
The “Wealth of Networks” and Institutional Repositories: MIT, DSpace, and the Future of the Scholarly Commons

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ABSTRACT

This article draws on Yochai Benkler’s *The Wealth of Networks* to examine the concept of the commons as it applies to scholarly communication, and in particular to the phenomenon of institutional repositories and how they align with evolving practices in the exchange of information. It discusses how a culture of openness at MIT is manifested in its institutional repository, DSpace, and how the MIT Libraries have transformed positions in support of scholarly publishing initiatives and the development of a scholarly commons.

INTRODUCTION

We often need both the view “from 10,000 feet” and the view “from the trenches” to fully understand change. Both viewpoints are useful in thinking about the future of institutional repositories (IRs) and their place in the scholarly commons—in the open, network-based sharing of the intellectual output of universities. Here, we view IRs through the lens of Yochai Benkler’s book, *The Wealth of Networks*, which broadly analyzes the impact of the network on information exchange; but also “from the trenches” by looking at recent library staff changes involving and surrounding MIT’s DSpace and scholarly communication. Together these viewpoints offer some insight as to where IRs are likely to fit in the future landscape of scholarly communication, and what challenges await as libraries move to support the scholarly commons.

IRs AND THE WEALTH OF NETWORKS: THE VIEW FROM 10,000 FEET

Yochai Benkler’s award-winning 2006 book, *The Wealth of Networks*, describes dramatic changes the global network has brought to the methods,

systems, and business models that exist to support the flow of information. These new practices reflect "the emergence of a new stage in the information economy," which he dubs the "networked information economy" (Benkler, 2006, p.3). This economy is radically more decentralized, characterized by nonmarket peer production, increased individual autonomy, and loose collaborations among individuals. According to Benkler's analysis, the success of any service or product will in large part be driven by how that service or product fits into this new economy's commons-like structure. Benkler's analysis provides a context for the massive changes in how information is created, shared, and stored, and can help us understand what role institutional repositories (IRs) are likely to play in scholarly communication in the near future.

Benkler makes the case that our new information economy brings individuals center stage. Where mass communication conglomerates and big publishers dominated information channels in the recent past, we are seeing the "emergence of a new information environment, one in which individuals are free to take a more active role than was possible in the industrial information economy of the twentieth century" (Benkler, 2006, p. 2). Since institutional repositories allow for the kind of "decentralized individual action" that Benkler talks about as "carried out through radically distributed, nonmarket mechanisms that do not depend on proprietary strategies" (p. 3), conceptually IRs are manifestations of—and deeply relevant to—our new world. The new social practice of direct sharing of scholarly information, unmediated by a market, in a commons-like environment, perfectly mirrors Benkler's vision of the new flow of information.

Benkler's description of the characteristics of the networked information economy speaks directly to the role and functions of an IR, for IRs are inextricably aligned with one particular social practice among those emerging in the new economy: authors posting their research papers on the Web. The barrier of high capital costs to communicate have fallen, and the net result is a new social practice in which individuals share communications that formerly were restricted to mass media or, in the case of research, scholarly journals. Though authors have other Web channels for posting their work, IRs directly support this kind of "self-archiving" function for authors. This individualized, nonmarket "publishing" is expected to develop in our new economy. The logical conclusion (barring a lack of investment to build sufficient services) is that IRs, since they act as reservoirs for outputs of nonmarket "publishing," will grow as well.

It is not difficult to see the potential range of motivations for authors in self-archiving. Such posting allows for feedback earlier in the publication process; quicker access; wider distribution; and a convenient way of meeting institutional and research funder goals for sharing research. Posting speeds the research cycle and may allow for new research methods, such as data mining; it offers inexpensive communication and increased access

and visibility for faculty reputation and advancement. While these benefits accrue to authors who post anywhere on the Web, IRs offer a unique combination of persistent identifiers and preservation, the context of institutional history, and increased findability.

Based on the “fit” of IRs with author practices in a new networked information economy, it is perhaps not surprising that IRs have rapidly penetrated their proposed base of research universities and institutions. In the short period since initial launch in 2002, they have become widespread: even back in early 2005, 40 percent of U.S. doctoral granting universities had IRs operating (Lynch and Lippincott, 2005), and the OpenDOAR site that tracks IRs includes more than 1,000 worldwide as of December 2007.¹ There is virtually 100 percent deployment in Germany, Norway, and the Netherlands (van Westrienen and Lynch, 2005).

