the main goals of ESENCE, and its contributions to building digital infrastructure for research and education was described throughout this report. The merging of technology and education is rapidly advancing, and materials like those available in ESENCE must be accessible in a free and easy manner. ESENCE collected, organized, and archived materials that to help instructors – even those without formal ethics training themselves – to incorporate ethics and RCR into classrooms and laboratories.

7.5. Other Aspects of Public Welfare beyond Science and Engineering

The online resource, ESENCE, was available without barriers on the World Wide Web. Because materials were licensed with Creative Commons licenses, they could be further shared and modified. Thus, the site could be used in professional settings as a resource for business ethics, as well as for use by government agencies, nonprofit institutions, and educational institutions beyond the university setting. Members of the public interested in science and engineering would find the materials in ESENCE of interest, as would primary and secondary school teachers looking for various ethics resources.

ESENCE has value beyond the United States and may be a tool to develop transnational dialogue between the U.S. National Science Foundation and its counterparts in other governments as decision makers develop shared values and standards for the conduct of science and engineering globally.

The intersections across disciplines that are at the cutting edge of scientific discovery, the increasing ubiquity of computing and digital tools, and the globalization of science and engineering education and practice demand a robust, flexible and accessible online resource for ethics and responsible conduct of research. The ESENCE online resource was designed to respond to these challenges.

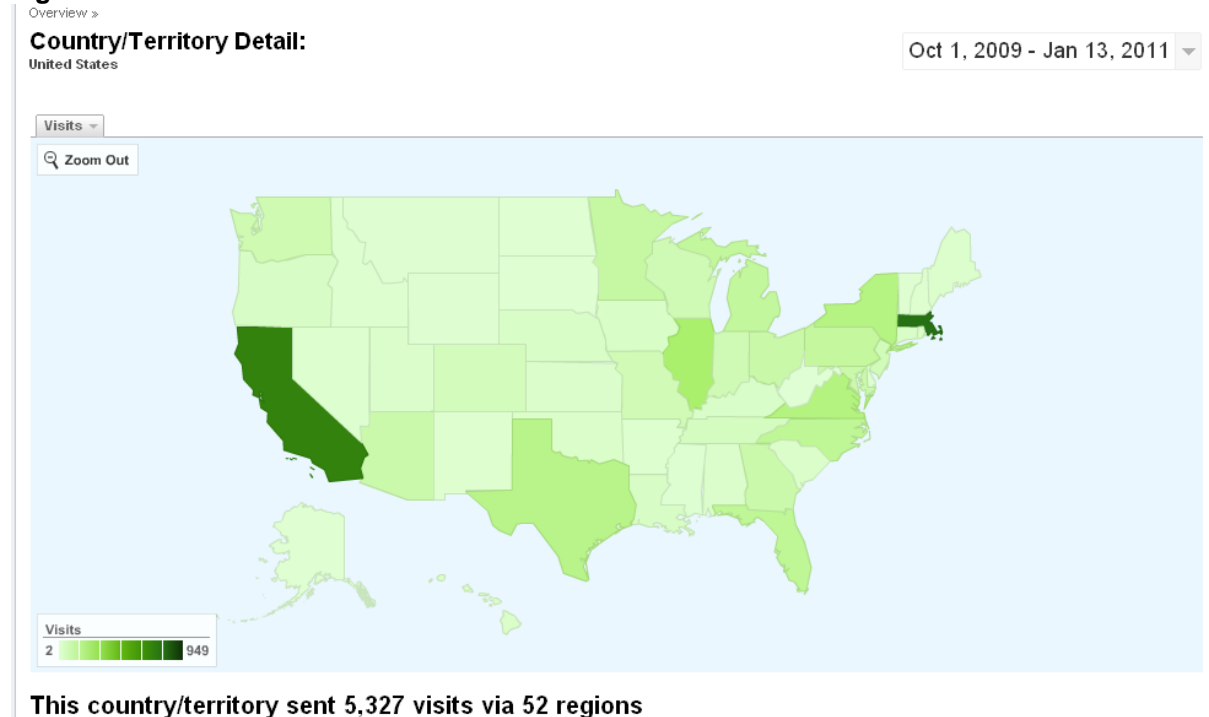
APPENDIX A: Statistics of Site Usage and Key Site Features

