

DSpace Governance:
A Report for the
DSpace Federation Governance Advisory Board Meeting
March 30-31, 2006

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About this Document

This document seeks to provide context and background information to the ad hoc DSpace Federation Governance Advisory Board in preparation for its meeting on March 30-31, 2006. It does not intend to draw any specific conclusions or recommendations; rather it aims to present the issues for discussion.

The document begins with a summary of the issues at hand for the DSpace Federation Governance Advisory Board:

- **1.0 Introduction:** A call to action and the formation of an ad hoc governance advisory board, initiated by MIT and HP and supported by the DSpace community.
- **2.0 Governance Advisory Board Charge:** Outcomes sought from the ad hoc DSpace Federation Governance Advisory Board.
- **3.0 DSpace Mission:** Construction of a mission statement for the DSpace community.
- **4.0 Scope of Governance Activities:** A summary of activities necessary to the long-term sustainability of the community that could factor into the type and structure of governance organization chosen.
- **5.0 Governance Options:** An examination of governance, staffing and funding options available to the DSpace community.
- **6.0 Conclusion**

The Appendices intend to provide more detailed information on topics summarized in the main body of the paper, as well as make available additional background context on other relevant topics to the governance discussion.

- Appendix A: Known DSpace Installations
- Appendix B: Countries with DSpace Deployments
- Appendix C: DSpace Service Providers
- Appendix D: DSpace Federation Governance Advisory Board Members
- Appendix E: DSpace History
- Appendix F: The DSpace Community and Its Governance Needs
- Appendix G: A Brief Overview of the Open Source Software Movement
- Appendix H: Case Study: The Apache Software Foundation
- Appendix I: Case Study: The Sakai Foundation
- Appendix J: Case Study: The .LRN Consortium
- Appendix K: Case Study: MySQL AB
- Appendix L: Related Reading List

1.0 Introduction

It has been just over three years since the DSpace open source software was released. In that time, a DSpace open source community made up of organizations that either use or develop the DSpace software has emerged. The user base, primarily made up of academic research libraries at universities, has expanded to over 125 known installations (Appendix A: Known DSpace Installations) located in over 35 countries (Appendix B: Countries with DSpace Deployments) around the world. The DSpace software code contains contributions from nearly 60 developers from these institutions.

Investment in DSpace continues to grow. Adopters employ technical and functional experts to build and expand local DSpace services and pursue various research agendas pertaining to the DSpace platform. They gather and manage collections, for deposit in DSpace, of digital material that require long-term stewardship and outlays for server, back-up and storage hardware. In addition, they offer technical support to the community and commit resources to further develop the DSpace platform. For-profit companies (Appendix C: DSpace Service Providers) have established business models around the DSpace platform, providing value-added services to the community, and also contribute some platform enhancements. As the stakes grow higher for those involved with DSpace, so do the demands for more coordination and greater long-term stability for the project.

As the originating sponsors of the project, developers of the platform, and copyright owners of the DSpace software, MIT and HP have provided a substantial amount of coordination and infrastructure over the years to foster the project's development. Still today, they provide project guidance, technical leadership, infrastructure, and general coordination of various aspects of the project. Other institutions increasingly aid these efforts, reflective of their investment in the platform and the health of DSpace's open source community. MIT and HP hoped for this broad involvement from the inception of the project so that they and the community could enjoy the benefits of shared maintenance and development of the software, and greater impact on the research and standards associated with digital content dissemination and preservation.

To further cultivate and advance the sense of collective responsibility for the platform, MIT and HP believe that the community has reached an appropriate point in its development at which it needs a representative governing and legal ownership structure that reflects DSpace's status as a shared open source software resource and provides for the long-term sustainability of the software. This represents a critical juncture for DSpace. The questions posed by this transition are complex and the outcomes of the decisions made will have long-standing effects on the platform and community.

The DSpace community discussed the need for greater coordination and a formal governance structure at its 2005 DSpace User Group meeting. As a group, they agreed to a governance planning process that called for the formation of an ad hoc advisory board, made up of representatives from MIT, HP, other DSpace installations, DSpace service providers, and experts in open source software and the majority domain of use (i.e. higher

education and research libraries in particular). The board was asked to make a recommendation to MIT, HP and the community for an innovative, but practical, governance strategy for DSpace that fosters its active, decentralized community of contributors while providing the appropriate level of centralized support and guidance.

2.0 Governance Advisory Board Charge

The charge of the DSpace Governance Advisory Board is to recommend:

- A mission for the DSpace Federation, that defines its target user base/membership and aspirations for advancement of the platform
- A governance structure and associated staffing models and funding strategies, including...
- A set of central services to the DSpace community, and
- A destination or a legal owner for its intellectual property

The governance structure should be one that provides for the sustainability of DSpace, so long as a community of users is present to support it. It should foster leadership distributed throughout the community and not rely on one or two institutions', or on one or two individuals', participation for its operation. Each of DSpace's stakeholders, the adopters, developers, and commercial service providers, should have representation. The case studies found in Appendices H-K illustrate governance structures currently in practice in different communities, but each community has particular needs and characteristics that require unique solutions. The advisory board has been challenged to think innovatively, but practically, about a governance structure that will best meet the DSpace community's needs.

3.0 DSpace mission

Organizations form because the individual or institutional participants have a common purpose or objective. Many organizations capture this in a mission statement. Although the DSpace community will not necessarily create an independent organization (i.e. it could choose to join an existing one), a DSpace mission statement will help set the context for evaluating options for the community's future governance structure and the platform's legal entity. The governance advisory board is charged with creating a mission statement for the DSpace community as the first step in the governance process.

A mission statement should contain the following elements:

1. What are the opportunities or needs that we exist to address? (the purpose of the organization)
 2. What are we doing to address these needs? (the business of the organization)
 3. What principles or beliefs guide our work? (the values of the organization)
- (Radtke, 1998)

The mission statement should be succinct and focused, yet sufficiently broad to endure changes within the DSpace community and from external factors. It also should represent the community's needs, values, and goals and inspire their commitment. The process of creating a mission statement can have a deceptively simple outcome, yet entail intense contemplation and debate to develop. The remainder of this document presents information that aims to inform that debate. The following draft mission statement intends to facilitate the process, by providing a starting point for discussion.

The mission of the DSpace community is:

Purpose: To provide open access to scholarly research materials and preservation of digital materials

Business: by collaboratively developing software products to capture, manage, preserve, and redistribute digital scholarly research materials

Values: within the principles of open source, and with the goal of furthering the missions of academic and research institutions.

4.0 Scope of governance activities

The following list describes activities that could have important long-term implications for the sustainability of the DSpace community. A governance organization should provide the means to accomplish some or all of these activities as a set of services to the community. The governance advisory board is charged with prioritizing these activities and suggesting which activities a central organization could better manage directly and which activities the central organization should facilitate, but delegate to volunteers throughout the community. More details on each area of activities are provided in Appendix F.