This rapid growth would probably not surprise Benkler, whose description of a new networked information economy sounds like a description of an institutional repository: they are built upon the distributed nonmarket mechanisms that support cooperative action among individuals. Looking at Benkler’s analysis of the economics of the twenty-first century, it seems clear that IRs offer a support service for an emergent phenomenon that is fundamental to the flow of information in our networked world.

FUTURE DEVELOPMENTS

Of course any new service or tool, even if it is fundamentally aligned with the broad dynamics of the networked information economy, will need to keep evolving to meet new needs and expectations if it is to find and retain users. And it is abundantly clear that IRs will have to develop in the near future if they are to be relevant and widely used. There are some areas that seem ripe for development. Research is becoming more and more data driven, across more disciplines, so the need to support data management, curation, and archiving will expand and become more pressing. IRs are well positioned to fill this need, and so we can expect—and need to encourage—data-related IR services grow. This growth will be spurred by the need for researchers to fulfill funder requirements like those of the National Institute of Health (NIH), which as of 2003 has required a data-sharing plan for grants over \$500,000.² Faculty do not have the time or resources to manage large data sets themselves, making this a clear need for IRs to fill.

Functions like federated search across IRs are being developed and will enhance their value to researchers, effectively allowing IRs to act like subject repositories, by offering a subject search based on stored metadata, distilled from papers stored in many IRs. The current distinction between an IR and a subject repository is likely to blur considerably as these services develop. For example, at MIT we are working on some discipline-based experiments run on DSpace, as well as considering the federated

search concept to support a single discipline that will draw from several institutions’ IRs. In these pilot projects, we are looking at a preprint server for a narrowly-defined discipline that is not covered by a subject repository; a server for a cross-institutional research group’s collection of simulations in a field where these are valuable resources to share; and an effort to draw together papers in one field that are split among three universities. Such projects will join IRs in a way that makes them more relevant to researchers—whose primary allegiance is often their discipline.

Also thinking in terms of relevance to researchers, we can imagine new services that satisfy funder requirements for open access by offering smooth, automated, dual submissions to an IR and a discipline repository. This service would be a productive way to simultaneously achieve faculty, funder, and institutional goals. It seems time to explore the feasibility of this kind of service, given the advent of the 2008 NIH Public Access Policy and its requirement for open access to NIH-funded, peer-reviewed manuscripts through PubMed Central within twelve months of publication.³ Similarly, faculty and IRs might both be well served by further developing some services already underway, in some form, on some campuses—services that scrape data from faculty bibliographies (or other sources), harvest articles based on that data, and automatically populate an IR. Technical, legal, political, and interpersonal issues will have to be addressed to make such a service fully-automated, but this direction seems likely to yield results that will be of interest to authors, their institutions, and readers.

Other services likely to make IRs more valuable to researchers include personal and collaborative workspaces to accommodate the growth in collaborative research—something made easier by the network. Benkler’s analysis reinforces the observation that research has become more international and more collaborative based on the availability of the network, which makes “doing things that require cooperation with others . . . much more attainable” (2006, p. 9). This will “increase the range and diversity of . . . collaborative projects . . .” (p. 9), which will in turn demand an infrastructure—like IRs—to support such projects.

Citation management and analysis tools to provide feedback on use and quality are also likely to emerge as services supported by institutional repositories. These will be attractive to authors as well as administrators. Similarly, data-mining and filtering tools that will help researchers identify relevant work from a growing volume of research—a volume too high to allow any one researcher to read all relevant papers one-by-one—are likely to be needed and supported by IRs. “Our literature,” as Clifford Lynch has observed, “is no longer being digested one article at a time by the eyeballs of human beings” (as quoted in Plutchak, 2007). The demand for services to support this kind of data mining rather than the direct use of “eyeballs” to sift the vast volume of research has the potential to be one of the key drivers to encourage open access through an institutional repository.

Benkler (2006) argues that collaboration to create quality control mechanisms and filters is a natural component of networked information and, by extension, of IRs. Because of this innate capability for individuals to work collaboratively to develop filtering and quality control mechanisms, the doom-and-gloom scenario in which the Internet degenerates into a tower of Babel has not come into being. "Order," he says, "emerges in the networked environment" (p. 172). This occurs because "filtering for both relevance and accreditation has become the object of widespread practices of mutual pointing, of peer review" (p. 466). We need our IRs to support this kind of peer review.

With the development of more filtering and quality mechanisms and practices, it seems quite possible that the use of IRs as research assessment tools for universities could expand. This has already been suggested in Belgium, where there has been lobbying to make the IR a source for funding allocation (van Westrienen & Lynch, 2005), by using it as the base for institutional and departmental quality measures.

