

Current Models of Digital Scholarly Communication

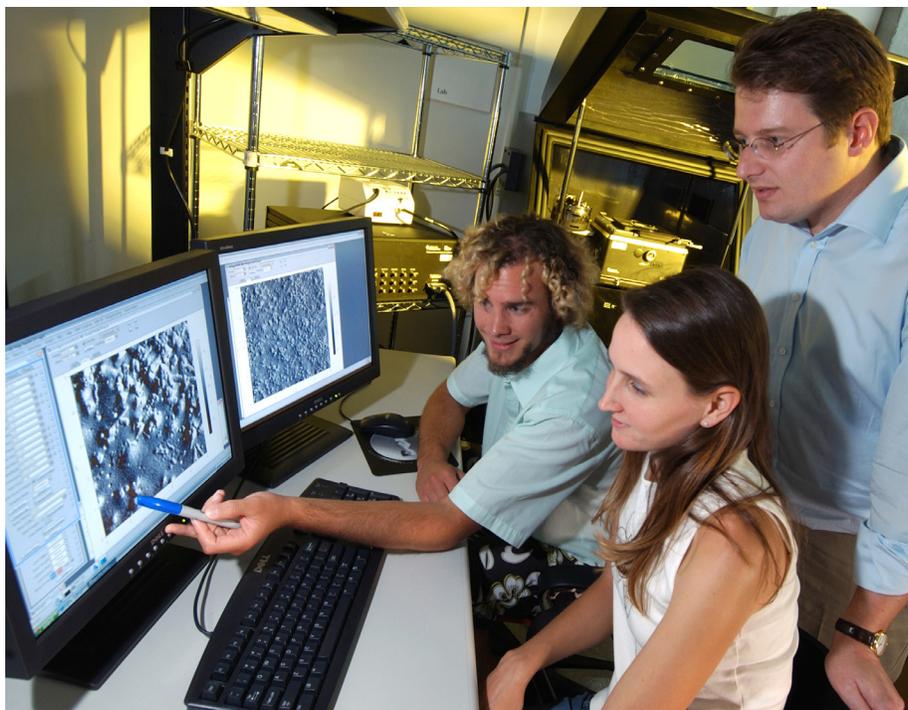
Results of an Investigation Conducted by Ithaka for the Association of Research Libraries

November 2008



I T H A K A

Nancy L. Maron
K. Kirby Smith



Association of Research Libraries

Current Models of Digital Scholarly Communication
Results of an Investigation Conducted by Ithaka Strategic Services
for the Association of Research Libraries



I T H A K A

Ithaka is an independent not-for-profit organization with a mission to accelerate the productive uses of information technologies for the benefit of higher education worldwide. Ithaka promotes innovation in higher education by supporting entrepreneurial not-for-profit initiatives to develop sustainable organizational and business models. We aim to combine a commitment to the core values of higher education, a deep understanding of technology and its impact, and experience developing economically sustainable not-for-profit business models, to help advance community-wide benefits during this time of technological transition.

Published by the
Association of Research Libraries
Washington, DC 20036
www.arl.org

Cover photo courtesy of the National Science Foundation



This work is licensed under the Creative Commons Attribution-NonCommercial 3.0 Unported License. To view a copy of this license, visit <http://creativecommons.org/licenses/by-nc/3.0/> or send a letter to Creative Commons, 171 Second Street, Suite 300, San Francisco, California, 94105, USA.

Contents

- Preface.....5
- Executive Summary.....7
- Introduction9
- Methodology 11
 - Creation of the field team11
 - Identifying new digital scholarly resources12
 - The data gathering process12
- How Faculty Use Digital Publications 15
 - How do scholars use these sites?.....15
 - How often do scholars report using these resources?.....15
 - In what ways do scholars engage with new models of digital publishing? ...16
- Types of Digital Scholarly Resources 17
 - E-only journals18
 - Reviews 21
 - Preprints and working papers 22
 - Encyclopedias, dictionaries, and annotated content 24
 - Data resources 26
 - Blogs..... 28
 - Discussion forums 29
 - Professional and academic hubs..... 31
- Summary of Findings 33
- Looking Ahead: Digital Scholarly Resources and the University Library 35
- Appendix A: Field Team Participation 37
- Appendix B: Current Models of Digital Scholarly Resources by Type 39
- Appendix C: List of Interviews 47
- Appendix D: Digital Scholarly Resources by Disciplinary Group..... 49

List of Figures and Side Bars

Figure 1. Frequency of Use of Submitted Digital Scholarly Resources	16
Figure 2. Digital Scholarly Resources by Type	17
EXPERIMENTING WITH PUBLIC PEER REVIEW: <i>Atmospheric Chemistry and Physics</i>	19
EXPANDING THE DEFINITION OF A JOURNAL: <i>JoVE's</i> video articles	20
ESTABLISHING LEGITIMACY FOR DIGITAL BOOK REVIEWS: <i>Bryn Mawr Classical Review</i> and <i>H-France Review</i>.....	22
IN THE FOOTSTEPS OF arXiv: PhilSci Archive	24
IMAGES BEFORE WORDS: Visualizing Cultures and Image-Driven Scholarship	25
HARNESSING THE POWER OF USERS: eBird.....	27
ACCELERATING THE SPEED OF SCHOLARLY DISCUSSION: PEA Soup.....	29
THE CONTINUING RELEVANCE OF THE LISTSERV: H-France Forum.....	31
ONE-STOP SHOPPING: Alzheimer Research Forum.....	32

Preface

How are we to understand new forms of scholarship and scholarly works in their own right? It is a vexing question for those of us who aspire to grasp how the system of scholarly communication is adapting to a digital networked environment. Nearly a decade into the twenty-first century, new forms are no longer hypothetical but increasingly part of the everyday reality of research and scholarship.

The urge to consider new forms in comparison to the monograph and journal genres that dominate library collections and the consciousness of the Academy is powerful. Yet, this frame for interpreting changing practices of scholarly communication carries the risk of falling into a certain circularity of thought – we may acknowledge that scholarly works will change and yet behave as if anything that doesn't look like a traditional work of scholarship is not a scholarly work; thus the immutability of traditional publishing models becomes axiomatic. Different becomes less by definition. From this perspective, any counter-example is regarded as exceptional rather than appreciated as transitional or transformational.

Yet, for close observers of scholars and scholarship, something about this doesn't seem quite right. Within the library community, discussions of new kinds of scholarly works have tended to return again and again to the same short list of examples. While these seem to be thriving and growing, scholars and research can often identify others they use. Collectively, there has been a sense that many new kinds of scholarly works are successfully contributing to the scholarly communication system, but that effective frameworks for noticing them,

understanding trends and patterns, or simply judging how far change has progressed are lacking.

An organized scan of new models of scholarly works has been needed, and this study set out to identify examples from as many disciplines as possible. With a sizable collection of resources, it becomes easier to ask questions like: Are there emerging genres? What kinds of quality control practices are used? What are different disciplinary strategies?

Fortunately, as a plan for a study of new model works developed, staff in Ithaca's Strategic Services Group agreed, with the happy result that ARL commissioned Ithaca to implement the study and develop the final report.

The study that produced this report was conceptualized as a project that would look squarely at new forms of scholarship and scholarly works and consider them in their own lights. It was also conceived as a mechanism to engage librarians and faculty members in mutual explorations of the ways in which scholars and researchers are already relying on new models.

From the outset, the study was designed to concentrate on new kinds of works that are already in active use within a research community or discipline. Yet one of the challenges was that no listing for new model resources exists. The [Directory of Open Access Journals](#) is perhaps closest to a registry, but its scope is limited to a particular genre and by an accessibility criterion. In many cases it seems that only the scholars who create or use a new kind of work or collection are aware of it.

The field study concept solved this problem by providing a mechanism to work directly with faculty to identify new model works they were using with the result that this research was a unique community effort. This innovative qualitative approach succeeded in generating a substantial collection of examples for analysis.

But the field study served a second important function by providing a structure that encouraged and supported librarians to reach out to local faculty and consult with them in exploring the kinds of works that were in use in various disciplines. Initiating several hundred of these conversations on campuses in the US and Canada was a substantial study outcome in its own right. ARL is grateful for the contributions of these generous volunteers – both librarians and faculty members.

The richness of examples that emerged from the field study validates impressionistic observations that a variety of new models have become embedded in disciplinary communication practices. If regular use by a community of scholars is a reasonable measure of success, then a substantial number of new model resources are successful. By closely examining the diverse examples collected for the study, the authors have taken a major step toward describing a largely unexplored ecosystem – one that we now know occurs across a wide range of disciplines. Further, the exemplar resources gathered in the database released with this report should help other explorers of the changing landscape of scholarly communication.

For those who believe scholars and researchers are unwilling to change their practices of sharing new

knowledge, this work offers significant evidence to the contrary. While the faculty members who spoke with librarians for the study may not be entirely representative of their communities, hundreds of conversations found that established scholars and relative novices alike reported using and contributing to new kinds of works in their field. Notably, a large proportion of the works faculty talked about with librarians were developed by scholars (rather than traditional publishers) to meet needs or pursue opportunities that served their desire to advance the creation of new knowledge in their field. Just as scholars themselves invented the scholarly journal, they are taking the lead in inventing a new generation of scholarly works.

This study is intended to support librarians, scholars and researchers, campus and association leaders, along with other interested constituencies navigating shifting patterns of scholarly communication. It presents new landmarks for those who want to engage in further exploration. But, it also provides a basis for ongoing dialog about how best to advance positive change in scholarly communication.

The field study has already advanced conversations about changing communicative practices on many campuses, and this report provides an opportunity to deepen those and begin new ones.

Karla Hahn
Director, Office of Scholarly Communication
Association of Research Libraries

Executive Summary

The networked digital environment has enabled the creation of many new kinds of works that are accessible to end users directly, and many of these resources have become essential tools for scholars conducting research, building scholarly networks, and disseminating their ideas and work. The decentralized distribution of these new model works can make it difficult to fully appreciate their scope and number, even for university librarians tasked with knowing about valuable resources across the disciplines. In the spring of 2008, ARL engaged Ithaka to conduct an investigation into the range of online resources valued by scholars, paying special attention to those projects that are pushing beyond the boundaries of traditional formats and are considered innovative by the faculty who use them.

A field team of librarians at ARL institutions in the US and Canada was assembled to interview faculty members on their campuses about the digital scholarly resources they find useful in their work. The field team of 301 librarians at 46 institutions interviewed professors about the digital resources they use. Ithaka staff then evaluated each resource to ensure that it met ARL's definition of "original and scholarly works," those resources containing born-digital content by and for a scholarly audience. Of the 358 responses the field team gathered, 206 unique digital resources met these criteria. These resources are included in a publicly-accessible database.¹ The final report is based on both the fact-checked results of the field study and interviews

subsequently conducted by Ithaka with project leaders of eleven representative resources. This qualitative approach, while not statistically meaningful, yielded a rich cross-section of what innovation in digital scholarly resources looks like today.

The final report identifies eight principal types of digital scholarly resources:

- E-only journals
- Reviews
- Preprints and working papers
- Encyclopedias, dictionaries, and annotated content
- Data
- Blogs
- Discussion forums
- Professional and scholarly hubs

This report profiles each of these eight types of resources, including discussion of how and why the faculty members reported using the resources for their work, how content is selected for the site, and what sustainability strategies the resources are employing. Each section draws from the in-depth interviews to provide illustrative anecdotes and highlight representative examples.

Among the findings of this study were:

- While some disciplines seem to lend themselves to certain formats of digital resource more than others, examples of innovative resources can

¹ The database is available at: <http://www.arl.org/sc/models/model-pubs/search-form.shtml>

be found across the humanities, social sciences, and scientific/technical/medical subject areas.

- Traditions of scholarly culture relating to establishing scholarly legitimacy through credentialing, peer review, and citation metrics exert a powerful force on these innovative online projects. Almost every resource suggested by the interviewed scholars incorporates peer review or editorial oversight. Though some born-digital journals are beginning to experiment with open peer review, the examples we observed were still in early stages.
- Many digital publications are directed at small, niche audiences. There appears to be a very long tail in the field of digital scholarly resources with many tightly-focused publications directed at narrow audiences and capable of running on relatively small budgets.
- Some of the resources with greatest impact are those that have been around a long while. Given the importance of longevity in establishing scholarly reputation, the necessity of building an audience to attract high-quality content, and the time it takes to fine-tune a digital resource, even excellent new digital publications

may need years to establish their place in their scholarly community.

- Innovations relating to multimedia content and Web 2.0 functionality appear in some cases to blur the lines between resource types. We observed “video articles,” peer-reviewed reader commentary, and medieval illuminated texts coded as data – all evidence of the creative format mash-ups that challenge us to re-think the definitions of traditional content categories.
- Projects of all sizes are still seeking paths to sustainability. For open access sites – the vast majority of the resources studied here – the challenges can be great, since subscription fees are not an option. Nearly all of the publications that emerged in our survey are experimenting to find economic models that will support their work.