Membership and resources

- Develop and communicate a common vision for growth and sustainability of the DSpace community, including membership strategies and approaches to leveraging community resources.

Business planning

- Assist companies and user institutions with developing service and business models around DSpace.

Marketing and community building

- Build awareness and educate potential user institutions or end-users about the features, functionality, and benefits of the DSpace platform.
- Assist in the organization of regular user group or technical development meetings.

Outreach to other projects and initiatives

- Extend existing and build new working relationships of the community to related research and development projects engaged in complementary efforts.
- Coordinate participation in national and international standards development, as related to the project.

Legal oversight

- Manage, with the help of legal counsel, licensing, intellectual property, and other legal policies.

Fundraising

- Raise investment for DSpace from a range of sources, including academic institutions, foundations, governments, and corporations and manage those funds in keeping with the mission and goals of the governance organization.

DSpace core development and support

- Identify and engage resources for core DSpace feature development, system architecture planning and development, bug fixing, quality assurance testing, release management, documentation, and user support.

Process facilitation

- Act as a facilitator for the DSpace committer group to further develop technical governance processes.

Collaboration infrastructure

- Coordinate operational and administrative aspects of the DSpace community, particularly the communication and networking infrastructure such as the platform's website, email lists, and collaboration tools.

Technical oversight

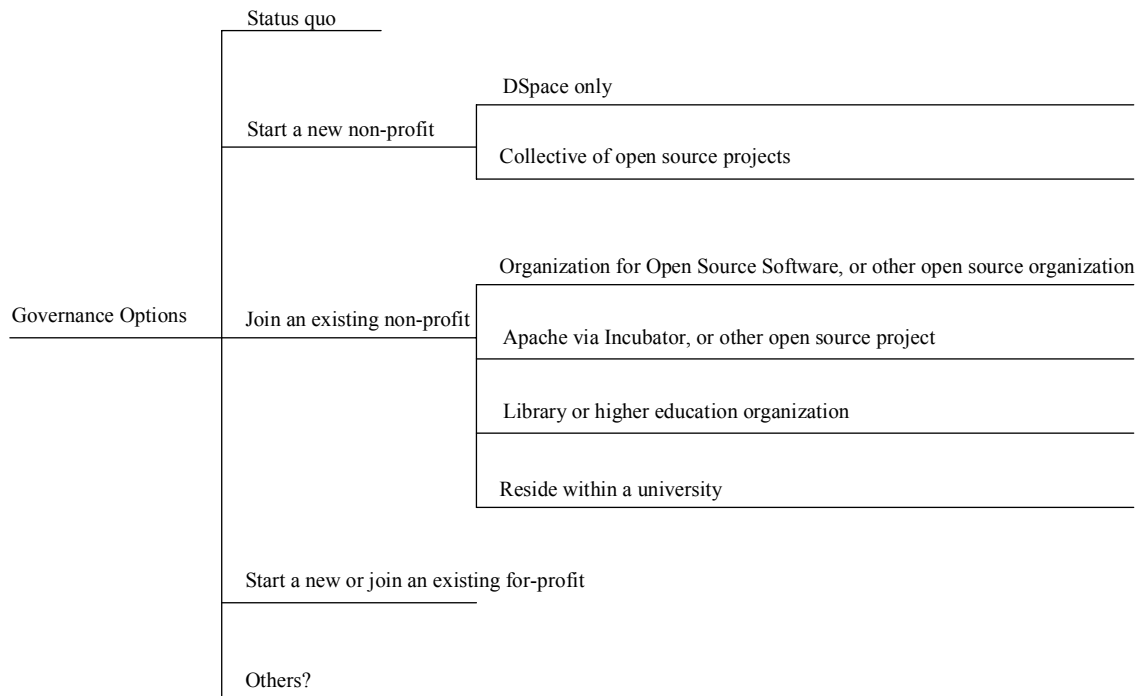
- Address how to foster more integrated collaboration between DSpace's adopters, domain experts and developers.
- Define an explicit relationship between the governing DSpace body and the DSpace development community by delineating the degree to which a governing body facilitates and intervenes in technical issues.

Liaison with DSpace Service Providers

- Serve as a liaison with commercial ventures offering services and support to the DSpace community.

5.0 Governance options

The following diagram depicts a set of governance options available to the DSpace community. The options include ones that other open source projects have chosen and some that represent alternatives not currently in practice, but the list is not necessarily exhaustive. This document then examines each of these options in detail, exploring governance, staffing and funding models. MIT, HP, and the DSpace community seeks an organization that will serve as a long-term steward for the platform that embodies the DSpace mission and provides the necessary services to sustain it. The governance advisory board is charged with reviewing the options described below, brainstorming others and developing a suitable recommendation that meets the objectives set forth by the community.



5.1 Status quo

Developing a governance structure and finding an appropriate legal owner for DSpace involves addressing complex issues and making decisions with long-standing effects on the platform and community. Before taking on this task, it is sensible and worthwhile to ask the question: could the current situation continue to work?

Open source projects cite the following the reasons for developing more formal governance structures:

- Intellectual property rights are better defined and more defensible when owned by a single legal entity
- Protect code, trademarks, licenses, and brand
- Gain some protections and privileges afforded to corporations
- Protect volunteer contributors from individual liability
- Enter into agreements collectively
- Live beyond efforts of founders (O'Mahony, 2005)

This list provides a useful framework for evaluating DSpace's current situation and its potential in the future. As relates to the first three of these issues, MIT and HP, with their corporate status and ownership of DSpace's assets, have the ability to provide the necessary legal oversight and protection on behalf of the community. Similarly, DSpace institutions that employ the volunteer contributors offer them protection from individual

liability. These are fundamental issues for open source projects, and DSpace had the good fortune of protection from the outset.