In thinking, then, about what niche the IR could fill in the networked information economy, Clifford Lynch's commentary again seems apt: IRs are "being positioned decisively as general-purpose infrastructure within the context of changing scholarly practice" (Lynch & Lippincott, 2005). IRs are already widespread, and well-positioned to act as the infrastructure for a wide range of activities that an author, a university, or another research organization will want to engage in, supporting needed storage and management of digital objects.

CHALLENGES

There are challenges along the road to successful, well-populated and used IRs, as there are for any service or product that works to find a niche in our new networked information economy.

For IRs focused on faculty research, the most significant barrier is content recruitment under an author-deposit model. Faculty are largely unaware that IRs exist or of the reasons they might want to post their work in one. Study after study confirms our impressions on campus, that the vast majority of faculty simply do not know that their campus offers an IR. At the University of California, in a 2007 study, fully 82 percent of faculty polled were not aware or had not much knowledge of IRs. On an anonymous campus surveyed in a University of Michigan School of Information study, even among faculty whose work was included in the IR, only 29 percent were aware of the IR's existence (Kim, 2007). A 2005 study of senior journal authors found that only 10 percent knew a little or a lot about IRs, though this number was reported as 33 percent in a similar study done the same year (Mark Ware Consulting Ltd, 2006). In 2007, Cornell's assessment of its DSpace implementation was that it was "underpopulated and underused" (Davis & Connolly, 2007). Overall, 50 percent of existing

IRs have fewer than 1,000 documents (Rieh, Markey, St. Jean, Yakel, & Kim, 2007).

It is common knowledge that self-deposit has not resulted in heavily populated IRs. At the University of California, a 2007 study revealed that 31 percent of authors polled posted their work on a personal or departmental site, but only 14 percent in a repository of some kind (University of California, 2007). Carnegie Mellon University found in 2006 that 13 percent of authors self-archive (Covey, 2006), mirroring Stevan Harnad's estimate that 15 percent of authors voluntarily self-archive (Harnad, 2006). These numbers vary dramatically by discipline, of course, with a rate widely believed to be near 100 percent in high energy physics (Morrison, 2007), and at much lower rates in other fields. Without an institutional or funder mandate, relying on faculty to deposit their work in IRs is not likely to result in a critical mass of content.

Researchers want to self-archive to improve access to their content, but the value added by an IR as opposed to their own Web page or a disciplinary repository is not something immediately apparent to them. We need to find ways to make the service more immediately relevant to faculty. Such change will require the support of good interface design, strong personalization, and customization options for authors, an easy—and preferably mediated—submission process, needed services like threaded discussion, and support for copyright issues that arise, as well as ongoing communication about the role and purpose of the IR.

These challenges could be seen as evidence that IRs have failed—that, as Dorothea Sal, University of Wisconsin's Digital Repository Librarian succinctly sums up: "What institutional repositories offer is not perceived to be useful, and what *is* perceived to be useful, institutional repositories do not offer" (Salo, 2007, 6). Salo's proposed solution to this problem, providing "value to faculty *on faculty terms*" offers an essential framework—a mantra, even—for moving forward. But it is also essential to keep in mind that the failure of a particular idea—direct faculty submission of their work into an IR—does not reflect a failure of the concept of the IR, or the IR as a platform. As Salo points out, we can work with faculty interests—such as depositing into disciplinary repositories—to support IR development. The failure of self-deposit is not a failure of the IR as a tool, it's a failure of one notion of how to best populate that tool. It is a sign that our experiment needs to be tweaked.

While IR software may well need user-focused development, a recent survey of DSpace repository managers suggests that there is a solid base to build from. No big unaddressed needs were revealed in the survey; 81 percent of respondents profess to be either "somewhat" or "highly" satisfied, with another 13 percent saying DSpace is serving their needs. And many of the concerns that were raised are being addressed with new positions and activities (M. Kimpton, personal communication, February 14, 2008). For

example, the recent hiring of a director for the foundation will help map out priorities based on the survey and provide a focus for fund-raising; the new technical director will help build a technical infrastructure that will allow for smooth contributions; the community outreach manager will help raise awareness of the features of particular installations and recommend service providers; and the foundation will help bring repository managers together, removing barriers to information sharing and allowing more voices to be heard. These kinds of changes exemplify the retooling of the IR experiment that can help us move forward productively.