Figure 1. International Reach of ESENCE Materials



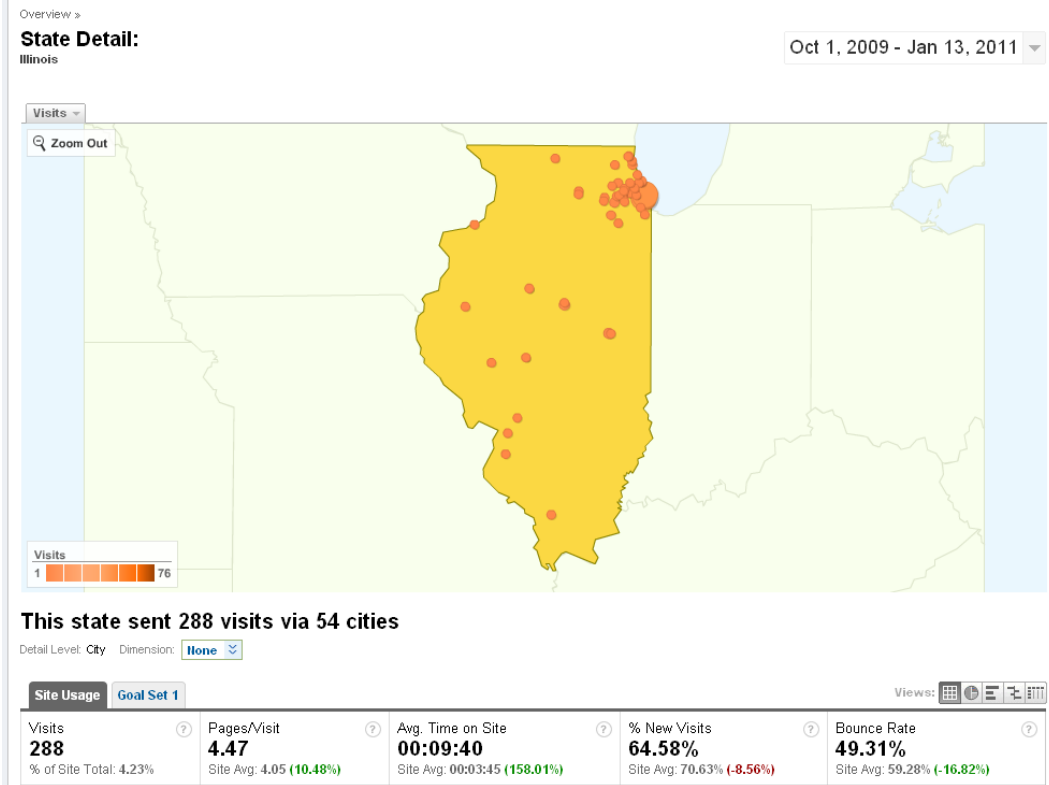
The map overlay above displays visually the reach of ESENCE materials. Visitors to the ESENCE website have come from 102 countries, with the majority of visitors coming from within the United States. (Figure from Google Analytics).

Figure 2: Visitor Locations within the United States



Since its launch in October 2009, ESENCE has received visits from all 50 states in the US. (Figure from Google Analytics).

Figure 3: Example of City Usage Data



Google Analytics enables ESENCE to track site visits at the city level. Using Illinois as an example, this figure shows 288 visits. (Figure from Google Analytics).

Figure 5: Pushing Out Materials through Google Scholar



Records within ESENCE are discoverable through popular search engines like Google Scholar and the Online Computer Library Center (OCLC) WorldCat, as well as through the ESENCE site itself.

Figure 6: Features of ESENCE Records

The screenshot shows a web page for an article titled "Is There an Effective Approach to Detering Students from Plagiarizing?". The page includes a search bar, navigation links, and a list of authors. Callout boxes point to specific features:

- Links to other works by author:** Points to the author list at the top of the article.
- Links to publisher's version of article:** Points to the "Link to Full Content" button.
- Connects users with their own library's resources:** Points to the "Find in your library" button.
- Indicates author's location:** Points to a map showing the location of the authors.
- "AddThis" button to share materials:** Points to the "AddThis" button in the top right corner.
- Creative Commons license:** Points to the Creative Commons Attribution-NonCommercial-NoDerivative Works 3.0 License icon.
- Comment with or without signing in:** Points to the "Post a new comment" section.

ESENCE Web 2.0 features into the site, including comment forums, geocoding, RSS feeds, and dynamic browsing.