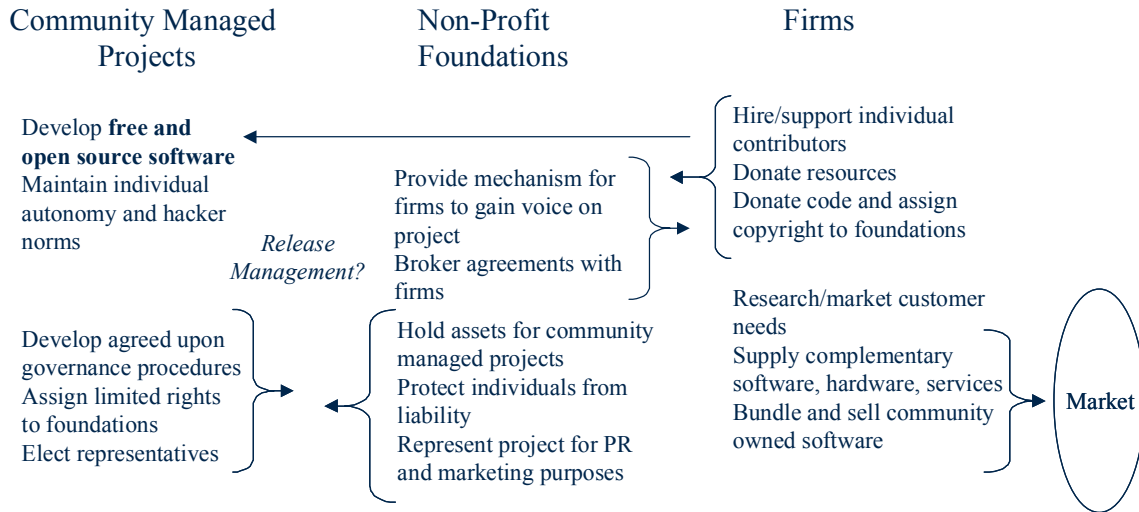
The remaining two issues, along with the needs summarized in the earlier section Scope of Governance Activities, highlight the shortcomings of the current model. The DSpace community, as it exists today, has no forum through which it can make decisions that represent the wishes of the community, centrally administer services, and collectively enter into agreements. Without a coordinating structure that represents the community's interests, it is far more difficult, if not impossible, to lobby, negotiate with and establish contractual relationships with other organizations. This issue manifests itself at the strategic level with commercial service providers, standards bodies, and related research and development projects and at the operational level in negotiating contracts with vendors that might, for example, run a user group meeting on the community's behalf or provide collaboration infrastructure services to the community.

Finally, if DSpace continued to operate under the current arrangements, it would likely continue to rely on the underlying support provided by MIT and HP. What if MIT and HP were to disagree on an issue or if one or both of them were to disengage from the project? Would the project be at risk? Would DSpace survive this kind of fracture? DSpace prospects for sustainability will increase if a model were found to safeguard it against these risks and help ensure that DSpace lives without reliance on the involvement of its founders.

5.2 Starting a non-profit

Many open source projects address their need for a more formal governance structure by starting a non-profit foundation. Apache, Sakai, and .LRN have chosen this path, for example. It provides the corporate status that allows the community to enter into collective agreements and aids in protection from individual liability and wrongful use of the community's assets. It, minimally, establishes an independent entity with a board of directors, a set of by-laws and other mechanisms for making decisions and guiding the project in accordance with the wishes of the community.

A non-profit foundation also can play a useful liaison and coordination role between the community, commercial service providers, and the market, as described in the diagram below:



(O'Mahony, 2005)

Starting a non-profit raises a number of practical questions about how DSpace would implement such a plan. How would it be governed? What kind of staffing is required? How much does it cost to run a non-profit? From where would the funding come?

The case studies of the Apache Software Foundation, the Sakai Foundation, and the .LRN Consortium (Appendices I-K) each offer details on various open source software non-profit models. In summary, the Apache Software Foundation operates under a lightweight, low-cost, nearly cost-recovered approach to community management that distributes responsibility throughout the all-volunteer community. Apache requests no membership fees, but does ask for donations. The majority of the investment in the platform comes from the many corporations with a vested interest that directly contribute to and provide support for the platform.

The Sakai Foundation employs three staff, a framework architect, a release manager, and a technical support manager, resulting in a more costly infrastructure and reflecting its community's desire to have a more centralized approach to technical decision making. Sakai does not have an executive director (although they have plans to hire one in the future), rather the Sakai Board provides leadership and oversight for the Foundation. Because Sakai's market of higher education users represents a smaller resources pool than other open source projects like Linux and Apache, the Sakai Foundation obtains multi-year financial commitments from its university members and commercial affiliates to support the foundation's activities and the ongoing development of the platform. This

does not preclude non-members from using the software, but does prevent them from accessing the full resources of the Sakai Foundation.

The .LRN Consortium is a hybrid, in many ways, of these two models. It embraces much of the distributed technical governance model of Apache but employs a part-time release manager. Volunteers comprise the rest of the project participants, including the Executive Director, although it is the Consortium's hope to fill that role with paid staff. Even with the addition of the Executive Director as paid staff, the Consortium costs and infrastructure remain minimal. A major flaw of the .LRN Consortium, however, resides in the financial model. The \$250 membership fee, while it encourages member participation even from financially limited institutions in developing countries, barely covers the release manager's part-time salary and basic consortium operations. If DSpace were to adopt a similar model to .LRN's governance structure, it would need to develop a more sustainable business model.

To start a "DSpace Foundation", the community would have to select a Board of Directors and agree to a set of by-laws. These constitute necessary steps for incorporation as a non-profit. For both the board structure and the by-laws, there are many examples from which to draw, yet each of these tasks requires considerable time for research, discussion and consensus building throughout the community. Legal fees for incorporation are approximately \$5,000 and the annual tax filings by an accountant are also approximately \$5,000. Examining the needs of the community, as described in the earlier section on Scope of Governance Activities, points to the likelihood that DSpace requires either an extremely active Board of Directors or an Executive Director, who would provide overall project leadership, outreach to the community members and associated project and initiatives, facilitation of the technical community, fundraising, and coordination of resources. Additionally, a full-time or part-time technical resource could manage some of the less popular, yet necessary technical tasks such as release management, quality assurance, and documentation.

Any non-profit must balance its proposed costs with its ability to raise funds. The most important aspect of any funding mechanism developed, it should offer value to those that contribute. A "DSpace Foundation" has a number of funding options to consider. The following lists a few ideas, but the governance advisory board can likely recommend others:

- Membership fees, including all the possible variations:
 - Flat yearly fee, possibly with a multi-year commitment
 - Tiered fee structure, based on size of institution or ability to pay
 - Tiered fee structure, free to higher education and a fee for corporations
 - Mixed fee structure, the more an institution contributes in-kind, the lower the membership fee
- Commercial affiliates program for which companies pay an annual fee
- Percentage of revenues from commercial service providers
- Profits from user group meetings and DSpace training workshops
- Donations (from institutions, corporations, foundations etc.)
- Sale of DSpace paraphernalia

Membership fees offer the most predictable revenue stream but pose a barrier to participation, if some potential adopters cannot afford the fee. This runs counter to the philosophy of open source software and could put constraints on the growth of the adopter community. Tiered fee structures, based on participant's ability to pay, could alleviate the problem, however. The two options that pertain to commercial service providers could become viable in the long-term if interest from the corporate sector persists and grows, but almost certainly would not be sufficient currently. The remaining three funding mechanisms in isolation may not prove reliable and sizable enough to sustain a non-profit foundation, but taking these options in combination with membership fees, for example, may allow for cost recovery. Most higher education open source projects rely on membership fees.