So while, as Salo reminds us, "We cannot keep looking the other way, pining after mandates we cannot realistically achieve, hoping against hope that the great faculty behemoth will awaken from slumber" (2007, p. 25), we can make incremental changes to improve IRs and their utility for our campuses. The February 2008 motion by Harvard's Faculty of Arts and Sciences that will make their work openly available on the Web will be fulfilled through an institutional repository run by the Harvard libraries (Darnton, 2008). The unanimous Harvard vote on this motion reminds us that when faculty become aware of the issues related to access to their work, they do care, and that our campuses do need IRs to support open access to faculty research.

MIT AND DSPACE: A VIEW FROM THE TRENCHES

Origins of DSpace

MIT's institutional repository, DSpace, was launched under an open source license in 2002 after two years in collaborative development with Hewlett-Packard, which funded the project. It was intended as a "dynamic repository for the intellectual output in digital formats of multidisciplinary research organizations," and as an open source system, tool, and platform for collecting, managing, indexing, and distributing digital items (Smith et al., 2003). As such, it directly supports MIT's mission to share its research as widely as possible and to preserve it for the future. Indeed, DSpace grew out of faculty needs and a desire to support MIT's mission of "generating, disseminating, and preserving knowledge, and to working with others to bring this knowledge to bear on the world's great challenges" (Massachusetts Institute of Technology, n.d.).

The original goal of DSpace was to capture the faculty's intellectual output in digital formats: research papers, other documents, datasets, images, audio/visual material, databases, or any other format they deemed important. MIT started with two important policies that emerged from this original goal: only *faculty* research would be accepted and *faculty* would choose what would be submitted. We have migrated from this focus to include several additional types of material. Material authored by nonfaculty (or non-MIT faculty) is now included if a particular community finds

that content of value, as long as the necessary copyright permissions are obtained. Material from the MIT Libraries and Archives is now included, particularly reformatted images and e-theses, which are heavily used and valued content. In addition, DSpace now also accepts educational material, such as lecture notes, sample exams, course calendars, complex simulations and visualizations, multimedia presentations, and videos of key lectures. OpenCourseWare (OCW) (<http://ocw.mit.edu/>), MIT's openly accessible course system, is a particularly important example of this educational content. To support OCW, DSpace houses older course websites so that courses can be examined and course material found after the course is no longer actively taught and available openly on the Web through the OCW site. MIT currently has about 6,000 research papers in DSpace, and a total of over 20,000 items, from over 2,000 authors.

The transition in approach to collections supported by DSpace reflects a key point about DSpace software and other IR software: it was built to house digital output of research organizations, but the details of what content is managed by the software is primarily a matter of policy, not technology.

DSpace was created as open source software and has been widely shared among a growing community of implementers. In July 2007, this community acquired a solid organizational framework in the DSpace Foundation, which has assumed responsibility for providing leadership and support to the ever-growing DSpace community, and which will encourage even wider distribution and use.

Support for MIT's Mission: Evolving Librarian Roles

DSpace is one expression of a culture of openness at MIT. MIT's mission creates a strong impetus to sharing MIT's research and educational outputs as quickly and widely as possible, driving a commitment to openness. The beginnings of the Free Software Movement, the World Wide Web Consortium, and the idea of open course content all began at MIT. MIT now also supports TechTV, MIT World, and OpenWetWare. Through all of these efforts, MIT could be said to be working toward the vision of a scholarly commons, a “collective enterprise,” as MIT Professor Hal Abelson, a founding director of Creative Commons, refers to it. In a podcast on supporting the intellectual commons he asks:

what should civic virtue mean in a university? What kind of place should a university be? What kind of responsibility do we have? I think that we have to recognize as a university that we are about sharing knowledge. We are about building a strong intellectual community. We're about spreading knowledge . . . in a way that it can be shared and grow. (Duranceau & Abelson, 2008)

This vision of an intellectual commons is certainly not unique to MIT—one does not have to dig too far to find references to the concept and

its adherents, including wide-ranging discussions in the recent book *Understanding Knowledge as a Commons* (Hess and Ostrom, 2007). But MIT's commitment to these principles is longstanding and deep, and it is significant that the MIT Libraries operate within this culture of openness. We develop services that support MIT's mission and its many collaborative, open initiatives for sharing scholarship, research, and educational materials.

Scholarly Communication

It was within this context of a commitment to making MIT's outputs as openly available as possible, and in recognizing MIT's need to ensure future access to scholarship and sustain efforts in scholarly publishing reform, that the MIT Libraries in 2005 put forward to the administration the idea of an initiative to educate authors about retaining rights to their work. The need for such support was also made clear in the Libraries' 2005 survey, in which users rated copyright services as important, but awareness of them low. Another factor in the environment at the time that reinforced the Libraries' perception of a need for this initiative was the NIH public access policy of 2005, which requested deposit of peer-reviewed articles into PubMed Central. This policy led to the creation of the MIT amendment to standard publisher copyright agreements,⁴ launched in spring 2006, under the auspices of the Committee on Intellectual Property, offering support to faculty who wanted to comply with the policy.