This report indicates several ways that university librarians can play a central role in sharing information about these digital resources with the campus community, and in guiding new projects toward success. In addition, the field team model has provided a path for enriching future interactions between faculty and librarians, one which ARL continues to develop.

Introduction

As electronic resources for scholarship proliferate, more and more scholars turn to their computers rather than to print sources to conduct their research. While society journals, university presses, and conference proceedings still form the backbone of the scholarly publishing enterprise, alongside them many new digital scholarly resources have appeared, sprouting up wherever there is a devoted individual or team of scholars willing to create and nurture them. Born-digital journals, blogs, wikis, and other forms of online publishing and discussion now appear in every discipline. While some of these digital resources resemble their print predecessors, others are quite novel, making use of the space, speed, and interactivity that the Internet allows. Though many digital scholarly resources are small in scale, this does not necessarily make them marginal; some have already gained widespread acceptance in their fields on par with the print publications that, until just a decade ago, held an unchallenged monopoly on disseminating scholarly work.

This rapid proliferation of Web-based resources has had an impact on how scholars conduct research and keep abreast of new work by their peers. In the past, a university professor might expect to learn about new work in her field by reading articles published in scholarly journals. Well-articulated systems of selection, review,

publication, and distribution also existed for scholarly monographs. For both types of publication, the campus library played a central role in gathering these scholarly outputs for the academic community.

Today, the university library still plays a central role in distributing both print and online resources, but the networked digital environment has enabled the creation of many new kinds of works that are accessible to end users directly. The decentralized distribution of these new digital resources can make it difficult to fully appreciate their range and number, even for university librarians tasked with being familiar with valuable resources across the disciplines.

Given the wealth of digital scholarship created and disseminated independently by scholars, research teams, associations, and other entities, the Association of Research Libraries (ARL) wanted to explore the variety of online resources currently in use by the scholarly community. In spring 2008, ARL engaged Ithaka to help survey the broader landscape of these resources, to understand more about the resources that exist, and to highlight particular examples of innovation. Using a variety of examples that emerged through this investigation, this report describes some of the ways in which scholarly communication is occurring in a digital world.

Methodology

ARL's objective was not to provide an exhaustive survey of the resources in use across all disciplines, but rather to highlight interesting and relevant examples of digital scholarly resources, their contribution to the scholarly process, and the organizational and business models that help them survive and thrive. For this reason, a qualitative research approach was selected. Although qualitative research does not enable statistically-driven conclusions or generalizations, it is a valuable method for unearthing unique examples and understanding broad trends. ARL asked Ithaka's Strategic Services group to support them in the creation, training, and deployment of a team of librarians to interview faculty members about the digital scholarly resources they use, and in the interpretation of these results. We hope this investigation will be of interest both to faculty and students looking for digital sources for their research or new models for publishing their own work, as well as to the librarians who support faculty and students in these endeavors.

Creation of the field team

A field team of librarians at ARL institutions in the United States and Canada was recruited to interview faculty members on their campuses about the digital scholarly resources they find useful in their work. ARL invited librarians from all its member institutions and other institutions involved with the Institute on Scholarly Communication to participate, and assembled a field team of 301 volunteers from 46 colleges and universities in the

United States and Canada.² Librarians from three pilot institutions – the University of Washington, Cornell University, and the University of British Columbia – signed on to help develop the interview protocols. In some cases, the entire library staff assigned to faculty liaison work was asked by their director to participate; at other institutions, interested librarians joined independently.

The participating librarians embraced this project not only because of their interest in new digital scholarly resources, but also because it provided an opportunity for structured interaction with faculty members at their institutions. In fact, many participating library directors voiced support for this project as a means to initiate or continue deep engagement between librarians and scholars on campus. The value of this field team in facilitating conversations about digital resources between librarians and faculty could extend well beyond its role in this particular study.

Ithaka and ARL conducted Web-based training sessions to provide the field team members with necessary background on the project's goals and to present the questionnaire that would structure their conversations with faculty. A question-and-answer session followed the presentation and the webcast was archived on the ARL Web site so that new field team members joining after that date could still benefit from the training. As the field work started, an electronic discussion list allowed members of the field team to share questions and tips with the entire group.

² For a list of institutions that participated in the field team, please see Appendix A.

Among the topics discussed in detail during the training was how to define the new models of digital scholarship we were looking for so librarians could ensure that their conversations focused on similar resources. When the library field team participants conducted their interviews, they asked faculty members to identify for them the “online works you rely on to keep up with current research,” and, specifically, those that could be described as containing original scholarly work. They were asked not to focus on search engines or sites that provided only collections of links.³

Identifying new digital scholarly resources

ARL’s primary interest was in identifying sites with content that was both original and scholarly. “Original” was defined as born-digital material (content that appeared first on the Web site in question). In cases where the resource consisted of digitized primary source content, such as medieval manuscripts, we considered it original if the site facilitated some sort of new scholarly manipulation of the content, or if it was published alongside a layer of original scholarly annotation. Though digitized versions of print publications and search tools pointing to content hosted elsewhere may be extremely useful to scholars, they were outside the scope of this study. “Scholarly” resources are those authored by and for the scholarly community. This definition encompassed a wide variety of formal and informal resources, including peer-reviewed publications like e-only journals, but also sites that scholars use to share casual information or thoughts-in-progress, including discussion forums or blogs. Considered outside the scope of the study, however, were popular-interest resources, such as YouTube and Wikipedia. Although it would be fascinating to study the way that sites like these are becoming both the subject of and a resource for scholarly work, because the

³ Several faculty members did, in fact, mention search engines and aggregations of links. See footnote 4 for a discussion of those resources that were excluded from the field study.

focus of these resources is not scholarly communication they were considered outside the scope of this study.

The data gathering process

Between April 1 and June 17, 2008, field team members conducted interviews with faculty members to ask them about the online resources they use that contain original scholarly work. The faculty members were encouraged to offer as many examples as they felt were relevant. For each resource cited, the field team member asked a set of questions including how the scholar uses the resource, his opinion on how the resource accomplishes something innovative, and how often he uses it. In addition, field team members asked a series of questions relating to the resource, including its method of selecting content and business model. In some cases, faculty members knew this information. When they did not, field team members conducted follow-up research about the sites after the interviews to verify factual information and to fill in answers to questions that the faculty member could not answer. Finally, field team members entered this information into a Formspring database set up by ARL. The field study conversations yielded 358 responses. Three of these were from interviews with scholars who said they used no digital resources at all; the other 355 described digital resources.

The Ithaka team then reviewed each suggested resource to determine if it met the agreed-upon definition of a new digital scholarly resource. About two-thirds of all responses – 240 resources – met the requirement of containing some original scholarly content.⁴ This set

⁴ While 240 of the entries faculty and librarians submitted to the study database met the criteria set out by ARL as “scholarly and original,” 115 did not. These resources, though often of high quality, were excluded from analysis for this report. They included: aggregations of links to other sites; software and digital tools; digital copies of print content; industry newsletters; commercial and/or mass audience sites; and teaching-focused resources. Faculty reported using these resources daily far more often than they did the resources that include works of original scholarship. This suggests that scholars’ priority is to find relevant content, regardless of where it is hosted. Among the additional reasons

included several resources named by more than one respondent. The number of unique resources that scholars reported to the library field team participants was 206.⁵

At this stage, Ithaka staff assessed all of the resources in this group, and assigned each to one of eight categories of resource types for purposes of analysis. Ithaka then selected eleven representative projects and conducted in-depth phone interviews with project leaders and key staff to gain a deeper understanding of the mission, goals, and organization of the different publishing models. These interviews helped Ithaka gain insight into how their leaders think about strategies for creating and developing site content over time, metrics for understanding the site's users, experimentation with technical innovations, and different sustainability strategies.⁶

This report relies upon three sources of data:

- **Data gathered by the field team through faculty interviews.**

The method employed by the field team, known as convenience sampling, is commonly used in exploratory research. It suited the time and resource constraints of the project as well as the goal of creating a qualitative assessment of a specific type of resource. The information gathered by the field team helped guide us to examples of innovative digital scholarly resources that faculty are using today. Faculty members' answers to the librarians' questions also helped to explain why professors use certain resources, what they find most innovative and valuable about them, how often they use them, and whether they contribute to the resource as authors or editors. These data points provided a glimpse into the way that these digital publica-

tions are being incorporated into the workflow of some scholars.

- **Data about the resources themselves.**

This information, supplied originally by the faculty member, and corrected or verified by the field team member, helped to describe the types of content on the site, methods of selecting content for the site, whether or not there is a peer review process in place, if there appeared to be institutional support for the site, and more. In addition, the team at Ithaka inspected the sites to verify as much of this information as possible.

- **In-depth interviews conducted with the project leaders and key personnel.**

The interviews Ithaka conducted with the leaders of eleven representative projects provided a picture of just how these projects have grown and developed over time, the strategies that have worked (or not) for some of them, and the ways in which project leaders think about fulfilling their mission. The interviews were conducted, when possible, by both an interviewer and a note-taker.

By integrating these three sources of information, this project offers a snapshot of what innovation in digital scholarly resources looks like today. The report begins by assessing the ways in which faculty report using the new digital resources they recommended. Then, we examine eight types of digital scholarly resources, describing their content, the ways faculty report using them, and their strategies for success. Examples drawn from specific digital projects provide a fuller picture of the kinds of resources in use, the innovations underway, and the challenges their leaders face in sustaining them.

faculty cited for using these resources were quick access, easy searching, and useful overviews.

⁵ See Appendix B for a listing of the 206 unique resources discussed in this report.

⁶ For a list of the interviewees and resources, see Appendix C.

How Faculty Use Digital Publications

How do scholars use these sites?

How do scholars use digital resources to help with their research needs? Providing access to the most current research was by far the most frequent reason suggested by the faculty with whom field team librarians spoke. Facilitating exchanges among scholars and supplying useful co-location of works were also mentioned often, field librarians reported. Many faculty indicated that the resource they suggested accomplished not one, but all three of these goals. Scholars in different disciplinary categories – humanities, social sciences, and science, technical, and medical (STM) fields – tended to note different reasons for finding a resource useful. Librarians noted that across all disciplines faculty emphasized their interest in access to current research as the most important benefit of the resources they identified. Field librarians speaking with scholars about humanities and social sciences resources, however, were much more likely to find that faculty appreciated those resources for facilitating exchanges between researchers than did faculty nominating resources in STM subjects. This does not mean that scientists are not interacting with their colleagues using the Internet, but that they less frequently cited those types of sources, such as blogs and discussion lists, where “exchanges among scholars” is a primary function. By far, STM resources – data sites and e-journals were most often named – seemed to be valued for providing access to new research; we heard this response more frequently for STM resources

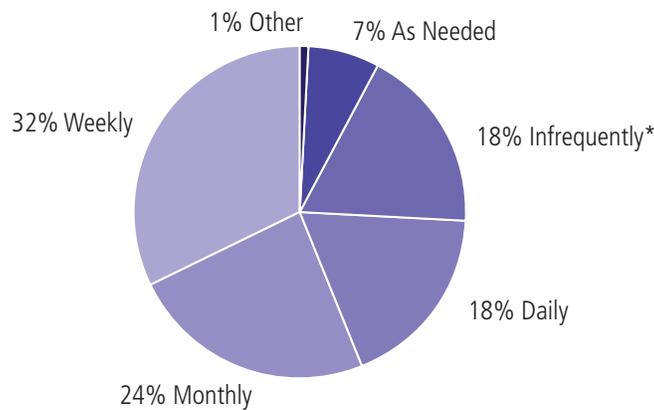
than for any others. Faculty members told librarians that other aspects they appreciated in these sites included news and alerts about publications, conferences, and other developments in the field; and access to different types of content including data, primary source material, reviews, and teaching materials.⁷

How often do scholars report using these resources?

About half of the faculty in our study told field team librarians that they used the site they named at least weekly. This was similar for interviewed scholars in all disciplines. Certain content types, however, seem to demonstrate specific patterns of use; faculty who used data sites, for example, told librarians that their usage was not constant, but rather varied depending on their current research project. In addition, it is interesting to note that many of the resources scholars mentioned using daily were those considered outside of the scope of this study, such as search sites like Google, reference sites like Wikipedia, and other finding tools like online catalogs and aggregations of links pointing to content held elsewhere.