Many other open source projects have chosen to start non-profits. Should DSpace follow a similar route? Certainly, many of the attributes of a non-profit meet the needs of the DSpace community. An independent non-profit has risks, however. DSpace would no longer have the dedicated protection, legal, financial or otherwise, offered by MIT and HP or any other institution with means to support it during down-cycles. Assuming that the number of open source projects in higher education increases and the trend to start non-profit foundations continues, universities will need to allocate valuable programming resources and funding across an increasingly crowded field. How many open source software non-profit foundations can higher education sustain? Are universities willing to pay membership fees, such as those required by the Sakai Foundation, to multiple software projects? Are there economies of scale that projects could gain by sharing an administrative structure?

An alternative to creating a "DSpace Foundation", the community could investigate creating a non-profit organization as a **joint venture with other higher education open source software projects** with complementary technologies. They would share a common user base to which they can market software and services. Many projects are making a transition from their origins as sponsored research projects jointly developed by large institutions to community-based open source projects, and would be able to share best practices. Most of these projects also face similar challenges to produce application-level software in an open source environment, as described in Appendix C: Open Source Software – Navigating Uncharted Waters. Rather than fragment the higher education market and its limited pool of resources, this combined effort could offer a comprehensive suite of interoperable services managed under a shared infrastructure. The primary risks DSpace faces with this solution arise from the typical issues, such as misaligned missions, visions and cultures, posed by joint ventures between two entities.

5.3 Join an existing non-profit structure

A variety of existing non-profit structures could serve as a long-term home for DSpace. This option would likely require less start-up effort than a new non-profit, such as the work involved to identify a Board of Directors and write by-laws. Presumably, an existing organization would afford greater stability than an independent DSpace non-

profit. An existing organization could provide access to new users or resources not currently served by or available to DSpace.

Depending on the organization chosen, DSpace could establish a stand-alone entity within the structure of another organization or it could integrate into the organization to take advantage of existing governance, staffing, and funding. MIT and HP likely would transfer ownership of or license the intellectual property. At a minimum, to ensure that the DSpace community's interests are served, some resources, volunteer or otherwise, would need to negotiate with the proposed organization, conduct the due diligence, and provide oversight during the transition period and perhaps play an ongoing role.

Continuing with the idea posed in the above section to join forces with other higher education open source projects, Ithaka, a non-profit foundation with a mission to accelerate the productive uses of information technology for the benefit of higher education, has recently conducted a study (results from which will become available in April 2006) examining the need for an open source coordinating body. Nicknamed **“OOSS” for Organization for Open Source Software**, it potentially proposes to support the development and advancement of open source software. At this early stage, predicting what this organization might provide and elements required of or by the DSpace community for participation proves impossible. At the same time, this poses an opportunity for the DSpace community to try to influence OOSS' development, should the advisory board express preference for this option, as an option for DSpace's long-term governance and sustainability.

A number of **non-profit organizations exist within the library domain and higher education** that share many of the DSpace community's values and goals. In broad categories, there are library consortiums, such as the Center for Research Libraries (CRL), library information technology consortiums, such as Online Computer Library Center (OCLC) and Research Library Group (RLG), and other higher education consortiums not specific to libraries. HP and MIT could investigate transferring ownership or licensing the technology to an organization like one of the above. Accessing the member institutions of such an organization could expand DSpace's user base. Further, many of these organizations have established relationships with projects and initiatives complementary to DSpace's. The DSpace community would have the chance to further its mission in collaboration with other organizations with similar agendas. Funding mechanisms at the membership consortiums are typically well established, providing ready resources to the project. A library organization could also benefit from the addition of DSpace in its portfolio. Selling DSpace services may prove an attractive opportunity to augment the organization's revenue. The visibility and global reach of DSpace could attract new members and the issues that the platform addresses could open up new areas of service. Drawbacks to this plan include constraints on the DSpace community's ability to expand beyond higher education and libraries and misalignment of mission and culture. To ascertain the feasibility of this option and interest among library organizations, MIT and HP could issue a request for proposal and involve the DSpace community in establishing evaluation criteria and deciding the outcome of the proposal process.

Joining another open source software project represents another option for consideration. For example, the Apache Software Foundation has an Incubator committee, described in more detail in Appendix H, which offers a path for becoming an Apache sub-project. DSpace models many of its practices after the Apache Foundation, including the contributor/committer meritocracy; a tendency toward a low-cost, lightweight project infrastructure; a preference for a more laissez-faire approach to roadmap management; and a shared philosophy to “let a thousand flowers bloom.” Those sources of commonality could make the Apache Incubator an attractive option for DSpace on its way to becoming an Apache project. The licenses in use by the two projects are similar, which would ease the transition. DSpace would join an existing organization, where it would have access to a well-established infrastructure and a vast network of resources.

On the other hand, DSpace differs from Apache both in its user base and in the type of software it creates. Apache’s nominal membership entity is an individual (even if they are paid by an organization to do the work) while DSpace’s is an institution (even if it is represented by an individual in the community today). Apache produces middleware software. DSpace produces niche, application-level software with an application-specific underlying middleware layer. While the role of the DSpace committer fits cleanly with Apache’s project management structure, it is unclear how DSpace’s domain experts and the institutional adopters would factor into decision-making on platform development. The community would likely need to appoint leadership for the sub-project to represent the interests of the community and carve out a variation in the traditional Apache project management approach. These misalignments, however, may prove impediments too significant to overlook and DSpace may prove too niche an application to fit within the Apache framework. Further, they demonstrate examples of more general issues that DSpace will need to investigate carefully if it were to consider joining another open source software project.

A final option in the category of joining an existing non-profit concerns **transferring DSpace’s intellectual property to another university**. The possibility exists that a DSpace community member institution could volunteer to serve as long-term steward for DSpace. The volunteering university would have to provide significant subsidization, similar to what MIT and HP currently provide, for the entire community. This solution might run counter to the objectives of the governance process, in which the DSpace community moves to a community-owned model that does not rely on one or two institutions for its sustainability.

5.4 Start a new or join an existing for-profit

In the mass-market software sector, open source projects are pursuing for-profit business models to sustain themselves. MySQL (see Appendix K) and Red Hat, for example, have succeeded in developing profitable business models based on subscription services and dual-licensing, in which the software is offered under a free open source license and a

for-fee proprietary license, the latter of which provides the user additional services and support. DSpace could pursue a similar path, starting a for-profit company to support the DSpace community. The company could offer premium technical support, training, installation, software customization, repository hosting, consulting and other services. Alternatively, for-profit companies such as BioMed Central and OneOverZero already offer some or all of these services and MIT and HP could consider transferring or licensing DSpace's intellectual property to one of them.