The request for support for this new initiative resulted in a position of Scholarly Publishing and Licensing Consultant (SP&LC), created in September 2006. This position, funded in part by the Provost's office, was designed to lead the MIT Libraries' outreach efforts to faculty in support of scholarly publication reform and open access activities at MIT, and to act as the Libraries' chief resource for licensing policy and negotiations. The main responsibilities of the position are to:

- develop and implement a program to increase awareness among MIT faculty, researchers, and students about scholarly communication issues in the digital environment;
- establish mechanisms to assist faculty with publishing choices, publishing agreements, and management of intellectual property;
- speak and write about the issues in various MIT forums and publications;
- manage scholarly communications and copyright websites; and
- work effectively with library staff on scholarly communication issues and prepare communication tools they can use with their constituencies.

When the new position was filled and announced through the MIT Libraries' blog, Peter Suber reported on it within his blog "Open Access News," saying it was "another great idea from MIT. Until OA is as familiar as email, every university should have something like this" (Suber, 2006). The position was part of a holistic approach to the world of digital scholar-

ship, and as such, is also responsible for license negotiations for subscribed content, as well as working directly with the creators of that content, by engaging with authors about the impact of giving away rights. This combined focus on licensing and author copyrights has yielded an unusual 360-degree view of the copyright and contractual parameters under which content is created, leaves, and comes to (or returns to) MIT.

While it is certainly possible to distribute responsibilities for copyright outreach to a variety of individuals working in an academic library, it is remarkable what visibility can be achieved when a single point person is assigned a specialized role. Looking at the impact this position has had at MIT in the roughly one year it has existed, it is fairly clear the same results—at least in the MIT Libraries—are unlikely to have been accomplished in the same time frame if the duties had been fragmented among many individuals.

One of the first tasks the SP&LC engaged in was to rewrite and redesign a scholarly publication website (MIT Libraries, n.d.). This involved reframing key messages from the faculty point of view, focusing on retaining rights and increasing the impact of research, and adding new content, as well as testing the new site with MIT faculty and researchers. The SP&LC also launched a series of podcasts and video tutorials on author rights and open access (MIT Libraries, n.d.); offered a series of workshops for library staff; and offered a series of talks for faculty and graduate students.

One major effort of the first year was to provide support for authors using the MIT amendment to publisher agreements. In the first year, more than sixty faculty and students used the new position for individual consultation about their publication agreements and other copyright issues—a new service that is apparently filling a significant gap. The SP&LC carried out a survey of all known users of the MIT amendment, which confirmed the need for support in using the amendment as well as faculty interest in retaining rights to their work. Comments made during the survey of amendment users made it clear that support for negotiating changes to standard publisher agreements is needed, and is a highly-valued service.

The SP&LC has organized and offered a series of talks and seminars to the MIT community, including a January 2006 panel "Copyright Unlocked" that involved faculty and the Associate Provost discussing open access in relation to MIT's mission, and faculty actions related to their rights. This was the venue for the first public release of a draft faculty resolution on open access, which is being shepherded by the Libraries through academic departments that are represented on the Faculty Committee on the Library System. These departmental meetings have offered the opportunity for wide-ranging conversations about copyright, publisher agreements, and the future of journal publishing.

The new position has yielded several new opportunities for the Libraries: a chance to speak to graduate students about publishing, through

their graduate student council's professional development group; the first inclusion of these issues in the new faculty handbook; and the first inclusion of publishing and copyright as a topic in the graduate student.

In just the first months the position was available, MIT authors approached the new Scholarly Publishing & Licensing Consultant about issues that ranged from a desire to work out a publisher agreement for digitizing a Springer Lecture Notes volume from the 1970s; to questions about the use of the MIT amendment; to a need for someone to act in support of a student group that was working to encourage more open access to research by bringing attention to publicly accessible alternatives to closed and restrictive models of academic publishing (Duranceau, February 21). Another major effort in the first year emerged out of a need to coordinate a faculty response to the imposition of DRM by a scholarly society for access to their technical papers at MIT and other universities (Duranceau, 2007, March 16).