⁷ For an ongoing study of scholarly communication, assessing “how and why scholars do what they do to advance their fields, as well as their careers,” see Diane Harley, Sarah Earl-Novell, Sophia Krzys Acord, Shannon Lawrence, and C. Judson King, “Interim Report: Assessing the Future Landscape of Scholarly Communication,” (Spring 2008), available at: <http://cshe.berkeley.edu/publications/publications.php?id=300>

Figure 1. Frequency of Use of Digital Scholarly Resources (n=240)



* "Infrequently" includes resources that scholars reported using a few times a year, annually, or less often.

In what ways do scholars engage with new models of digital publishing?

Scholars are both the producers of and the audience for digital scholarly communications. While many of the ways in which scholars contribute to print publications also exist in the digital world – writing and peer-reviewing articles, editing journals, reviewing books, etc. – electronic media also facilitate new forms of scholarly contributions. Examples of this include moderating a discussion list, contributing data to a shared repository, posting thoughts and annotations on a blog, or editing a wiki. Almost half of the interviewed faculty contributed to the resource they suggested to the librarians. Nearly a third of these contributions consisted of offering content; other forms of participation included contributing reader commentary, contributing editing services, managing a site, providing peer review to e-only journal articles or moderating a discussion list.⁸ And not surprisingly, it ap-

pears that those scholars who nominated a site to which they contribute were more likely to tell librarians that they visit that site daily.

Our findings suggest that scholars at all stages of their careers are experimenting with participation in new models of digital publishing. We found no evidence that the assistant professors with whom librarians spoke – presumably younger and more immersed in a digital world – contributed to the resources they suggested more frequently than their more senior colleagues. Perhaps there are other factors encouraging senior faculty to participate (the protections of having tenure, invitations to participate from other colleagues) and discouraging younger faculty (a sense of caution regarding where to publish work before receiving tenure). Further research would be needed to better understand the factors motivating or discouraging faculty to participate in different forms of digital communication.

⁸ It is worth noting that the librarians who conducted these conversations may have been inclined to seek out faculty members with a reputation for being active users of digital resources, so these numbers may not be representative of rates of contribution across the academy.

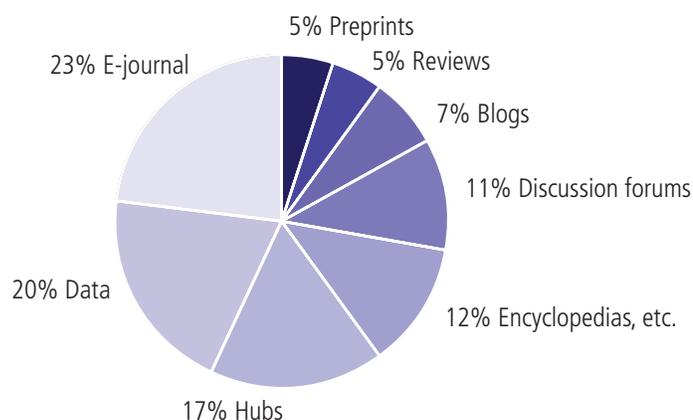
Types of Digital Scholarly Resources

While many scholarly resources combine several types of formal and informal content, we found that most of the original scholarly resources in our sample featured one primary content type. For purposes of analysis, we placed each of the 206 resources into one of eight content categories. In instances where a resource contained multiple content types – for example, an e-only journal that also had a blog – we categorized it based on the element of the site the scholar reported using, or the content type that appeared to be predominant. Some resources included extensive content in several of these categories. We described these sites, whose value was not in any single element, but in the aggregation of many forms of content, as “hubs.” The list below includes the eight publication types we examined and the number of unique resources we examined in each,

listed in the order in which we will discuss them. The categories have been loosely grouped based on similarity in content; so, we discuss article-focused formats like e-only journals, reviews, and preprint servers in turn, as we do with informal formats like blogs and discussion forums.

- E-only journals (51)
- Reviews (10)
- Preprints and working papers (10)
- Encyclopedias, dictionaries and annotated content (24)
- Data (41)
- Blogs (15)
- Discussion forums (21)
- Professional and scholarly hubs (34)

Figure 2. Digital Scholarly Resources by Type (n = 206)



While the sample collected through the field team survey was not intended to be statistically representative of all projects in all disciplines, it does provide us with interesting clues about the relative prominence of different genres of digital publication, both overall and within particular disciplines. Although e-only journals were well-represented across the disciplines, different content types stood out in each broad subject area.⁹

- In the humanities, e-only journals were the most commonly cited genre of content, followed by discussion forums. Resources facilitating informal exchange, like discussion forums and blogs, appeared more frequently in the humanities than in the other subject areas.
- Among the social sciences resources, the largest group was professional and scholarly hubs, followed by e-only journals. It is interesting to note that preprint resources were actually mentioned more frequently than any other content type in the social sciences; however, most faculty members mentioned the same resource: [Social Science Research Network](#).
- Based on our sample, sites that enable access to and publication of data seem especially important in the STM field. Within the group of STM-focused sites, the largest group by far was of these data resources, followed by e-only journals and professional and scholarly hubs.

In the following sections we discuss each of the eight types of new digital scholarly resources in turn, sharing findings on each content type, examining how scholars said they are using it, the methods of editorial selection in evidence, the disciplinary patterns that

⁹ See Appendix D for a breakdown of the eight different genres of content discussed in the paper, by disciplinary group.

emerge, and the revenue-generating strategies most often used. Along the way, representative or exceptionally innovative cases provide further detail to the profiles of each model.

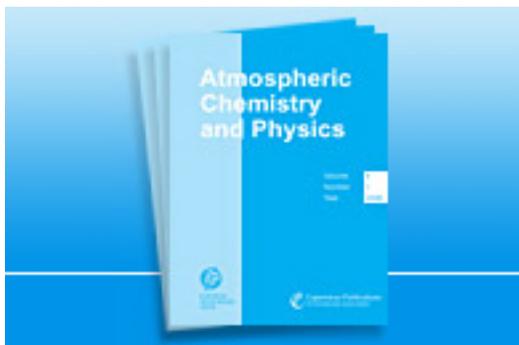
E-only journals

E-only journals – the resource type suggested most frequently by the scholars interviewed for this study – are shaped by the same forces in online academic culture as their print forbears, including credibility, prestige, and tenure and promotion decisions. They strongly resemble traditional print journals in terms of editorial guidelines, peer review, and a well-defined scholarly mission, while also incorporating a variety of innovations made possible by the digital environment. The journals named by scholars in this study represented a nearly even cross-section of disciplines, including humanities (17 titles), social sciences (12 titles), and STM (22 titles).

Incrementally, some e-only journals are using digital technologies to improve the publication process in a variety of ways. Faculty frequently told librarians that speedy access to new work, the open access model, and the benefits of being part of a network or online community of scholars made the e-only journals they suggested innovative. Other innovations mentioned relate to novel features like associated discussion lists or public commenting. *PLoS*, a collection of online journals in the biological sciences, includes the option to comment on an article, as does *Industrial and Organizational Psychology: Perspectives on Science and Practice*, which encourages both peer commentary and responses by an article's author. Other innovations in this category take advantage of the flexibility that the digital environment allows to accelerate the speed of publication and the peer review process, and to explore the possibilities of including new media formats.

Ecology and Society is an example of an e-only journal that conforms in many ways to traditional ideas about what a journal should be, while also exploring the advantages and opportunities of the new online publish-

EXPERIMENTING WITH PUBLIC PEER REVIEW: *Atmospheric Chemistry and Physics*



Once the editors of *Atmospheric Chemistry and Physics* determine that a submitted article meets basic standards of quality, it is posted to the site as an open access discussion paper. For eight weeks, anyone may read and comment on the paper; these comments are posted and archived alongside the paper itself. After this period, the paper undergoes a more traditional peer review process by referees who have the option to remain anonymous.

This novel process has not hurt the credibility of the journal; *Atmospheric Chemistry and Physics* has the highest ISI ranking of any journal in its field. However, the site only receives about one comment from a member of the public for every four discussion papers posted, suggesting that their core audience has not yet embraced this modified peer review process.

ing environment.¹⁰ For example, *Ecology and Society* publishes new articles as soon as they are ready in an "Issue in Progress," allowing readers to access new content much more quickly than they would be able to if they had to wait for several articles to be published in a print issue. Every six months, the issue is "closed" and given a volume and issue number, facilitating citation and enabling traditional citation analyses to be applied. This strategy nods to the imperative to catalog and cite scholarly content in familiar ways while still facilitating more rapid dissemination of content.

Digital publication can allow a range of types of written content to co-exist more easily than they would in print. The peer-reviewed journal *The Asia-Pacific Journal: JapanFocus* includes scholarly articles, English translations of articles originally written in Japanese, as well as shorter, more journalistic or thought pieces, and many articles that include extensive photographs and multimedia. The journal editor feels strongly that this addresses the needs of his online audience for material that addresses contemporary issues or offers historical perspectives on contemporary issues. Compared to other Asian journals, he told us that *Japan Focus* is "a different kind of hybrid . . . Other journals may limit publication to research articles of 6,000 to 10,000 words, extensively footnoted..." Because the journal's position is that much important writing in contemporary affairs is being done by journalists or by scholars adopting journalistic techniques, their editor believes online readers will benefit most from a range of work: "short, hard-hitting, direct articles to long, heavily-footnoted research articles."¹¹

Concerns persist in the academy that publication in e-only journals will be perceived as less prestigious than publishing in print. Will the work be cited in the best journals? Will it be considered a legitimate publication

¹⁰ Interview with Lance Gunderson, editor-in-chief of *Ecology and Society*, August 20, 2008.

¹¹ Interview with Mark Selden, a founder of *JapanFocus*, July 18, 2008.

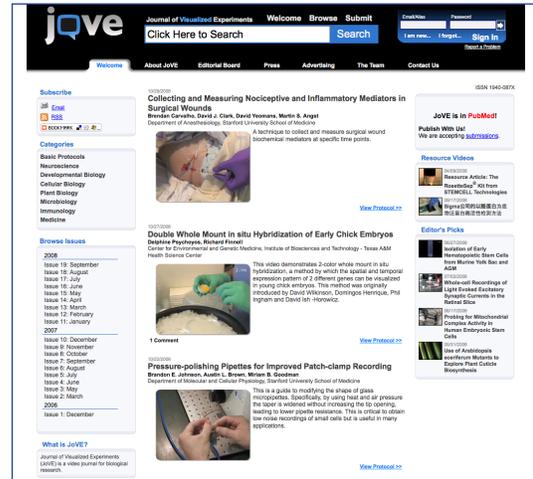
by a tenure review board? Misperceptions about the level of peer review of open access publications have contributed to these concerns, although leaders of the open access movement have continued to argue that quality and cost are not synonymous, and that notions of access and prestige can be separated.^{12 13} Online journal publishers take strategic action in this area to re-create the measures of legitimacy and excellence that long-established scholarly publishers enjoy due to their longevity and reputation. The vast majority of e-only journals in our sample rely on a peer review process to regulate the quality of their publication. Furthermore, the publications that instead employ editorial selection tend to describe themselves as “magazines” – publications for which one would not expect formal peer review. Experimentation with peer review among the titles we saw has come mostly in digital management of the process. For example, *Ecology and Society* has a custom-built system to help automate the process of distributing manuscripts and reminding reviewers to respond, and *Western Journal of Emergency Medicine* developed an online training module for reviewers. The few journals in our sample that experiment with enabling open and public peer review alongside traditional peer review, like *Atmospheric Chemistry and Physics* (see inset on previous page), see limited scholarly participation in the public process, emphasizing the strength of cultural norms about traditional blind peer review for the titles we examined.

Many of the e-only journals that emerged from the field study included some form of multimedia content. In many journals, the digital environment enables the

¹² Peter Suber, *SPARC Newsletter*, September 2008, available at: <http://www.earlham.edu/~peters/fof/newsletter/09-02-08.htm#prestige>

¹³ Diane Harley, Sarah Earl-Novell, Jennifer Arter, Shannon Lawrence, C. Judson King, “The Influence of Academic Values on Scholarly Publication and Communication Practices,” in *The Journal of Electronic Publishing* (MI: Scholarly Publishing Office, University of Michigan, University Library)10, no. 2 (Spring 2007), available at: <http://dx.doi.org/10.3998/3336451.0010.204>

EXPANDING THE DEFINITION OF A JOURNAL: *JoVE's* video articles



JoVE: Journal of Visualized Experiments has been explicit and successful in its effort to be considered a journal, referring to its contributions as “video-articles.” The founders of *JoVE* seek to speed up the knowledge transfer that currently takes place in laboratories, researcher to researcher. While the “methods and materials” section of a scientific article currently serves this function, the founders realized first-hand just how difficult it was to re-create experiments, a critical aspect of the scientific process. As they point out on the Web site, “written word and static picture-based traditional print journals are no longer sufficient to accurately transmit the intricacies of modern research.”

publication of data visualizations, large data sets, or audio and video clips that serve to illustrate the text of scholarly articles. A few publications, like *JoVE: Journal of Visualized Experiments* (see inset) are making multimedia a more central element of the work.¹⁴ However, it is worth noting that the pressures of traditional scholarly publishing may affect the opportunities for an e-only journal to innovate in this way. The editor of *Ecology and Society* told us that though they tried to promote the innovative use of digital technologies in the articles they published, they found that many times the scholars submitting the best research were reluctant to incorporate multimedia elements, instead presenting their work in more traditional forms. Faced with a conflict between including more innovative multimedia content and including the best-quality scholarship, they choose to publish the more traditional works.