The process for starting a for-profit is nearly identical to starting a non-profit. The primary differences in these models lie in the tax benefits and how the corporation reinvests any "profits" generated. In the case of a for-profit, DSpace certainly would require a CEO to oversee operations and additional staff to manage and sell services among other responsibilities. Joining an existing for-profit organization would entail resources to identify an appropriate suitor, perform due diligence, and negotiate legal agreements involving the transfer or licensing of intellectual property. It would also entail some oversight during the transition.

What MySQL and Red Hat possess to grow and sustain their service business, however, is a user base in the millions that provides significant sales opportunities and allows MySQL to spread its fixed costs over a wide number of customers. To succeed as a for-profit company, DSpace would need to dramatically increase its adopter base and would likely need to expand beyond higher education to do that. Higher education user institutions would likely need to cede substantial control over the software, which could morph into something less highly tuned for institutional repositories. With its roots in higher education and its altruistic objectives to open access to scholarly materials and preserve them into the future, the DSpace community would need to reconcile these views with a for-profit business model. Further, if the community wished to start a new non-profit, someone with an entrepreneurial spirit and a vast amount of energy propelled by a vision of untapped opportunities, such as those that pioneered the MySQL and Red Hat organizations, would need to emerge within the DSpace community.

6.0 Conclusion

Any of the above options could serve as a governance model for DSpace and there may be others that the governance advisory board members contribute to the discussion. Each option has its strengths and its drawbacks. Selecting a governance structure requires careful examination of the complex interplay between open source software, the unique aspects of the higher education (and, perhaps, corporate and government) user community, and the objectives that the DSpace software attempts to achieve. To assess the suitability of an option, the governance advisory board will evaluate each one relative to its fit with the agreed upon DSpace mission and its ability to manage the governance activities that the board deemed most appropriately handled centrally. The advisory board will conclude its charge by discussing the practical issues that pertain to the implementation of the selected option, such as leadership, staffing, and funding.

Appendix A: Known DSpace Installations

The following institutions or organizations have self-registered on the DSpace website.

[Academia Sinica, Taiwan](#)
[AIST Grid Technology Research Center, Japan](#)
[ALADIN Research Commons, Washington Research Library Consortium \(USA\)](#)
[American Museum of Natural History Research Library \(USA\)](#)
[ANU DSpace \(Australia\)](#)
[Bergen Open Research Archive, Norway](#)
[Boston University \(USA\)](#)
[Brigham Young University \(USA\)](#)
[Bristol Repository of Scholarly Eprints \(ROSE\), UK](#)
[Bromley College, UK](#)
[Case Western Reserve University \(USA\)](#)
[Chapel Hill School of Information and Library Science Electronic Theses and Dissertations \(USA\)](#)
[CNRS/MSH-Alpes, France](#)
[Cornell University \(USA\)](#)
[Dépôt de documents et de données \(Érudit\) \(Canada\)](#)
[Digital Repository at the University of Maryland \(USA\)](#)
[DLEARN at the University of Arizona \(USA\)](#)
[Document Server@UHasselt \(Belgium\)](#)
[Drexel University \(USA\)](#)
[DSpace@Cambridge \(UK\)](#)
[DSpace@SLU \(Saint Louis University, Phillippines\)](#)
[DSpace a la Universitat de Girona \(Spain\)](#)
[Dspace at DGSCA - Universidad Nacional Autónoma de México](#)
[DSpace at Indian Institute of Management Kozhikode, India](#)
[Dspace at Indiania University Of Pennsylvania \(USA\)](#)
[DSpace at INRA Avignon \(Institut National de la Recherche Agronomique, Research Center of Avignon, France\)](#)
[DSpace at MIT \(USA\)](#)
[DSpace at NCL \(National Chemical Laboratory, Pune, India\)](#)
[DSpace@nitr \(National Institute of Technology, Rourkela \(India\)](#)
[DSpace at Radboud Universiteit Nijmegen \(The Netherlands\)](#)
[DSpace at Ural State University, Russia](#)
[Vidyanidhi Digital Library & E-Scholarship Portal, University of Hyderabad \(India\)](#)
[DSpace at Zhejiang Univeristy, P.R.China](#)
[Earth-prints.org: research in Atmosphere, Cryosphere, Hydrosphere and Solid Earth fields \(USA\)](#)
[Ecological Restoration Institute, Northern Arizona University \(USA\)](#)
[Edinburgh Research Archive \(UK\)](#)
[Erasmus University Rotterdam \(the Netherlands\)](#)
[e-space at Manchester Metropolitan University \(UK\)](#)
[European University Institute \(Italy\)](#)
[ETD of Indian Institute of Science, Bangalore \(etd@IISc\), India](#)
[George Mason University \(MARS\) \(USA\)](#)
[Glasgow University \(UK\)](#)
[Göteborg University Open Archive \(Sweden\)](#)
[Hokkaido University collection of scholarly and academic papers, JAPAN](#)
[Hong Kong University of Science and Technology](#)
[Humboldt eScholar -Humboldt State University \(USA\)](#)
[Ibero American Science & Technology Education Consortium, Mexico](#)
[IdeA, Indiana University Purdue University Indiana \(USA\)](#)
[Indian Statistical Institute, Library, Bangalore, India](#)
[Information And Library Network Centre \(INFLIBNET\), India](#)
[Institute for Political Science, University of Duisburg-Essen, Germany](#)
[I-revues, service d'édition électronique de l'Institut de l'INformation Scientifique et Technique du CNRS, France](#)
[Kansas State Publications Archival Collection, Kansas State Historical Society and Kansas State Library \(USA\)](#)
[KU ScholarWorks \(University of Kansas\) \(USA\)](#)
[Leiden University, The Netherlands](#)
[Librarians' Digital Library \(LDL\) at DRTC, Indian Statistical Institute, Bangalore, India](#)
[Los Alamos National Laboratory, New Mexico \(USA\)](#)
[Loughborough University, UK](#)
[LSpace at London South Bank University \(UK\)](#)
[Malmö University Electronic Publishing \(Sweden\)](#)
[Materials Digital Library \(USA\)](#)
[Modiya Project \(NYU, USA\)](#)
[MSpace at the University of Manitoba \(Canada\)](#)
[Nagoya University, Japan](#)