Faculty, researchers, and students have commented both directly and indirectly on their need for this position and the support it offers. Some of the comments have been:

- "We are woefully uninformed . . . who can we ask about copyright agreements?"
- "What is that thing I sign without thinking about it when I finally get the referees to agree that my work is worthy of their . . . journal? Don't tell me I need to learn about copyright law now, I have enough trouble with non-linear MHD theory!"
- We are "not comfortable" "granting [the publisher] exclusive rights to our work."

All of these conversations raised awareness at MIT about the problems with a closed model for publishing research, but one topic that emerged within the first six months of the arrival of the SP&LC has the most potential to shape the future of our DSpace implementation. A faculty member contacted the new SP&LC to request support in using DSpace to build a discipline-specific preprint server for a small international group of researchers not currently supported by a subject repository. This venture into non-MIT content and into a kind of subject-based rather than institutionally-based approach is new territory for MIT's DSpace, and represents an emerging trend, as was noted above.

Staff partnerships within the MIT Libraries have also been an important focus for the new scholarly publishing role. In the MIT Libraries, subject specialists are the key connection to faculty and students. When the position was first launched, the new SP&LC offered a survey to staff to find out what their needs were in the area of scholarly communication; the survey identified a low level of confidence and awareness of the issues, and insufficient knowledge, tools, and ability to stay current were all re-

ported as obstacles in the survey. In response, in the first year, the SP&LC offered librarians several hands-on workshops, including one on starting and sustaining conversations about scholarly publishing, copyright, and open access issues with faculty.

Also for librarian staff, the SP&LC has created wiki pages with staff tools, including for example, a faculty publishing practices assessment form that provides a structured inquiry into a faculty member's publishing history and practices, including whether he or she posts work on the Web, helping to prompt questions that would be appropriate for a meeting or hallway discussion. Another tool is a presentation template devised to offer subject specialists information about the major issues, with prompts to customize with details they have researched about their own disciplines, department, and faculty.

The SP&LC has carried out these varied initiatives, but this position is not designed to be responsible for IR marketing, design, and development. For this, another new role was created in early 2007: the new DSpace product manager. It was expected that the SP&LC and the DSpace product manager would coordinate efforts, with the SP&LC raising awareness about the reasons to retain rights and the advantages of submitting research to MIT's IR (in addition to subject repositories) and with the Product Manager working on marketing tools for the IR and identifying and supporting the needed service and interface changes that would encourage submission once the rights issues were taken care of.

This new DSpace product manager position was designed to gather and prioritize user requirements, define product strategy, and work with engineering staff to further develop the software around which the repository services are built, as well as launch new service features. An important aspect of the role is intended to be planning and executing a marketing communication strategy, built on market research that has identified the value proposition MIT's IR represents for its community; another main goal of this position is to create services and market them with the goal of increasing the DSpace user community at MIT. The product manager has developed a "road map" for services and features that need to be addressed first, and has begun the process of enhancing MIT's DSpace so that it can fully assume the roles imagined here.

Programming staff has also been newly devoted to DSpace, in an effort to address user needs. While it has taken time to reallocate staff for DSpace programming, this new staff—like the SP&LC and the DSpace Product Manager—is seen as part of an essential transition that the MIT Libraries and other libraries, too, will need to make if our IRs are to succeed. We will need to have significant resources—and particularly sufficient technical resources—available locally if DSpace is to fulfill its potential.

During the first year that the SP&LC and DSpace Product Manager have coexisted, it has become clear that the issues of copyright retention,

self-archiving, and IRs intersect and interrelate and need to be considered as parts of a whole picture of scholarly communication, not as isolated services or topics. If rights issues aren't addressed, the best interface design won't help us populate DSpace. Yet DSpace needs to be managed and developed to meet user needs so that submission is an attractive proposition, once the rights issues are addressed.

While one person could theoretically be responsible for this full-range of issues, at MIT we have found it efficient to have one person focus on the conceptual and practical issues of rights retention and another on building a technical environment that works for those who do have the rights to post. For example, a faculty member expressed an interest in having his book available in DSpace when the SP&LC was fielding a rights inquiry about posting articles; this author was able to draw on the technical skills of the DSpace product manager to sort out whether it was possible to present the book so that individual chapters could be separately downloaded.

These two roles have proven fundamental to moving the development of services that support open access to research forward, but their existence also speaks to a sober reality: IRs—like all initiatives that reposition library services in a growing commons environment—cost money and take significant staff time. It takes a strong commitment to move in these new directions with any kind of speed. But these positions have also shown that it is important that libraries invest in such new roles if they are to move nimbly and find a place in the evolving scholarly communication system. The kind of focus and persistent application of energy that such positions allow for is invaluable when there is a need to move in new directions.