Most of the e-only journals that emerged through our study use an open access model. In fact, the few examples of subscription-based support were for e-only journals published by commercial publishers or scholarly societies; the independent titles tended to be open access. Even when editorial labor is donated, however, publications still need to generate revenue to support costs such as Web hosting and copy editing. Many of the e-only journals we found have in-kind support from their host institution, in the form of server space, technical support, or the contributed staff time of programmers. Other revenue-generating strategies we observed included soliciting donations from readers, advertising, and (particularly in STM fields) author fees.

¹⁴ Interview with Moshe Pritsker, CEO, and Nikita Bernstein, CTO of *JoVE: Journal of Visualized Experiments*, August 15, 2008. Following our interview, *JoVE* was accepted for indexing in MEDLINE and PubMed, the official databases maintained by the National Library of Medicine. Co-founder Pritsker points out that *JoVE* is the first video journal to be accepted by NLM, an act that constitutes the “official ‘blessing’ of the scientific community for *JoVE* specifically and for the multimedia-based scientific journals in general.”

Reviews

Reviews of scholarly works have emerged as an important form of digital scholarly publishing, meeting a real need in the scholarly community for rapid notification about and evaluation of new works. These articles, which analyze and summarize the arguments of recently-published monographs or scientific studies, have long been important in many disciplines, where scholars appreciate this means of learning of new works and of having the guidance of a peer to place the work in context. And the process is valuable for the authors themselves, as a strong review in a well-regarded publication can be essential for scholars who hope that their work will be embraced by scholars and purchased by libraries. Unfortunately, the process of writing, editing, and publishing a review in a traditional print journal can take so long after the monograph’s publication that one of the major benefits of the review – to help scholars identify the best new scholarship – can be greatly diminished.

Ten different online sources of reviews were mentioned by the scholars who spoke with the field team librarians. Six of these resources review works in the humanities, reflecting the long-standing importance of the monograph in that scholarly community. One resource focused on social science, and three covered STM content. Several sites were mentioned by multiple scholars, including the *Bryn Mawr Classical Review* in the humanities, and *UptoDate* and *Faculty of 1000* in medicine and biology.¹⁵ Regardless of discipline, scholars universally reported turning to these resources for the same reasons. Every scholar who reported using a review site said that the resources provide access to current research or updates on developments in fields of interest.

The digital review resources innovate in several ways. First, digital reviews are not subject to the space restrictions of their print cousins. *H-France Review’s*

¹⁵ Interview with Richard Hamilton, editor of *Bryn Mawr Classical Review*, July 27, 2008

Editor-in-Chief was pleased not to have to restrict authors to a short word limit, allowing space to include a detailed review of the literature in the book review.¹⁶ This context-setting is not always possible when space is in short supply but is an extremely valuable element in the review for the scholars and students reading it. Not only can digital reviews be longer in length, but a greater number of reviews can be written by a widely distributed group and published at low cost. In addition, digital publication enables reviews to be published as soon as they are prepared, without a wait for a new print cycle – a major benefit both for authors and readers. For example, the *Bryn Mawr Classical Review* strives to deliver “a review a day, every day,” to the nearly 10,000 subscribers to its e-mail list. The greater volume of digital reviews (and the fact that faculty are often able to receive updates about new reviews via e-mail) may contribute to the fact that many of the scholars who use reviews reported relying on them daily or weekly.

The low cost of adding digital content allows scholars writing for a digital format to engage more substantively with the work they are reviewing, while not reducing the number of works that the publication reviews. Here, however, book review editors still face an “old media” challenge. While the book reviews may benefit from the economics of online space, they must still confront the high cost of mailing printed monographs to an international body of reviewers. The director of one highly successful review site told us that his single greatest expense each year is the approximately \$10,000 needed to mail books to reviewers around the world.

Preprints and working papers

Preprint and working paper servers provide scholars with access to new research and permit them to share their own work without the delay a journal’s lengthy peer review and publication process can cause. Of course, there are many vehicles for scholars to exchange early

¹⁶ Interview with David Kammerling Smith, editor-in-chief of *H-France*, August 18, 2008.

ESTABLISHING LEGITIMACY FOR DIGITAL BOOK REVIEWS: *Bryn Mawr Classical Review* and *H-France Review*

Bryn Mawr Classical Review

Editors: Richard Hamilton (*Bryn Mawr College*)
James J. O'Donnell (*Georgetown University*)
Camilla Mackay (*Bryn Mawr College*)
Assistant Editors: Jie Yuan, Jessica Sisk
Senior Advisor: Anne Mahoney (*Tufts University*)



While all scholarly publications must establish credibility in their field, this is especially important for e-only publications. Reviews use a variety of techniques to demonstrate that their resource can be trusted to have high-quality content. Founders of the *Bryn Mawr Classical Review*, the second-oldest e-only humanities journal, addressed this both through the early involvement of prominent scholars and also by initially publishing a print supplement to the review to help reassure readers of the content’s quality.

In addition, establishing high standards for submissions can help reviews establish credibility. While book reviews rarely engage in the double-blind peer review process favored by many scholarly journals, they often use a non-blind peer review process that allows them to carefully manage the quality of the content accepted for inclusion in their publications. *H-France Review* requires that all of their editors have both a PhD and a published book, and only those with a PhD are permitted to submit reviews to the journal. In addition, the editor carefully manages the assignment of reviews to encourage participation of senior scholars in the field and insure that significant new works and works by new scholars are assigned for review with particular care.

versions of their work. Scholars may post preprints on personal Web pages or in institutional repositories, share them through society-sponsored channels, and e-mail draft copies to networks of trusted colleagues. In addition, dedicated preprint servers play an important role in certain disciplines. Our study results suggest that the landscape for these servers is dominated by the oldest, largest preprint servers like **Social Science Research Network** (SSRN) and **arXiv**, although we also found smaller working paper exchanges in some niche fields as well.¹⁷

We classified ten of the resources faculty suggested to field team librarians as preprint or working paper servers. Two of these resources were humanities-focused, six were in the social sciences, and two were in STM fields. The scholars who suggested preprint servers tend to use them very frequently. We suspect that this heavy use may be due to several factors. First, since the barriers for publication on these sites are low, often involving just a simple vetting for broad disciplinary relevance, the volume of new content appearing on preprint servers can be significant. **arXiv**, the preprint server hosting papers in physics, mathematics, computer science, quantitative biology and statistics, receives thousands of new papers a month, with over 5,000 in July 2008 alone. This creates an incentive to check back frequently to learn about new research. In addition to using preprint servers to learn about developments in the discipline and the new work of their peers, many respondents reported using the servers to share their own work, as well.

Although our sample shows that niche working paper exchanges exist in some fields, these results suggest that it is still the older, more traditional servers that attract the most use. **SSRN**, a preprint server focused on economics, business, and law, while also expanding into the humanities, was mentioned by eleven differ-

ent scholars, and **arXiv** was mentioned by seven; the other preprint servers were each mentioned once. These sites are large – **SSRN** contains over 190,000 working papers, and **arXiv** has over 490,000. Almost all the scholars who said they contributed to preprint servers contributed to **SSRN** or **arXiv**, and a large majority of the scholars who told us they use preprint servers daily or weekly use one of these sites.

Nearly all of the preprint resources we examined are open access. One exception was the **National Bureau of Economic Research** (NBER), which offers institutional subscriptions to the working papers **NBER** scholars produce. Even **SSRN**, a commercial site, makes any paper uploaded voluntarily by a researcher freely available, though it generates its revenue through institutional subscriptions to curated networks of content and through its Partners in Publishing program. The other preprint sites we looked at make their content available for free and had few apparent strategies to generate revenue outside of grants and support from host institutions.

Our study results underline the importance of disciplinary culture in influencing the extent to which preprint sites are valuable. The field of economics, for example, has a particularly strong tradition of working paper exchange; **NBER** distributed printed and bound working papers for decades before use of the Internet was widespread. The abundance of economics-related preprint and working paper resources highlighted by our study may be explained by the fact that the distribution and use of this kind of literature has been a part of the culture and workflow of economists for a long time. The same may be said for **arXiv**, which has become an important site for those in physics, math, and computer science. Scholars in other STM fields, however, have been much less likely to post preprint work.¹⁸ One attempt to

¹⁷ For example, 77% of those resources classified here as professional/academic hubs include working papers/technical reports as one of their content types. Many of these hubs are themselves society and association sites.

¹⁸ The Ithaka Report “Scholarly Communications in the Biosciences Discipline,” highlights the reluctance of those in some branches of biology to share pre-publication work beyond small, private groups of colleagues, the result of deep concerns about having one’s

change this is **Nature Precedings**, the preprint server for the biological sciences started by the Nature Publishing Group; since 2007, more than 1,100 papers have been uploaded to the site.

While large preprint resources are expanding into new disciplines – **SSRN** recently branched into the humanities, for example – others are content to deliver a service to a well-defined niche audience. **PhilSci Archive**, for example, focuses on the philosophy of science, taking care to limit the submissions to the archive to just those addressing topics in this field. While the project's leaders would like to see greater participation from across the full range of philosophy of science, the Archive's greatest strength today is within "the sub-niche of philosophy of physics." Its leaders are willing to be patient, though, and are in "no hurry" to force the issue "since pressing people who are reluctant will surely backfire. The success of the archive itself will be its best advertisement."¹⁹ While some niche preprint servers like **PhilSci Archive** model themselves after existing sources, other sites experiment with newer models for exchanging work. The **Online Feminist Philosophy Draft Exchange**, for example, utilizes a **Google Group** to exchange working papers.

Encyclopedias, dictionaries, and annotated content

This category of new digital publication includes resources attempting to provide comprehensive, authoritative reference for a topic, as well as resources that layer primary source material with definitive scholarly commentary. Whether or not they explicitly call themselves "dictionaries," "encyclopedias," or "documentary editions," they all in some way declare their mission to

research "scooped," and the importance of peer-reviewed publication to tenure and promotion decisions. Available at: <http://www.ithaka.org/publications/pdfs/JSTOR%20BioSci%20Study%20Report%20Public%20final1031.pdf>

¹⁹ Interview with Justin Systma, academic consultant for PhilSci Archive, July 25, 2008. Project founder John Norton was interviewed via e-mail, as well.

IN THE FOOTSTEPS OF arXiv: PhilSci Archive



PhilSci Archive, which serves scholars in the philosophy of science, further demonstrates how the preprint culture of one discipline may influence practices in adjacent fields. Philosophy of science is a discipline that overlaps significantly with theoretical physics and **PhilSci Archive** was inspired in large part by the success of arXiv. "Philosophers of science have a strong interest in all sciences including physics, and **PhilSci Archive** was inspired in large part by the success of arXiv. Since the three founders of **PhilSci Archive** (Clifton, Earman, Norton) all work or worked in philosophy of physics, we knew the model of [arXiv] very well and just thought that philosophy of science should have the same thing," according to founder John Norton.

IMAGES BEFORE WORDS: Visualizing Cultures and Image-Driven Scholarship



One of the most vibrant examples of experiments in multimedia scholarship, **Visualizing Cultures** provides a place for scholars “devoted to transcending the printed word and hard-bound text” to create original works on topics relating to Chinese and Japanese social and cultural history. Called “units,” these works consist of four elements: an essay, heavily illustrated by images and other media; a visual narrative (almost an image essay) annotated with captions to guide the reader through the sequence of images; an image database, including all images used in the essay as well as additional ones on the topic; and when available, video clips on the topic which may include author commentaries, interviews, animation, and source footage.

The site, first launched in 2002 at MIT on their OpenCourseWare platform, is original in the types of multimedia, image-driven scholarship it makes possible, and in the project’s many partnerships with the academic and cultural institutions that provide many of the images available on the site.

methodically gather valuable materials on a given topic, often subject to a rigorous review process. Our sample included thirteen humanities resources, three social science resources, and eight STM resources, that fit in this category. Most of the resources we found through our field study are completely open access, although a few require some minimal level of registration for visitors.