[National University of Singapore](#)
[OdinPubAfrica](#)
[Ohio State University Knowledge Bank \(USA\)](#)
[Open Universiteit Nederland \(The Netherlands\)](#)
[Oregon State University \(USA\)](#)
[Papyrus : Dépôt institutionnel numérique de l'Université de Montréal \(Canada\)](#)
[Portfolio@Duke University \(USA\)](#)
[QSpace at Queen's University, Kingston Ontario \(Canada\)](#)
[QUEprints, Cranfield University \(UK\)](#)
[RECERCAT Dipòsit de la Recerca de Catalunya \(Spain\)](#)
[Reposcom@PORTCOM - Communication's Sciences Repositories Portal, Brazil](#)
[Rice University \(USA\)](#)
[RIT Digital Media Library \(USA\)](#)
[Roskilde Universiteit Center Digital Archive \(Denmark\)](#)
[Simon Fraser University, BC \(Canada\)](#)
[SISSA Digital Library \(Italy\)](#)
[Sistema Bibliotecario de la Educación Superior Universitaria Estatal de Costa Rica \(SIBESE-CR\)](#)
[SMARTech Scholarly Materials and Research at Georgia Tech \(USA\)](#)
[State University of New York, System Administration \(USA\)](#)
[Superior Tribunal de Justiça / Brazil](#)
[Swinburne University of Technology Image Bank \(UK\)](#)
[Sydney eScholarship Repository \(Australia\)](#)
[Teaching and Learning Research Programme Publications \(University of London, UK\)](#)
[Texas A&M University Libraries Institutional Repository \(USA\)](#)
[Texas Digital Library \(USA\)](#)
[T-Space at The University of Toronto Libraries \(Canada\)](#)
[University of Aberdeen Research Archive \(AURA\) \(UK\)](#)
[Universidad Autonoma De Occidente, Colombia](#)
[Universidad de los Andes \(Colombia\)](#)
[Universidad de Talca, Chile](#)
[Universidade da Coruña, Galicia, Spain](#)
[Universidade do Minho, Portugal](#)
[Universidade Federal do Paraná, Brasil](#)
[Università degli Studi della Tuscia, Italy](#)
[Università di Parma \(Italy\)](#)
[Universitat Politècnica de Catalunya \(UPC\) - DSpace.Revistas \(Spain\)](#)
[University of Bristol Repository of Scholarly Eprints \(ROSE\) \(UK\)](#)
[University of Calgary, Alberta \(Canada\)](#)
[University of Delaware \(USA\)](#)
[University of Dortmund, Germany \(productive system with approx. 15,000 Items\)](#)
[University of Ghent \(Belgium\)](#)
[University of Groningen, Germany](#)
[University of Guelph, Canada](#)
[University of Hyderabad, Hyderabad \(A.P\)-46, India](#)
[University of Illinois, Urbana-Champaign \(will be "live" in Fall 2006\) \(USA\)](#)
[University of Kassel, Germany](#)
[University of Macedonia Library, Thessaloniki, Greece SOON TO BE RELEASED](#)
[University of Manitoba \(Canada\)](#)
[University of Michigan, Ann Arbor \(USA\)](#)
[University of Namibia, Windhoek, Namibia](#)
[University of New Brunswick \(Canada\)](#)
[University of New Mexico, DSpaceUNM \(USA\)](#)
[University of Oregon Scholars' Bank \(USA\)](#)
[University of Rochester's UR Research \(USA\)](#)
[University of Stirling, Scotland, UK](#)
[University of Tennessee in Knoxville \(USA\)](#)
[University of Texas at Austin Libraries Digital Repository \(USA\)](#)
[University of Texas at Austin, School of Information \(USA\)](#)
[University of Vermont \(USA\)](#)
[University of Wales Aberystwyth \(UK\)](#)
[University of Washington, Seattle \(USA\)](#)
[University of Washington Health Science Libraries \(USA\)](#)
[University of Wisconsin, Madison \(USA\)](#)
[Utrecht University, Netherlands](#)
[Vanderbilt University e-Archive \(USA\)](#)
[Vrije Universiteit Amsterdam, The Netherlands](#)
[Waseda University, Japan](#)
[Washington University School of Medicine, St. Louis \(USA\)](#)
[Wesleyan University, Middletown, Connecticut, USA](#)
[Woods Hole Open Access Server \(USA\)](#)
[Youngstown State Univeristy, Youngstown, Ohio, USA](#)

Appendix B: Countries with DSpace Deployments

Africa (consortium of 25
member states)
Australia
Belgium
Brazil
Canada
Chile
China
Colombia
Costa Rica

Denmark
France
Germany
Greece
Hong Kong
India
Italy
Japan
Mexico
The Netherlands

Norway
Philippines
Portugal
Russia
Singapore
Spain
Sweden
Taiwan
UK
USA

Appendix C: DSpace Service Providers

Hewlett Packard India
Hewlett Packard Japan
Open Repository from BioMed Central
The AePIC team at CILEA in Italy
Lester Bowser in USA
OneOverZero

Appendix D: DSpace Federation Governance Advisory Board Members

Mr. Chris Rusbridge, Chair (Director, Digital Curation Centre, UK)
Dr. Adrian Burton (Project Leader, Australian Partnership for Sustainable Repositories)
Dr. Matthew Cockerill (Publisher, Biomed Central)
Ms. Susan Gibbons (Assistant Dean for Public Services & Collection Development, University of Rochester)
Ms. Geneva Henry (Executive Director, Digital Library Initiative, Rice University)
Dr. James Hilton (Associate Provost for Academic, Information & Instructional Technology Affairs, University of Michigan)
Dr. Clifford Lynch (Executive Director, Coalition for Networked Information)
Ms. Carole Moore (University Chief Librarian, University of Toronto)
Dr. Siobhan O'Mahony (Assistant Professor of Business Administration, Harvard Business School)
Dr. A.R.D. Prasad (Associate Professor, Documentation and Research Training Centre, Indian Statistical Institute)
Mr. Nick Wainwright (Research Director, Digital Media System Department, HP Labs)
Mr. Peter Walgemoed (Director, Carelliance BV, Netherlands)
Ms. Ann Wolpert (Director, MIT Libraries)

Appendix E: DSpace History

In November 2000, MIT Libraries and HP Labs began a research and development collaboration to create an operational software system with broad functionality to capture, manage, preserve, and redistribute digital scholarly research materials in a variety of formats for a variety of purposes. Two years later, in November 2002, they released DSpace 1.0 as open source software. Here began the transition of DSpace from a closed, sponsored research project to an open, community-based project.

Not surprisingly, the transformation did not occur overnight, and for nearly a year and half, MIT and HP continued as the primary developers and supporters of the project. During the time between November 2002 and March 2004, other institutions focused internally on their DSpace installations: downloading the software, installing it, collecting content and building service models that fit the needs of their organizations. They often consulted one of the DSpace listservs, created as a collective resource to answer support questions from the community. MIT and HP answered nearly all of the questions in the beginning, but as other institutions progressed further with their DSpace installations, they began to draw from their experiences and aid in this effort.

The first user group meeting held at MIT in March 2004 proved a milestone in the evolution of DSpace. At that point, several DSpace installations had provided some bug fixes and new code to the platform. At the user group meeting discussion ensued about the best ways to integrate those efforts and to encourage further code development from the community. The discussion brought about several changes within the community.