LIBRARIANS IN SUPPORT OF THE INTELLECTUAL COMMONS: EVOLVING TWENTY-FIRST CENTURY ROLES

The evolution of librarian positions at MIT to support a commons-based information environment involves more than just the scholarly publishing role and the DSpace product manager role. From 2002 to 2007, the MIT Libraries redefined fourteen librarian positions, roughly 20 percent of the staff. In all these cases headcount was repurposed, not increased, except for two new FTEs added, and the .5 FTE funded by the provost for the SP&LC. Every position altered during this time sets the stage for librarian roles that go beyond traditional purchase and access models. The positions emphasize new technologies, new services, and new ways of supporting faculty research.

We created a research group in 2002 to design and develop tools to support discovery, offering a new vision of the role of the librarian on campus as research partner and innovator. This group has developed partnerships with the computer science department, and with the administrative information services department. The MIT Libraries also created two nontraditional format positions in this time period, a new images librarian

(2003) and a new GIS librarian (circa 2004). The GIS librarian trains users with GIS tools and supports a GIS service, with purchased content and traditional collections only a part of picture. Also circa 2004, we created a data librarian position with a social sciences focus. This librarian is now working on open data issues on campus. She also offers access to and support for data sets, whether open access or purchased.

We have also made changes in the traditional subject specialist role, moving beyond "collection development" in a subject discipline. All of the changes we made are relevant to a world where content is not purchased in traditional ways. In 2005 and 2006, for example, we added an interactive research component to the computer science librarian, who is expected to work with faculty to operationalize their research; we created a new Internet tools development specialty; to another subject librarian's role, we added an intensive instruction component, working with faculty to devise online course-based tutorials; and for civil and environmental engineering, we added GIS responsibilities. Also in this period, the associate head of the engineering library was reframed to emphasize outreach rather than circulation and access. This individual has been focusing fairly heavily on scholarly communication issues in her new role.

New positions, as well as redefined positions, emphasize the same shift toward librarians providing infrastructure for a world where buying content under traditional models is not the main emphasis; providing innovative services for all content is. For example, the job description for the new information services librarian for engineering and science, created in 2005, deemphasizes "collections" and even "reference" for a focus on services and tools.

The new metadata specialist (2005) supports open access activities like MIT's OpenCourseWare, and participates in campuswide initiatives related to local digital content, not purchased content. The digital products manager, a position also carved out in 2005, is responsible for building new systems, particularly for more open access to theses. And when we publicized a vacancy for an associate director, instead of referring to it as involving "collections" as in the past, we recruited for an associate director for information resources, emphasizing managing systems, services, and technology in relation to content.

The fundamentals have not changed; the library staff supports MIT in its mission of "generating, disseminating, and preserving knowledge," but the details *have* changed. In a networked world where a commons model for sharing science and scholarship is becoming a more and more realistic vision, we have retooled positions and changed our emphases. But also, significantly, we have deepened partnerships on campus, including those with sponsored research, institutional research, intellectual property/general counsel, the university press, (which reports to the director of libraries), information services, and the faculty. We have moved more clearly

in the direction of becoming partners in facilitating worldwide scholarly communication in a trusted, and more open, information environment. Ironically, it seems that librarians are more at the center of the campus now than when our gateways and collections were the only game in town. As one MIT faculty member commented recently, in reference to copyright and author rights management: "I thought the faculty committee on the library system would be three years of dry drudgery. But it turns out librarians in their new role are now located at the center of the most contentious and important issues of the day" (Anonymous personal communication, May 11, 2007).

CONCLUSION: IRs AND THE COMMONS

MIT's staff changes reflect the evolution of a commons-like model outlined by Benkler in the *Wealth of Networks*. This evolution is not "preordained by the internal logic of technological progress" (Benkler, 2006, p. 468), and Benkler points out that there is a strong push in the other direction, to tighten enclosure of information and access through changes in copyright, patent, and other law. A key driving force, though, is the social practices that have emerged, and business practices that accommodate them. The genie is out of the bottle: "Even if laws that favor enclosure do pass . . . it is not entirely clear that a law can unilaterally turn back a trend that combines powerful technological, social, and economic drivers" (p. 471).

As Benkler argues, it is not likely that these powerful social and economic forces will be reversed. Indeed, many wealthy industrial players have already reoriented their business models to participate in a more commons-like economy. As one example, Benkler mentions IBM, Hewlett Packard, and Cisco, who have worked with nonprofits to block legislation that would infuse copy protection into our PCs.