Articles in the **Stanford Encyclopedia of Philosophy** (SEP) are individually authored, often by leaders in the field, and may contain the level of analysis and footnoting seen in journal articles. SEP describes itself as a unique “scholarly dynamic reference work,” priding itself on its ability to maintain high academic standards while benefiting from the expertise of over 1000 professional philosophers who contribute articles. **Encyclopedia of Life**, which describes itself as an “online reference and database” of information about Earth’s 1.8 million known species, encourages contributions from the lay public but has a team of experts to authenticate and select the material that will ultimately appear in each entry. Partnerships with data-gathering projects including **Fishbase** and **Tree of Life** provide additional sources of authenticated content that the project will use.

While encyclopedia projects like these attempt comprehensive coverage of a topic through articles summarizing current knowledge, other sites feature primary source content at their core. The digital environment enables scholars to publish commentary and annotations around this content, making them richer forms of publication than simple libraries of digital images. For example, **Roman de la Rose Digital Library** is a collection of digital surrogates of versions of that medieval illuminated text, whose originals are dispersed in special collections around the world.²⁰ The project allows side-by-side comparisons of digitized manuscripts that would

²⁰ Interview with Sayeed Choudhury, Associate Dean for Digital Library Projects at Johns Hopkins University, August 13, 2008. For more on the relationship between data in the humanities and the sciences, see: L. Sayeed Choudhury and Timothy L. Stinson, *The Virtual Observatory and the Roman de la Rose: Unexpected Relationships and the Collaborative Imperative*, available at:

be impossible otherwise. In addition, scholars contributed to the development of metadata for these digital surrogates, based on different critical interpretations of this work. The digitized texts are therefore searchable based on criteria reflecting scholarly output – and the research enabled by these searches will lead to new scholarly conclusions not possible in an analog world.

Several projects in this group are attempting to engage a wide community of scholars to contribute content, benefitting from the decentralization that new technologies allow. Examples of this include the **Stanford Encyclopedia of Philosophy** and, on a more modest scale, **PlanetMath**.²¹ This model offers some benefits of scale: a decentralized format allows scholars to contribute far more and more quickly than a print publication of comparable size; updating entries – the bane of a reference editor’s existence – can be managed online, protecting against the obsolescence of the work minutes after printed copies leave the press; and the work of this updating can be entrusted to the person who wrote the article in the first place, in whose interest (in theory) it is to have only the best, most accurate information available.

This model is not without its challenges, though. While digital encyclopedias and dictionaries built on principles of crowd-sourced editing, like **Wikipedia**, can benefit a great deal from decentralizing content generation, scholarly communication still emphasizes the necessity of expert editorial vetting to determine (or at least approve) who will be creating and editing the entries. In the case of **PlanetMath**, getting mathematics professors and graduate students to contribute articles was only the first step. The founders quickly ran into trouble with “orphaned” entries, abandoned when the authors who “owned” the entries either moved on or simply stopped contributing, and resulting in entries that

quickly became obsolete. By instituting a “use it or lose it” policy requiring that corrections to entries be made within a certain period of time, **PlanetMath** now manages the editorial process more closely, allowing articles to be transferred to new authors when necessary.

Data resources

The sciences were among the first fields to use technology to aggregate and share the results of research. For example, one of the projects investigated here, the **Protein Data Bank**, can trace its roots to the database its founders created in 1971.²² Today, this and other data projects are now available through the Internet to scholars around the world who can contribute their own data to them and harvest the data of others for their own research aims.

The field team interviews yielded 41 examples of data projects, a number second only to e-only journals in our sample. In some cases, these sites host the data output of a particular scientific endeavor for others to use and analyze. In other cases, the database itself is a dynamic entity, allowing scientists to deposit the output of their individual work, making it a valuable tool and source of reference for others, who contribute their work and benefit from the scale of the communal data. For example, the **RCSB Protein Data Bank**, part of “the single worldwide depository of information about the three-dimensional structures of large biological molecules,” collects data on protein structures from scientists around the world, who are often required by funding agencies to submit this information. Once submitted, data is reviewed and validated by the project’s over 30 US-based, full-time staff before being made freely accessible via the Internet.

Still other projects have taken the notion of data contribution a step further, beyond the walls of the academy. Community data initiatives²³ such as these aggre-

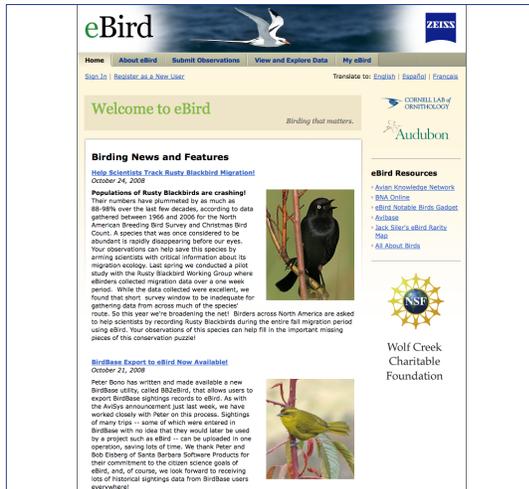
<http://www.academiccommons.org/commons/essay/VO-and-roman-de-la-rose-collaborative-imperative>

²¹ Interview with Aaron Krowne, founder of PlanetMath, July 24, 2008.

²² Interview with Helen Berman, Director of the Protein Data Bank, August 2008.

²³ The Science of Collaboratories project, <http://www.scienceofcollaboratories.org/>, identified Community Data Systems

HARNESSING THE POWER OF USERS: eBird



eBird, a community data project, relies on devoted amateur bird-watchers to supply their own observations to a large central database, where the results can be mined by professional ornithologists and environmentalists. The founders were aware of the intense birding activity taking place around the country, but realized that simply asking birders to enter their data online for research's sake was not enough. "People did not care about helping birds; engagement was an issue... initially we weren't giving them enough candy; enough tools to get them excited and to participate in the project..." So, they invested some time, spoke to people in the bird-watching community, and determined that users would find the most value in "the ability to manage and maintain their lists online, to compare their observations with others' observations." Once these tools were in place, eBird's founders noticed a steep increase in participation: from 40,000 observations a month, to 1 million observations per month today (only 4 years later).

gate the collective observations of large groups of users to build a single source that can have valuable applications to research. For example, by collecting the recorded observations made by amateur bird-watchers, eBird has been able to develop a large set of data regarding bird sightings, which proves valuable both to the scientific research community and to other non-academic parties interested in avian migration patterns.²⁴

When asked how the data resources contribute to their scholarship, most faculty cited the importance of "access to current research." The elements that faculty and librarians found the most innovative regarding the online databases, however, were much more clearly expressed as the benefits of having a variety of data all in one place, and being able to search that data. While having current data is certainly important, the increased functionality that the databases themselves allow is what is truly new. Nearly half of the faculty responses indicated that data resources were used either daily or weekly. The "other" responses almost all offered variations on this response by one faculty member: "intensely when working on a project, rarely otherwise."

Many of the data projects in our sample are supported by grants from foundations or government sources. For example, the **Protein Data Bank** has been able to sustain itself through a series of grants, in large part due to the prominence and importance of the resource to the scientific community. "Last time we counted, we had 16 different grants worldwide to fund this thing; 8-9 in the US from different agencies," one of the founders told us. Because of the unpredictability of the revenue stream, and the labor involved in monitoring and applying for so many grants, project leadership feels this model is not ideal, and has begun discussions about other sustainability options to pursue.²⁵

as one of the types/venues for digital collaboration for scholarship.

²⁴ Interview with Steve Kelling, Director of Information Science for the Cornell Ornithology Lab, and Chris Wood and Brian Sullivan, eBird project managers, July 21, 2008.

²⁵ For a discussion of the range of sustainability options digital resources can consider, see Kevin Guthrie, Rebecca Griffiths, and

Many data projects also receive some kind of support from their home institutions and some, though not many, have tried advertising or corporate sponsorship. **Chemspider** offers ads on its home page, as well as “compound-based advertising,” which allows advertisers to display ads in proximity to materials relevant to the products being advertised. Similarly, **eBird** has a corporate sponsor in Zeiss, a manufacturer of the optic devices that birders use.

Blogs

Though blogs may receive more attention in the popular media as vehicles for political commentary, celebrity gossip, or personal musings, this form of digital content is being put to interesting use by scholars, as well. In some ways, blogs may be thought of as an “updated” version of the traditional listserv (described in more detail in the section on Discussion Forums, below). For example, the scholars who created **PEA Soup**, a blog focused on philosophy and ethics, were eager to re-create the “water cooler conversations” about their work – working through new ideas informally – that they otherwise lacked as members of relatively small departments.²⁶ “We were more interested in the electronic equivalent of walking down the hall to talk to your colleague, but with people all over the country and world,” according to one of its founders.

Blogs are being employed across the disciplines – the study turned up seven humanities blogs, three social science blogs, and five science blogs – and tend to be read daily or weekly by the scholars who reported using them. Many blogs like **RealClimate**, a resource focusing on advances in climate science, are used primarily to alert readers (both scholars and laypeople) to new and interesting research and events in their community and

Nancy Maron, *Sustainability and Revenue Models for Online Academic Resources. An Ithaka Report*, available at: http://www.ithaka.org/strategic-services/sca_ithaka_sustainability_report-final.pdf

²⁶ Interview with Daniel Boisvert, a founder of PEA Soup, August 4, 2008.

field. Blogs like these add an interesting layer of commentary to published literature. Scholars told us that one blog like this “gives frequent updates of researchers’ opinions rather than just facts,” and another “attracts well established, well known writers in the field,” with lead articles that are “substantial, although no one is sharing original research.” Blogs also add value to resources focused on other sources of content, like e-only journals or encyclopedias. In addition to the fifteen blogs described here, at least 29 other resources from our sample include blogs as a supplemental form of content.

Though blogs are clearly an informal method of scholarly communication, posting restrictions allow them to maintain some degree of quality control and content vetting. Although all the blogs in our sample were completely open access, requiring no registration for readers, and although in many cases any reader may post a comment to a blog, the right to author blog posts must be specifically granted. This is not to say that blogs are closed endeavors – **PEA Soup**, for example, has 46 contributors, and frequently invites new ones to join. However, unlike discussion lists where all readers of the list are also potential contributors to the list, blogs tend to be a more “controlled” form of informal scholarly communication, allowing a limited number of authors to post work to a much wider audience. The higher bar for contribution was reflected in conversations field team librarians had with faculty. Only about a third of those scholars who nominated a blog indicated that they contributed to it through authoring, editing, or adding reader commentary; for comparison, close to two-thirds of those who nominated discussion lists contributed content to them.

Early ambiguity about the place of blogs in scholarly workflow may have limited their uptake to some degree at first. While this has not been a problem for **PEA Soup** contributors, its founder mentioned hearing worrisome stories about young scholars being denied interviews or jobs when other scholars mistakenly assumed

ACCELERATING THE SPEED OF SCHOLARLY DISCUSSION: PEA Soup

The screenshot shows the PEA Soup blog interface. At the top, it says 'PEA Soup: A blog dedicated to philosophy, ethics, and academia'. Below this is a navigation menu with 'ABOUT' and 'CONTRIBUTORS'. The main content area features a post dated 'November 06, 2008' with the title 'Moral Utterances, Nihilism and the Negation Problem'. The post text begins with 'Moral Utterances, Nihilism and the Negation Problem' and discusses David Faraci's work. To the right of the post is a search bar and a 'RECENT POSTS' section. Below the main post is a 'RECENT COMMENTS' section. The left sidebar lists various contributors.

PEA Soup, a blog for scholars of philosophy and ethics, serves as a tool for scholars to explore and develop nascent ideas with a community of interested individuals. PEA Soup's founder commented that this method of communication was very important in allowing them "to work through their ideas in an online community," and to "air ideas and get feedback and comment on current issues."

The benefits of a tool like this may be great; we heard one scholar speculate that, with blogs, a scholar can get "feedback in five days that once would have taken three months to get back. People could come to a settled view (on a philosophical question) in a number of months that even a few years ago might have taken years."

that informal, unpolished ideas that they had published on a blog were representative of their formal scholarly output. Rumors like this may have made some scholars reluctant to post on blogs, but we heard that the general scholarly community is increasingly coming to understand that while blogs may be an interesting (and citable) record of the development of scholarly thought, they represent interim stages, not a final product.

Although some larger resources, like the [Science-Blogs](#) network of 74 science-related blogs, have begun to experiment with advertising, most of the blogs that emerged through our study operate without advertising or other forms of earned revenue. Many are built on free blogging software like [Blogspot](#), [LiveJournal](#), or [WordPress](#). PEA Soup pays \$60 a year for their blog to be hosted and its four founders split this minor cost.²⁷ While they have considered adding advertising, they felt that the potential for revenue generation would not be worth the added clutter to the blog; in addition, they worried about the potential for controversy if one of the blog readers were to have an ethical objection to an advertiser. For many blogs, extremely low costs mean this lack of revenue may not be a problem.