First, among those adopters new to open source software, it created a better understanding and set of expectations about how open source projects work and the role that each installation can play to participate in the advancement of the platform. A “committer” group formed, following the model developed by the Apache Software Foundation (a leading non-profit organization that manages a number of highly successful open source software systems) and so called because they have rights to “commit” (i.e. submit) new code to the software, as the second major outcome of the user group discussion. This group, comprised initially of representatives from particularly active DSpace user institutions and more recently selected based on individual merit, has worked to clarify further the contribution guidelines, establish and improve technical processes, and develop collaboration infrastructure in addition to that originally established by MIT and HP. With an established committer group and a clearer path to submit and integrate new code, the community has gradually begun to engage in the development process. As of February 2006, the DSpace code base contains the work of nearly 60 developers. (Tansley, 2006)

The final element in DSpace’s transition from a sponsored research project to a thriving open source community is a governance structure that provides for full community participation without reliance on just one or two institutions. A governance structure can provide the needed coordinated leadership and strategic direction, build relationships with related projects and initiatives, and resolve issues effecting the community to enable

advancement of the platform to meet the needs of its users. Certainly, this will entail examination and recommendation of a sustainable financial model to support these activities. A pivotal meeting, the March 30-31, 2006 convening of the ad hoc DSpace Federation Governance Advisory Board likely will be the next major milestone in DSpace's evolution.

Appendix F: The DSpace Community and Its Governance Needs

DSpace adopters

While the community of DSpace adopters and contributors is somewhat diverse, higher education institutions, and particularly their research libraries, constitute the majority of the DSpace adopters so far. Most of these DSpace adopters use it to provide an "Institutional Repository" service, following the model proposed by SPARC (Johnson, 2002) and first instantiated by DSpace@MIT. These organizations care deeply about issues such as open access to scholarly research materials and preservation of digital materials. Stand-offs with scholarly publishers, who have formed monopolistic holds over academic markets and take advantage of this situation to rapidly increase journal prices; the explosion in the number of digital format and media types; the quantity of digital material created; and the rapid obsolescence of digital material have introduced to information management professions, including librarians, challenges without easy solutions. The library domain has fundamentally changed as a result. Increasingly, librarians seek technical solutions to adapt to this new world and to extend their library domain into new service areas such as archival storage for born-digital learning materials. Although DSpace will not immediately solve all of these problems, it presents a promising platform from which libraries can pursue solutions.

The following sections describe ways in which a more formal DSpace governance organization could advance the DSpace platform as it pertains to the adopter community.

Membership and Resources

Companies, higher education institutions, and libraries increasingly rely on open source software even for mission critical applications. In the past, libraries have purchased commercial software such as library automation and cataloguing systems. Accustomed to vendors providing software and services, library adopters new to using open source software often expect DSpace to operate in a similar fashion. Some, seeking a central source of authority, email HP and MIT to ask when certain features will become available. Some worry about the lack of dedicated technical support or other formal service mechanisms. Still others download the software and may develop it further locally, but either do not coordinate their development with the rest of the community and end up with highly customized solutions that they cannot upgrade or merge with the latest software version; or they do not understand or feel an obligation to contribute their enhancements for use by the broader community; or they limit the extent of their

involvement to local features and do not contribute to development of DSpace's architecture or core functionality. Open source software represents a paradigm shift for many DSpace adopters and, without the proper indoctrination, the community risks suffering from a free-rider¹ problem.

Because they have relied on vendors to provide software and customization, most DSpace adopters such as libraries do not employ large IT departments. Further, their IT departments often staff only system administrators who concentrate on daily operations for specific applications. Library IT departments rarely, if ever, staff programmers. The introduction of open source software - particularly applications such as DSpace that are fulfilling unmet needs - and the benefits open source offers have prompted many adopters to employ programmers, but the pool of developers remains small and competition will become fierce as more open source projects vie for resources. DSpace's sustainability, and the sustainability of open source projects in general, depends on a large, distributed pool of resources from which to draw. This raises the question: how many open source projects can libraries and higher education support?

A few museums and corporate and government research centers have adopted DSpace, indicating that DSpace may have broader appeal outside of higher education. The needs of these organizations and scope of the opportunity are not well understood. They likely will not be until the DSpace community makes a concerted effort to learn more about those potential adopters or someone from one of those communities becomes an active DSpace contributor. Building awareness about DSpace to attract these new adopters requires marketing efforts and probably development of new software features, but this strategy entails investment. Additionally, this strategy calls for an understanding of government and corporate markets, expertise that does not currently exist in the DSpace community.

Membership of the DSpace community and the resources necessary to support it are inextricably intertwined. If the community prefers to maintain DSpace's focus on the higher education market, it will need to construct governance, organizational, and funding mechanisms to overcome the resource constraints of its narrow market space. Broadening the scope of DSpace to include corporate and government users would build a larger adopter base that could result in a more stable and sufficient resource pool for DSpace, but would require investment and the current adopter base to sacrifice some control over the software that currently closely aligns with their specific needs. The DSpace community seeks advice from the ad hoc governance advisory board on this issue, as a necessary precursor to developing a direction for DSpace's future governance structure and membership strategy.

¹ A free-rider problem is one in which users “consume more than their fair share of a resource, or shoulder less than a fair share of the costs of its production.”
(www.wikipedia.org)

Business Planning

DSpace is not a typical open source software project, offering a solution to a well-understood problem. Along with related projects such as Fedora and ePrints, DSpace creates a new market for institutional repository software based on a loosely expressed need from faculty and researchers for a better way to manage and distribute their scholarly creations. Considerable fluctuation and uncertainty exists as to the scope and functionality of institutional repository software. Because it addresses less tangible, long-term issues such as open access to scholarly materials and digital preservation, the value proposition remains unproven. In addition, libraries and university administrations typically lack an existing budget line item to direct toward investment in DSpace.

The costs for operating a DSpace institutional repository depend on the type and size of service that an institution wishes to create. Some universities begin with modest implementations and use available resources to build their way to larger repositories. For more ambitious DSpace projects, obtaining a budget for DSpace often depends on the libraries' willingness to divert resources from other activities or the administration's understanding of the new challenges libraries face and willingness to support experimental approaches. In general, DSpace institutions must staff the project with a systems administrator, responsible for software maintenance, upgrades and local customizations. Also, institutions need to allocate resources toward the institutional repository's service and collection management, including definition of the service model, end user support and training, setting local policies and procedures, and marketing. Hardware (servers, storage, and back-up and recovery machines) represents the third major cost component to a typical DSpace service.