Research going on right now at MIT concludes that business practices that are aligned with a commons approach will succeed on their own merits: the economics favor the commons over enclosure. Professor Eric von Hippel, Professor of Management and Engineering Systems at MIT and expert on the economics of distributed and open innovation, has been studying the economics of businesses that use an open commons approach. He concludes that the open commons approach will win out over enclosure:

I think what we are going to see broadly across the economy is this kind of shift to an open commons-based as opposed to a closed and proprietary-based intellectual property system. And I think this is going to be better for everybody. . . . The economics are going to drive people who try to keep their systems closed, in most industries, into the weeds. The open alternatives will simply drive them out. It's not a matter of being altruistic, it's a matter of really corresponding to economic reality, and firms will have to adjust their business models accordingly. (Duranceau & von Hippel, 2007)

Like Benkler, von Hippel concludes—after extended study of the models that work in a networked world—that the commons approach will succeed where proprietary models do not. The significance of this for libraries and the other players in the realm of scholarly communication is that politics and philosophy will not be the main drivers toward a commons-based system for sharing research and scholarship. Economics, technology, and the social and practical realities of human behavior will be.

Librarians have the opportunity to be a central part of this vision of a scholarly communication commons, through working with new social, economic, and technical systems, including IRs. As Heather Morrison has pointed out, when faculty liaison roles are "expanded to include scholarly communications, anecdotal reports suggest that this enhances the quality of the relationship and communications between librarians and faculty, involving librarians more closely in a key priority for faculty members, their own research" (Morrison, 2007). She takes stock of a shift in librarian roles to support an open access environment, including "copyright officers becom[ing] author's rights consultants," and collections and e-resources staff "managing the economics and technology of change." Among other tasks, she sees librarians acting as the experts in assisting a shift from subscriptions to coordinating funds for article processing fees.

MIT's experience leads to the same conclusions, confirming that building a technical and human infrastructure to support a shift toward a digital scholarly commons is a significant service libraries can offer universities, and that we can be part of the change that is already underway, transforming scholarly communication and opening research up for wider, quicker distribution.

We have the chance to evolve together into a world that we hope will match the vision Benkler offers: IRs as part of a positive cultural transformation. As he says, "We have an opportunity to change the way we create and exchange, information, knowledge, and culture. By doing so, we can make the twenty-first century one that offers individuals greater autonomy, political communities greater democracy, and societies greater opportunities for cultural self-reflection and human connection" (Benkler, 2006, p. 473).

Benkler's vision is one of advancement of human culture and condition through wider distribution of information. Scholarly research fits naturally into this vision: of all the cultural and scientific information that we need to share to care for our world, the research being generated at our universities lies at or near the top of the list. Those working close to IRs have been lamenting for some time now that IRs have not radically transformed the realm of scholarly communication, or been avidly taken up by faculty. There is a tendency to talk of IRs as having failed. But a post mortem is premature: the concept of the IR is still new, and Benkler's analysis of our new economy suggests that IRs can be a useful and relevant part of

the scholarly communication landscape, with appropriate development and investment. Libraries can help support the transformation Benkler documents and foresees by advocating for this development and investment, and by reshaping positions to support services that reflect evolving social practices in the networked information economy.

NOTES

1. See OpenDOAR, retrieved December 12, 2007, from http://www.open_doar.org/onechart.php?cID=&ctID=&rtID=&clID=&lID=&potID=&rSoftWareName=&search=&groupby=c.cCountry&orderby=Tally%20DESC&charttype=pie&width=600&height=300&caption=Proportion%20of%20Repositories%20by%20Country%20-%20Worldwide, which shows 1,013 repositories worldwide.
2. U.S. Department of Health and Human Services, National Institutes of Health, Office of Extramural Research, 2003, NIH Data Sharing Policy, retrieved October 27, 2008, from http://grants1.nih.gov/grants/policy/data_sharing/index.htm
3. U.S. Department of Health and Human Services, National Institutes of Health, Revised Policy on Enhancing Public Access to Archived Publications Resulting from NIH-Funded Research, 2008, retrieved October 27, 2008, from <http://grants.nih.gov/grants/guide/notice-files/NOT-OD-08-033.html>
4. See <http://info-libraries.mit.edu/scholarly/mit-copyright-amendment-form/>, retrieved October 27, 2008. The amendment includes three key provisions: the authors retain nonexclusive right to use their own work in noncommercial and professional activities; to place the published version in an OA repository; and grant MIT rights to use work in educational activities.

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