Discussion forums

Although discussion forums – message boards, listservs, or other sites to which scholars can post comments and respond to others' thoughts – have been used by scholars nearly since the advent of the Internet, they are still important and heavily-used in many disciplines today. Some examples of innovative approaches to facilitating discussion emerged in our study, but most discussion forums took the form of an archived e-mail list. Perhaps the "oldest" of these new models of digital scholarly publishing, the continued importance of discussion forums is likely due both to their long-established presence in certain communities, and to the fact that their

²⁷ Technorati's State of the Blogosphere 2008 – Day 4: Blogging for Profit, available at: <http://www.technorati.com/blogging/state-of-the-blogosphere/blogging-for-profit/>

relatively basic technology is well-suited to facilitating a simple form of communication appreciated by scholars. By facilitating informal exchanges and enabling the quick dissemination of announcements and updates, these resources still play a critical role in many academic communities in the humanities and social sciences.

Twenty-one resources suggested by scholars fit into the category of discussion forums; about three-quarters of these were traditional discussion lists, or listservs. Fourteen of the resources are humanities-focused, six are in the social sciences and one includes all disciplines.²⁸ Our results included five different resources affiliated with **H-Net**, an organization of over 180 discussion networks in the humanities and social sciences. Comments from scholars about these twenty-one resources highlight the role discussion forums play in connecting scholars to each other and to new ideas. Scholars reported that discussion lists:

- Allow the scholar “to keep in touch with everyone, all the time,” and to “keep abreast of research in the field.”
- Bring “together a large quantity of timely, reliable information online.”
- Provide “daily updates in the field” and allow “scholars to post queries and get immediate (and delayed) responses that are archived and available to the entire community of scholars.”
- Act as “a forum for scholarly discussion prior to a peer review process; covers diverse topic areas; open to anyone; discussion of recently published works; the dialogue is more like a conference dialogue with a wider audience.”

²⁸ It is worth noting that although none of the resources we defined as discussion forums focused on STM subjects, this does not imply that scientists do not engage in exchanges with colleagues. Those STM faculty who named sources they liked for facilitating exchanges with other scholars tended to cite data sites and hubs, rather than blogs and discussion lists, for this purpose.

Although these e-mail lists enable a wide range of interaction, some scholars report that the lists are of only variable utility. In Ithaka’s 2006 report on scholarly communications in the history discipline, we found that every historian with whom we spoke used **H-Net** in some form. While the lists sometimes facilitated discussion about topics of broad interest, they were used more often to post basic questions about, for example, obtaining access to a particular archive or finding recommendations for good teaching materials. We found that the lists were used relatively rarely to work through nascent ideas in detail, or to share preprints or working papers.²⁹

Although scholars may not use discussion lists to engage in in-depth scholarly exchanges, they still use them heavily as sources of information and ways to communicate with others. Most of the scholars who nominated these discussion forums author posts or contribute commentary to them. Discussion forums also saw more daily use by the faculty who mentioned them than any other content type in our study. To some degree, this high level of use is a result of the format of the resources; subscribers receive listserv updates in their inboxes, so “use” is as easy as opening an e-mail. The informal nature of a discussion forum may contribute to the frequency of its use as well.

Though the **H-France Review** program generates many of the costs and faces many of the issues of the review sites described above, the discussion list itself is relatively inexpensive to run. **H-France** spends a few hundred dollars per year on Web site hosting, and is able to cover these costs from small grants and member donations. Many of the independent discussion lists in our sample likely have similar costs. Because listserv technology is inexpensive, many of these resources do not need independent sources of support. Five discussion lists in our sample use either free software like that provided by Google Groups, or were created with mail-

²⁹ For the Ithaka Report on Scholarly Communications in the History Discipline, please see <http://www.ithaka.org/publications/History>.

THE CONTINUING RELEVANCE OF THE LISTSERV: H-France Forum



H-France is not a “new” resource — it was founded in 1991 and has had a long history of connecting scholars in its discipline. The list was originally started with a small group of scholars so “that the types of conversations that occurred around the coffee machine [at Parisian archives] would occur online,” according to **H-France’s** Editor-in-Chief. Today, it boasts a subscriber list of over 2,300 scholars of French culture and history.

While newer forms of online discussion are available today – chat and instant messaging, real-time forums and discussion boards – the listserv has remained a mainstay of scholarly communication, allowing slightly more formalized communication than other, newer methods. Restricted access, list moderation, and list archiving are some elements that lend a greater sense of credibility and enduring value to the exchanges of ideas and information via the lists.

ing list capability provided by a scholar’s institution, and others were supported with mailing list tools provided by a scholarly society or association. One notable exception to this among the discussion lists is **H-Net**; it combines university support, grant support, donations, and some revenue from click-through book sales to support the organizational structure that houses many lists.

Although most of the resources in the discussion category are more traditional discussion lists described above, we also found evidence that some organizations are starting to innovate with new technology that facilitates informal interaction between scholars. For example, the **Emerging Scholars Interdisciplinary Network** was established to provide a forum for networking young scholars of color doing research in health-related fields. The resource includes a “Scholars Only Lounge” where members can discuss issues, share information, and read news alerts. Incorporating aspects of Web 2.0 functionality, the resource also allows members to create personal profiles, and to develop their own mini-networks around topics of interest. While resources like this suggest that Web 2.0 technology will enable new forms of scholarly exchange and interaction in the future, our study indicates that there may still be a place for more traditional listservs and discussion forums for some time to come.

Professional and academic hubs

While the majority of resources faculty mentioned focused on delivering one type of content, such as journal articles or data, a group of resources stood out for combining a wide range of content types in a single site. These “hubs,” often the digital portal for a scholarly society or professional membership organization, may offer e-only journals, reviews, access to preprints and conference papers, grey literature, blogs or newsletters that disseminate timely content, and functionality for networking with other scholars. Although these sites combine content from many of the other genres we

describe in this paper, we consider them separately here because their core innovation relates to their particular mix of multiple content types.

Many of the scholars who described these hub resources find them innovative or valuable because they are portals, or “one-stop shops” for information. A scholar who uses **IBMS BoneKEy**, the web portal for the International Bone and Mineral Society for example, described the site as combining “original articles and commentaries with other tools and resources, providing a portal-type approach to specialized subject information, continuing education, news, directories, employment services and retail offerings.” Another scholar said that the resource **Information for Practice** “represents a synthesis of information gathered by and directed toward social work practice professionals.”

Thirty-four of the resources mentioned by scholars are best described as this kind of professional or academic hub. Seventeen of these were in the social sciences, and sixteen focused on STM subjects; several were in applied branches of these fields, like nursing. Humanities hubs were rare; the study sample includes just one hub focused on music that fit this category. While most of the scholars who mentioned these sites rely on them primarily as clearinghouses for relevant information about a topic of interest, many also use hubs as tools to locate and network with colleagues, and to keep up-to-date with news, grant announcements, and conference information.

Large sites such as these require many resources to build and update regularly. Because many of these resources are built as the portal or Web-presences for a scholarly society, that society’s membership fees help to finance the sites. Perhaps because these large sites likely attract large audiences, they frequently support themselves in part with advertising or corporate sponsorships, as well.

ONE-STOP SHOPPING: Alzheimer Research Forum



The **Alzheimer Research Forum** brings together a variety of content types related to the study of this disease. The resource in part serves as a convenient way to access content published elsewhere; its paper-search functionality supports targeted searching of Alzheimer-related papers in the PubMed Central database, including papers recommended by **ARF** as being of particularly high quality. The site also includes original content, publishing news updates with brief articles and reviews of important developments and upcoming conferences, grant announcements, and job postings, as well as reference material. In addition to more traditional message boards/discussion forums, the sites also include user-generated content such as a “Hypothesis Factory,” a forum in which people can post and comment on others’ ideas, and a Knowledge Base which allows users to publish comments and annotations on materials.

Summary of Findings

The field study of digital scholarly resources revealed an impressive variety being used by professors today, many bearing a strong resemblance to their print counterparts, and some experimenting with exciting new features made possible by the online environment. While each type of digital scholarly content explored in this paper has its own distinctive characteristics, some overall trends began to emerge. Below is a summary of our findings, touching on those pertaining to the nature and content of the resources themselves; the types of challenges digital scholarly communication innovators face today; and the strategies they use to confront those challenges.

- **Digital innovations are taking place in all disciplines.**

We found examples of publications of nearly every content type across fields in the humanities, social science, and STM. While certain models appear to play a greater role in some disciplines than others (e.g., the exchange of digital working papers on [arXiv](#) in physics, or the continued importance of discussion forums and listservs in the humanities), we heard anecdotal evidence that models are indeed jumping the disciplinary divide as scholars observe new models that work and adapt them to suit their own discipline. However, it is worth noting that many of the sites incorporating the richest multimedia elements and the most innovative digital communication tools are in the sciences, whereas older technology like listservs emerged more prominently

in humanities fields. Further research might explore the factors that may be encouraging or discouraging the adoption of new forms of digital scholarly communication in various fields.

- **Digital publishing is shaped powerfully by the traditions of scholarly culture.**

Although the Internet has the potential to democratize scholarly publishing – nearly any scholar is able to set up a Web site to post his or her work and share it with others across the world at relatively low cost – old traditions of establishing scholarly legitimacy through credentialing, peer review, and citation metrics are still paramount, particularly for e-only journals and book reviews. Though we have seen cases of technical innovation – open peer review and multimedia-integrated articles, to name two – many scholars choose not to take advantage of these new innovations and instead publish more traditional articles, even in e-only journals.

- **Some of the largest resources with greatest impact have been in existence a long while.**

Although new digital publications emerge every year, many of the most popular and most robust resources have been in existence for years. Given the importance of longevity in establishing scholarly reputation, the necessity of building an audience to attract high-quality content, and the time it takes to fine-tune a digital resource, even excellent new

digital publications may need years to establish their place in their scholarly community. By the same token, we observed some well-established projects that continue to innovate; offering something “new” is possible for projects young and old.

- **Many digital publications are small, niche resources.**

There appears to be a very long tail in the field of digital scholarly publishing. Our study found a great deal of tightly-focused resources directed at niche audiences and capable of running on relatively small budgets. In some cases, this stance may appeal to those project leaders who cherish their “independence;” many resources seem content to remain small and serve their niche audience, and have few aspirations to grow. In other cases, though, the small scale and difficulty in securing a reliable revenue source can hinder desired growth and experimentation for these publications.

- **Innovations relating to multimedia and Web 2.0 content and functionality are encouraging the emergence of new types of publications.**

Although many of the digital scholarly resources are primarily text-based, we also saw examples that incorporated multimedia technology and networking tools to create new and innovative works. We observed “video articles,” peer-reviewed reader commentary, and medieval illuminated texts coded as data – all evidence of the creative format mash-ups that challenge us to re-think the definitions of traditional content categories. Many of the resources in our sample that incorporate these sorts of innovations – data sites, annotated primary source content, and the newest forums to facilitate exchanges between scholars – have no print corollary.

- **Establishing credibility is not easy, but is of critical importance.**

Maintaining quality control, whether by peer review or moderation of submissions, is a critical issue for nearly all digital publications. Above, we discussed the importance of peer review for more formal publications, but even a large majority of informal resources engages in some form of editorial selection or moderation to monitor and control the content that appears on the site. (As one editor put it, while they do not try to restrict the scholarly conversation, “We are not a free speech site.”) Particularly for “born-digital” publications with no print-based reputation for quality, quickly establishing credibility is necessary to attract and impact scholars in the field.

- **Achieving sustainability – especially for those resources with an open access mandate – is a universal challenge**

Small, low-cost options like blogs aside, the challenge for digital scholarly resources – open access or not – is how to generate the funds needed to support themselves over the long term. For the open access publications that comprise the majority of the resources we studied here, traditional subscription-based support is not an option, so finding an economic model to support their work requires experimentation. While resources in our sample employ a wide range of revenue models, including advertising, author fees, and corporate sponsorship, most appear to enjoy some degree of support from their host institution, including in-kind contributions of server space and/or technical support. The contributions of volunteers are also important to many of the examples we saw. The speed of digital communication has made it possible to harness the power of volunteer scholarly contributors from around the world.

Looking Ahead: Digital Scholarly Resources and the University Library

In a digital world, librarians seeking to support faculty and students in research endeavors have a dauntingly broad task.³⁰ In addition to the volume of scholarly resources distributed through traditional channels like commercial publishers and university presses, independent scholarly projects – often of great relevance, but sometimes unknown outside their area of focus – crop up in every discipline. This study revealed some of the rich variety of resources that faculty use to learn about new scholarship and communicate with their peers. Some of the sources suggested through faculty interviews are large and well-established enough to be considered “mainstream,” but many others are likely known only to those specialists in the field who use them on a regular basis. Learning about these many niche resources is only possible through an ongoing dialogue with those scholars who create and use them. In this way, the work of the field teams has not only highlighted a wide range of resources in use today, but also has established a valuable network to enhance library-faculty communications for the future. This communication can only benefit the library in its goal to guide faculty and students to the materials they require.

There may be a valuable role for the library to play in supporting these new digital initiatives, as well. One e-

only journal editor told us that he was eager to make his project discoverable through more library catalogs, but he was not sure how to achieve this. By sharing knowledge about independent digital scholarly resources with faculty either through an ILS or through direct research assistance, librarians can help promote high-quality projects and build the audience for these resources. Although preservation was not the subject of this study, it seems clear that librarians can initiate and contribute to conversations about the long-term preservation of new digital works. Preservation did not seem to be a top-of-mind concern for many of the smaller projects we investigated, and proactive library steps may be valuable in raising and addressing this unrecognized need. Librarians, with their broader knowledge of the landscape of digital scholarly resources, may also have a role to play in working with scholars to create new projects. By providing guidance on existing models and approaches to issues such as establishing scholarly legitimacy and credibility, librarians can help put new projects on surer footing. As outreach continues, libraries may also serve as an important nexus of communication for a variety of digital projects on campus. The creation of the ARL field team could be a useful step in fostering ongoing interaction between the library and faculty and in further establishing the pivotal role of the university librarian in the development and sharing of scholarly resources in a digital age.

³⁰ For a discussion of recommendations for the role of libraries in digital publishing on campus, see Laura Brown, Rebecca Griffiths, and Matthew Rascoff, *University Publishing in a Digital Age. An Ithaka Report* (July 2007), available at: [http://www.ithaka.org/strategic-services/Ithaka University Publishing Report.pdf](http://www.ithaka.org/strategic-services/Ithaka%20University%20Publishing%20Report.pdf)

Appendix A: Field Team Participation

301 librarians from 46 institutions registered to interview faculty. 160 librarians from 29 institutions contributed a total of 358 examples for resources from these interviews to the database. Numbers by institution are in the table below.

Institution	Individual Field Librarians	Individuals Submitting Entries	Number of Entries
Arizona State University	3	0	0
Bowling Green State University	1	1	1
Brown University	4	1	1
California Institute of Technology	1	1	1
Colorado State University	2	0	0
Columbia University	15	10	16
Cornell University	20	11	21
Dartmouth College	26	19	33
Emory University	1	0	0
Florida State University	1	0	0
Georgetown University	1	0	0
Grand Valley State University	4	3	8
Johns Hopkins University	8	4	12
New York University	29	7	15
Occidental College	1	0	0
Ohio Wesleyan University	3	2	9
Rice University	3	1	1
Smithsonian Institution Libraries	1	1	1
State University of New York, Buffalo	1	1	1
Trinity University	1	0	0
University of Alabama at Birmingham	11	7	21
University of British Columbia	15	11	28
University of California, Irvine	20	15	45
University of Connecticut	1	1	21
University of Illinois at Chicago	4	1	1
University of Illinois at Urbana-Champaign	1	0	0
University of Iowa	1	0	0
University of Kansas	8	1	1

University of Louisville	3	0	0
University of Massachusetts Amherst	13	7	13
University of Michigan	1	0	0
University of Minnesota	20	15	22
University of Nebraska-Lincoln	1	0	0
University of North Carolina at Chapel Hill	1	0	0
University of North Carolina at Greensboro	1	0	0
University of Northern Colorado	2	2	9
University of Notre Dame	2	2	3
University of Pennsylvania	1	0	0
University of Puerto Rico, Rio Piedras Campus	1	1	1
University of Texas at Arlington	9	5	6
University of the West Indies, Mona Campus	1	0	0
University of Toronto	7	7	20
University of Toronto Mississauga	5	0	0
University of Washington	18	5	13
Vanderbilt University	18	10	21
Virginia Commonwealth University	9	8	13
Washington State University	1	0	0
Grand Total	301	160	358

Appendix B: Current Models of Digital Scholarly Resources by Type

E-journals Title	URL
<i>Advancing Women in Leadership Online Journal</i>	http://www.advancingwomen.com/awl
<i>Applied and Environmental Microbiology</i>	http://aem.asm.org
<i>Astronomy Education Review</i>	http://aer.noao.edu/cgi-bin/new.pl
<i>Atmospheric Chemistry and Physics: An Interactive Open Access Journal of the European Geosciences Union</i>	http://www.atmospheric-chemistry-and-physics.net
<i>Beilstein Journal of Organic Chemistry</i>	http://www.beilstein-journals.org/bjoc/home/home.htm
<i>BioMed Central Series Biology Journals</i>	http://www.biomedcentral.com/info/authors/bmcseries
<i>Bulletin of the Indo-Pacific Prehistory Association</i>	http://ejournal.anu.edu.au/index.php/bippa/index
<i>China Brief</i>	http://www.jamestown.org/china_brief/index.php
<i>Classics@: An Online Journal</i>	http://chs.harvard.edu/chs/classics%40
<i>Communications in Information Literacy</i>	http://www.comminfolit.org/index.php/cil
<i>Critical Studies in Improvisation/Etudes critiques en improvisation</i>	http://www.criticalimprov.com/public/csi/index.html
<i>Cryptology ePrint Archive</i>	http://eprint.iacr.org/index.html
<i>dichtung-digital</i>	http://www.dichtung-digital.de/
<i>Digital Medievalist</i>	http://www.digitalmedievalist.org/
<i>dlib magazine</i>	http://www.dlib.org/
<i>Ecological Archives</i>	http://esapubs.org/archive/default.htm
<i>Ecology and Society</i>	http://www.ecologyandsociety.org
<i>Ecrypt Network of Excellence in Cryptology</i>	http://www.ecrypt.eu.org/index.html
<i>EDUCAUSE</i>	http://www.educause.edu
<i>Fabula, la recherche en litterature</i>	http://www.fabula.org
<i>History Cooperative</i>	http://www.historycooperative.org
<i>Industrial and Organizational Psychology (SIOP)</i>	http://www.siop.org/journal/siopjournal.aspx
<i>Japan Focus, an Asian Pacific e-Journal</i>	http://japanfocus.org/
<i>JMDE: Journal of MultiDisciplinary Evaluation</i>	http://survey.ate.wmich.edu/jmde/index.php/jmde_1
<i>Journal of Criminal Justice and Popular Culture</i>	http://www.albany.edu/scj/jcipc/
<i>Journal of Visualized Experiments</i>	http://www.jove.com
<i>LII / Legal Information Institute</i>	http://www.law.cornell.edu/
<i>Monastic Matrix</i>	http://monasticmatrix.usc.edu/
<i>New Journal of Physics</i>	http://www.iop.org/EJ/njp
<i>North Star Journal</i>	http://northstarjournal.org/
<i>Nucleic Acids Research</i>	http://nar.oxfordjournals.org

<i>Open Atmospheric Science Journal</i>	http://www.bentham.org/open/toascj/index.htm
<i>Palaeontologica Electronica</i>	http://palaeo-electronica.org/
<i>Particip@tions: journal of audience & reception studies</i>	http://www.participations.org
<i>Philosopher's Imprint</i>	http://www.philosophersimprint.org/
<i>Philosophy Compass</i>	http://www.blackwell-compass.com/subject/philosophy
<i>Physical Review Special Topics - Physics Education Research</i>	http://prst-per.aps.org
<i>PLoS (Biology)</i>	http://biology.plosjournals.org
<i>PLoS One</i>	http://www.plosone.org
<i>Postmodern Culture</i>	http://muse.jhu.edu/journals/pmc/
<i>Postmodern Culture</i>	http://www.iath.virginia.edu/pmc/
<i>Romanticism and Victorianism on the Net (RaVoN)</i>	http://www.ron.umontreal.ca/
<i>Scholar & Feminist Online</i>	http://www.barnard.columbia.edu/sfonline
<i>Science Daily</i>	http://www.sciencedaily.com
<i>Science Magazine Collections: Chemistry</i>	http://www.sciencemag.org/cgi/collection/chemistry
<i>SEMIOTIX: A GLOBAL INFORMATION BULLETIN</i>	http://www.semioticon.com/semiotix/
<i>Senses of cinema</i>	http://www.sensesofcinema.com
<i>SIAM Journal on Applied Dynamical Systems</i>	http://epubs.siam.org/SIADS/siads_toc.html
<i>The Forum : A Journal of Applied Research in Contemporary Politics</i>	http://www.bepress.com/forum/
<i>WestJEM: Western Journal of Emergency Medicine</i>	http://repositories.cdlib.org/uciem/westjem/
<i>Web del Sol</i>	http://www.webdelsol.com/

Reviews Title	URL
BioNews.org.uk	http://bionews.org.uk/
Bryn Mawr Classical Review	http://ccat.sas.upenn.edu/bmcr/
caa.reviews	http://www.caareviews.org/
Faculty of 1000 (Biology)	http://www.f1000biology.com
H-Net: Reviews	http://www.h-net.org/reviews/
Law and Politics Book Review	http://www.bsos.umd.edu/gvpt/lpbr/
Notre Dame Philosophical Reviews	http://ndpr.nd.edu
The Medieval Review (TMR)	http://quod.lib.umich.edu/t/tmr
The Public Journal of Semiotics	http://www.semiotics.ca/
UpToDate	http://www.uptodate.com

Encyclopedias, Dictionaries, and Annotated Content <i>Title</i>	<i>URL</i>
μSR Wiki	http://cmms.triumf.ca/wiki/index.php?title=Main_Page
A Hellenistic Bibliography	
Anglo-Norman Hub	http://www.anglo-norman.net/
Cuneiform Digital Library Initiative	http://cdli.ucla.edu/
Dictionary of War	http://dictionaryofwar.org/
Electronic Text Corpus of Sumerian Literature	http://www-etcs1.orient.ox.ac.uk/
Encyclopedia of Life	http://www.eol.org
EqWorld: The World of Mathematical Equations	http://eqworld.ipmnet.ru/
Internet Resources for Historians (del.icio.us - grown)	http://web.jhu.edu/history/historyresource.html
Jazz in Film Bibliography	http://www.loc.gov/rr/mopic/findaid/jazz/intro.html
Jazz Studies on Line	http://jazzstudiesonline.org/
Material History of American Religion Project	http://www.materialreligion.org/
MathWorld	http://mathworld.wolfram.com
MIT Visualizing Cultures	http://ocw.mit.edu/ans7870/21f/21f.027j/menu/index.html
Multitude TV	http://multitude.tv/
Natural History of Orange County	http://nathistoc.bio.uci.edu
Planet Math	http://planetmath.org
Roman de la Rose	http://romandelarose.org/
Stanford Encyclopedia of Philosophy	http://plato.stanford.edu/
The John Milton Reading Room	http://www.dartmouth.edu/~milton/
The Red Hot Jazz Archive	http://www.redhotjazz.com/
Therevidae	http://www.inhs.uiuc.edu/research/therevid/
Tree of Life	http://tolweb.org/tree/
Warring States Project	http://www.umass.edu/wsp/

Data <i>Title</i>	<i>URL</i>
All Catfish Species Inventory	http://silurus.acnatsci.org/
Allen Brain Atlas	http://www.brain-map.org
Birds of North America	http://bna.birds.cornell.edu/bna
Bordwell pKa tables	http://www.chem.wisc.edu/areas/reich/pkatable/
BugGuide	http://bugguide.net/node/view/15740
Challenging Problems in Chemistry & Chemical Biology	http://www2.lsddiv.harvard.edu/labs/evans/problems/index.cgi
Chemspider	http://www.chemspider.com/
Child Language Data Exchange System	http://childes.psy.cmu.edu/

Compact Muon Solenoid Experiment TWiki	https://twiki.cern.ch/twiki/bin/view/CMS/
Dalton Transactions	http://www.rsc.org/Publishing/Journals/dt/index.asp
DOE Joint Genome Institute	http://www.jgi.doe.gov/
EarthChem	http://www.earthchem.org
East View Cartographic	http://www.cartographic.com/
eBird	http://ebird.org/content/ebird/
Election Results Archive	http://www.binghamton.edu/cdp/era/
Ensembl	http://www.ensembl.org/index.html
FishBase	http://www.fishbase.org
FishNet 2	http://www.fishnet2.net/index.html
Flybase	http://flybase.bio.indiana.edu/
GENSAT Mouse Brain Atlas	http://www.gensat.org
Geokem: Geochemistry of Igneous Rocks	http://www.geokem.com/
GEON	http://www.geogrid.org/
GeoRoc	http://georoc.mpch-mainz.gwdg.de/georoc/
Gold Genomes Online Database	http://www.genomesonline.org/
Long-Term Ecological Research Network	http://www.lternet.edu/
Mouse Genome Informatics	http://www.informatics.jax.org
MPEX (Membrane Proteins of Known 3D Structure)	http://blanco.biomol.uci.edu/Membrane_Proteins_xtal.html
NCBI GenBank	http://www.ncbi.nlm.nih.gov/Genbank
Neogene Marine Biota of Tropical America	http://eusmilia.geology.uiowa.edu/nmita.htm
NLM Entrez Gene	http://www.ncbi.nlm.nih.gov/sites/entrez?db=gene
Online Cultural Heritage Research Environment	http://ochre.lib.uchicago.edu/
Paleobiology Database	http://paleodb.org/cgi-bin/bridge.pl
Protein Data Bank	http://www.wwpdb.org/
SafetyLit Injury Prevention Literature Update	http://www.safetylit.org/
Search360	http://wfxsearch.webfeat.org/clients/wfxdartmouth/advSearch.asp?cid=10340
Spectral Database for Organic Compounds, SDBS	http://riodb01.ibase.aist.go.jp/sdbs/cgi-bin/cre_index.cgi?lang=eng
Thayer School Wiki	https://wiki.thayer.dartmouth.edu/display/cnfs/Home
The Alvin Frame-Grabber System	http://4dgeo.who.edu/alvin
The STScl Digitized Sky Survey	http://archive.stsci.edu/cgi-bin/dss_form
Traditional Chinese Medicine Information Database	http://tcm.cz3.nus.edu.sg/group/tcm-id/tcmid_ns.asp
Visions 2000	http://www.visions05.washington.edu/index.html

Preprint and Working Paper Servers <i>Title</i>	<i>URL</i>
arXiv	http://arxiv.org/
ASIST Digital Library, E-Prints in Library and Information Science (E-LIS)	http://eprints.rclis.org/
Dispute Resolution Resource Center	http://www.kellogg.northwestern.edu/research/drrc/
IEP: Instituto de Estudios Peruanos	http://www.iep.org.pe/
Nature Precedings	http://precedings.nature.com
NBER National Bureau of Economic Research Working Papers	http://www.nber.org/papers/
Online Feminist Philosophy Draft Exchange	http://groups.google.com/group/feministdraftexchange?hl=en
PhilSci Archive	http://philsci-archive.pitt.edu/
Social Science Research Network (SSRN)	http://www.ssrn.com/
Vanchivard: The Vanderbilt Chicago Harvard Workshop for Andean Anthropology	http://www.vanderbilt.edu/vanchivard/

Blogs <i>Title</i>	<i>URL</i>
Biocurious	http://biocurious.com/
Design Your Life	http://www.design-your-life.org
Dial "M" for Musicology	http://musicology.typepad.com/
Grand Text Auto	http://grandtextauto.org/
Health Beat	http://www.healthbeatblog.org/
Hotgiraffe Livejournal	http://hotgiraffe.livejournal.com/
La Bloga	http://labloga.blogspot.com
Nature Blogs	http://blogs.nature.com/nm/spoonful
PEA Soup	http://peasoup.typepad.com/peasoup/
PERTicles	http://perticles.blogspot.com
Real Climate: Climate Science from Climate Scientists	http://www.realclimate.org
ScienceBlogs	http://www.scienceblogs.com/
The Center for Innovation in College Media Blog	http://www.collegemediainnovation.org/blog
The China Beat	http://thechinabeat.blogspot.com/
Video Vortex	http://www.networkcultures.org/videovortex

Discussion Forums <i>Title</i>	<i>URL</i>
Agade List	Subscription via listserv@unc.edu
American Association of Italian Studies Listserv	http://www.aais.info/
Andean Research Listserv	Dan_Sandweiss@unit.maine.edu

CHORALNET: THE INTERNET CENTER FOR CHORAL MUSIC	http://www.choralnet.org/
Economic History Services	http://eh.net/
Emerging Scholars Interdisciplinary Network	http://www.emergingscholars.net/
Epsilen	http://www.epsilen.com
FEAST - Association for Feminist Ethics and Social Theory	http://www.afeast.org/
H-France	http://www.h-france.net/
History and Philosophy of Science LISTSERV	http://www.hopos.org/listserv.html
H-Net: H-Afro-Am	http://www.h-net.org/~afro-am/
H-Net: H-Asia Asian History and Studies	http://www.h-net.org/~asia/
H-Net: H-German	http://www.h-net.org/~german/
H-Net: Humanities and Social Sciences Online	http://www.h-net.org/
Latino Caucus and Race & Politics (2 listservs of the American Political Science Assn)	ILATINO-C@listserv.ilstu.edu and RACE-POL@listserv.ilstu.edu
PMJS: Premodern Japanese Studies	http://www.meijigakuin.ac.jp/~pmjs/
PSI network: power, status & influence research group	http://www.psinetwork.org/
SHAKSPER: The Global Electronic Shakespeare Conference	http://www.shaksper.net
Society of Antiquaries of London Newsletter	http://www.sal.org.uk/salon
The Linguist List	http://www.linguistlist.org/
Victorian listserv	http://cfp.english.upenn.edu/archive/Victorian/

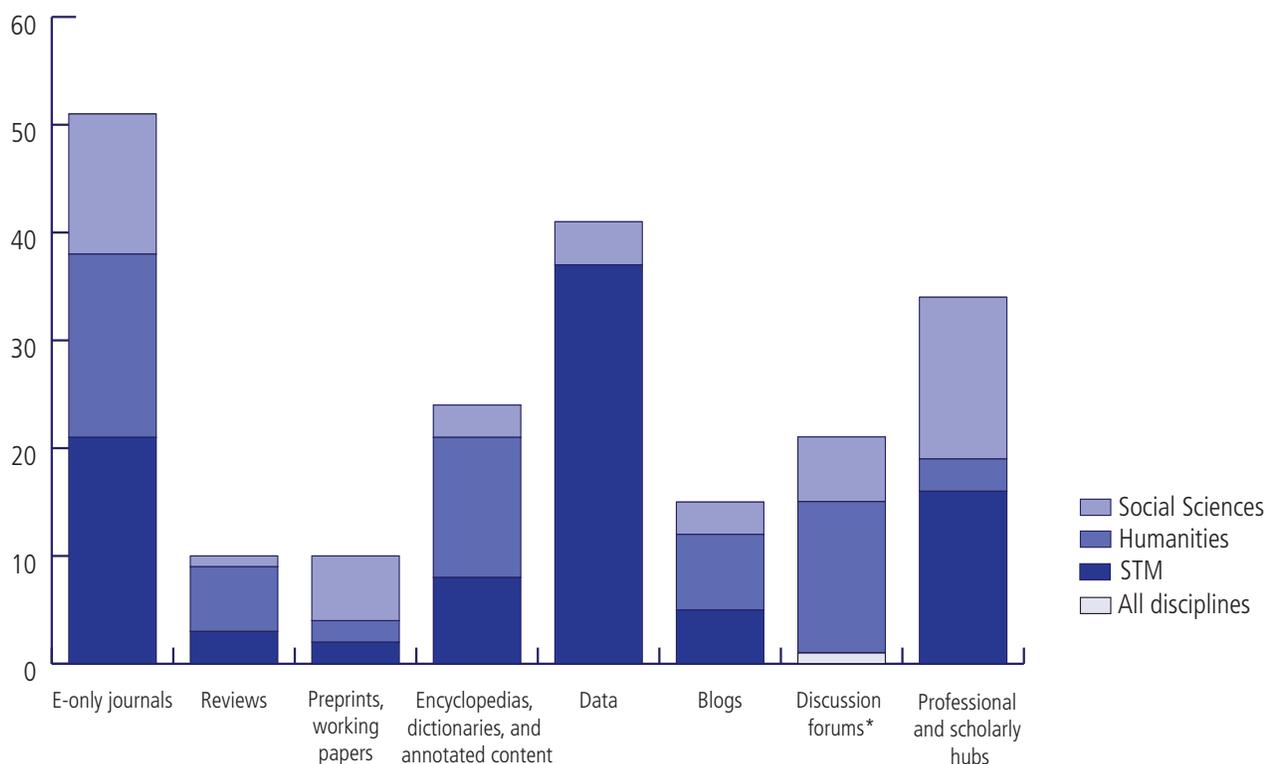
Professional and Academic Hubs <i>Title</i>	<i>URL</i>
Alliance for Aging Research	http://www.agingresearch.org
Alzheimer Research Forum	http://www.alzforum.org/
American Academy of Hospice and Palliative Medicine	http://www.aahpm.org/
American Association of Colleges of Nursing	http://www.aacn.nche.edu/
American Chemical Society	http://portal.acs.org/portal/acs/corg/content
American Economic Association Web	http://www.aeaweb.org/index.html
American Physical Society	http://aps.org/
American Planning Association Knowledge Exchange	http://www.planning.org
Arthur W. Page Society	http://www.awpagesociety.com/
asha (American Speech-Language-Hearing Association)	http://asha.org/default.htm
Association for Education in Journalism and Mass Communication (AEJMC)	http://www.aejmc.org/
Aunt Minnie	http://www.auntminnie.com/index.asp?sec=def
College Media Advisers, Inc.	http://www.collegemedia.org/
Community Campus Partnerships for Health	http://depts.washington.edu/ccph/index.html
Commonwealth Foundation	http://www.commonwealthfoundation.org/
Critical Resistance	http://criticalresist.live.radicaldesigns.org/

CTSNet.org: Cardiothoracic Surgery Network	http://www.ctsnet.org/
eBlackStudies	http://www.eblackstudies.org
eMedicine	http://www.emedicine.com/
Eurasian Strategy Project	http://ceres.georgetown.edu/esp/
Future Medicine	http://www.futuremedicine.com/
Hartford Institute/Geriatric Nursing	http://www.hartfordign.org
HBS Working Knowledge	http://hbswk.hbs.edu/
IBMS BoneKEy	http://www.bonekey-ibms.org/
Information for Practice	http://www.nyu.edu/socialwork/ip/
informs online	http://www.informs.org/
Jazzinstitut Darmstadt	http://www.darmstadt.de/kultur/musik/jazz/us.htm
Latin American Studies Association	http://lasa.international.pitt.edu
Living Books	http://livingbooks.nln.org
Perimeter Institute for Theoretical Physics, Multimedia Archive	http://www.perimeterinstitute.ca/en/Outreach/Multimedia/Multimedia/
Pew Center for Civic Journalism	http://www.pewcenter.org/
Poynter Institute for Media Studies	http://www.poynter.org/
Society for American Archaeology Digital Data Interest Group	http://www.alexandriaarchive.org/blog/?page_id=4
Society of Professional Journalists	http://www.spj.org/

Appendix C: List of Interviews

Interviewee	Title and Resource	URL	Resource Type
Helen M. Berman Professor of Chemistry and Chemical Biology, Rutgers	Director, Protein Data Bank	http://www.pdb.org	Data
Daniel R. Boisvert Lecturer in Philosophy, UNC - Charlotte	Founder, PEA Soup	http://peasoup.typepad.com	Blog
Sayed Choudhury Johns Hopkins University Library	Associate Dean for Digital Library Projects	http://romandelarose.org/	Encyclopedia, dictionary, annotated content
Aaron Krowne	Founder, PlanetMath	http://planetmath.org	Encyclopedia, dictionary, annotated content
Lance Gunderson Associate Professor of Environmental Studies, Emory	Editor-in-Chief, Ecology and Society	http://www.ecologyandsociety.org	E-journal
Richard Hamilton Professor of Greek, Latin, and Classical Studies, Bryn Mawr	Editor, Bryn Mawr Classical Review	http://ccat.sas.upenn.edu/bmcr	Review
Steve Kelling; Chris Wood and Brian Sullivan Cornell Ornithology Lab	Director of Information Science and Project Managers, eBird	http://ebird.org/content/ebird	Data
John Norton Professor of Philosophy of Science, Pittsburgh; Justin Systema	Founder and Academic Consultant, PhilSci Archive	http://philsci-archive.pitt.edu	Preprint server
Moshe Pritsker; Nikita Bernstein	CEO and CTO, JoVE: Journal of Visualized Experiments	http://www.jove.com	E-journal
David Kammerling Smith Professor of History, Eastern Illinois University	Editor-in-Chief, H-France	http://www.h-france.net	Discussion forum
Mark Selden Senior Fellow, East Asia Program, Cornell University	Coordinator, Japan Focus: An Asia-Pacific Journal	http://japanfocus.org	E-journal

Appendix D: Digital Scholarly Resources by Disciplinary Group



	STM	Humanities	Social Sciences
E-only journals	21	17	13
Reviews	3	6	1
Preprints, working papers	2	2	6
Encyclopedias, dictionaries, and annotated content	8	13	3
Data	37	0	4
Blogs	5	7	3
Discussion forums*	0	14	6
Professional and scholarly hubs	16	3	15

*In addition, one project classified as a discussion site aims to cover all disciplines, so does not figure in any one disciplinary group.