The above describes the daily operational costs of an institutional repository service, but the long-term costs remain far less clear. Market prices for data storage are declining, but hosting the vast quantity of materials that are candidates for institutional repositories each year, multiplied by years of accumulation, represents a potentially significant expense both in terms of storage hardware and data curation. Further, although there have been many studies into the costs of digital preservation, reports from those studies can draw no firm conclusions because there are no proven and consistently used preservation solutions on which to base that research. Someday, automated solutions, for which DSpace could serve as a delivery platform, may provide a low-cost approach to digital preservation but software systems can never completely automate the management of digital collections; care of valuable digital collections will always require some manual intervention.

Most DSpace institutions rely on university funding to operate DSpace. No DSpace institution has developed a self-sustaining business model for running their institutional repository service. Opportunities exist to obtain this goal. For example, libraries could offer value-added services such as scanning, metadata services, large scale data storage, and custom reporting services on a "cost recovered plus" basis, that would allow some profit margin to reinvest in the daily operations of the service. (Barton and Walker) Few institutions have thoroughly explored these options, however, and none have fully implemented them. Further, institutions could develop strategic relationships with other

institutions using DSpace to provide reciprocal back-up storage or data mirroring or pursue other tactics to gain economies of scale and reduce operating costs.

The extent to which universities continue to invest in the DSpace software and participate in its open source community depends ultimately on the total cost of ownership as it compares to competitive software products and services. Today, there are few, if any, systems available that provide similar functionality and none that are open source. Demand for services that help curate and preserve increasingly complex digital materials and collections will grow rapidly in the coming years as end-users discover the extent to which technical obsolescence effects their valuable personal and professional digital material. Competitive products will enter the market. To remain viable, DSpace must develop competitive functionality and maintain total cost of ownership in line with alternative products.

As a community, DSpace adopters need to collaborate on business plans that will more fully develop the institutional repository value proposition, expose ways to manage long-term costs, and offer innovative funding mechanisms. It is important for the health of the community that it works together, and with other communities facing these same challenges, to forge best practices for sustaining institutional repository services. A central governance organization could serve as the catalyst to bring together the appropriate expertise to assist DSpace adopters in developing viable business models.

Marketing and Community Building

Librarians and academics do not typically count marketing as one of their chief skills, but they have done an admirable job of spreading the word about DSpace and finding creative ways to build its business case within higher education. They have spoken about DSpace at conferences and written articles about their institutions' experiences. They have hosted user group meetings. These efforts have been informal or ad hoc, however. A centralized, coordinated effort, which a governance organization could provide, to build awareness of the platform, educate potential end-users and adopters of its benefits, organize regular user group meetings, and further empower existing adopters to serve as informal advocates could enable even more rapid growth.

Outreach to Other Projects and Initiatives

DSpace adopters have shared interests in initiatives outside of DSpace such as complementary research projects, national and international standards bodies, and other related projects. Often, individual DSpace institutions liaise with these groups external to the community. DSpace could more effectively exploit these relationships if there were a central body that could represent the mission and needs of the entire community.

Legal Oversight

DSpace currently requires contributors to relinquish copyright for their work to MIT and HP to maintain license compatibility and clear ownership of the code base, in case there

is a need to transfer this at a future date. The Apache Software Foundation (ASF) offers an alternative approach that also maintains clarity of ownership and may ultimately prove more palatable to the DSpace community. ASF contributors sign a Contributor License Agreement that grants the Foundation a “perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare derivative works of, publicly display, publicly perform, sublicense, and distribute” the contributor’s work. The DSpace community would benefit from legal counsel’s recommendation as to the best course of action.

Fundraising

Depending on the type of governance model that is recommended, the DSpace community may need to raise investment for DSpace from a range of sources, including academic institutions, foundations, governments, and corporations. A governance organization could coordinate those efforts and manage the funds in keeping with the mission and goals of the organization.

DSpace contributors

DSpace adopter institutions employ all of the DSpace developers. In general, the DSpace developer group operates similarly to open source projects like those managed by the ASF. The committer group consists of seven individuals that volunteer and represent various DSpace institutions. These committers dedicate time to system architecture planning and development, feature planning and development, bug fixing, integrating new code submissions, quality assurance testing, release management, documentation, technical support, participating in specialized work groups, and many other tasks to maintain and enhance the platform. The more general pool of “contributors” actively support the community by answering technical questions from users and providing bug fixes and software enhancements. A set of guidelines defines the steps to contribute code to DSpace.

The committers were encouraged to take on this leadership role by their employers while the DSpace community gained a better understanding of what is involved in technical leadership of its open source software and the many tasks necessary to sustain it. From the experience of the committers, the community now knows that upkeep of DSpace, particularly with its growing user base and the increasing number of ways institutions put the platform to use, requires more resources from throughout the community with a wider variety of skills and backgrounds relevant to the various technical tasks necessary for running an open source software project. The following sections describe ways in which the technical organization of the DSpace open source software project could improve and the role that a more formal governance structure could play.

Core Development and Support

An unduly large workload falls to the committer group. The available resource pool among DSpace adopters is small, restricting the group's ability to recruit qualified new participants. Much of the code development has focused on local, institution-specific needs and does not directly enhance the core DSpace architecture or functionality. The committers have taken on much of the responsibility for the core development work as well as tasks which no one else in the community volunteers to do, such as documentation. Release management is another example. Currently, the committers rotate responsibility for release management and have found this to be a time-consuming task that, for example, a committee of contributors might manage equally well with less burden placed on any one individual. Elevation to committer status rewards sustained and substantial commitment to the project, but should not entail primary responsibility for it.

A better model would involve recruiting more technical individuals to contribute that have the interest and skills for specific tasks and distribute that work into specialized work groups. Another model, one that could be used in conjunction with the model just described, involves staffing a single resource, as this paper later describes in the .LRN Consortium case study (see Appendix J), to manage certain technical tasks centrally, such as release management and quality assurance. A governance structure could also provide support as a communication mechanism for making the community aware of areas where contributions are needed.

Process Facilitation

The DSpace project would benefit from additional technical processes and procedures in a handful of areas, but among the plethora of responsibilities of the committers, these procedural-planning tasks often fall to the side. Technical stand-offs occasionally occur and remain unresolved for lack of facilitation or a method for charting a path forward. There seems to be a demand for more formal roadmap planning, but no process exists to accomplish this. Legal issues still exist as to how best to include contributed code. As the community extends and it envisions new uses for DSpace and ways to enhance it, the community should have a way to establish sub-projects and other classes of contributors. A central governance organization could facilitate these discussions and help establish the necessary structure.

Collaboration Infrastructure

A basic infrastructure supports the efforts of the developers. The DSpace developers deposit code centrally in SourceForge, the world's largest open source code repository, and use SourceForge's issue tracking database. SourceForge and MIT host group discussion email lists such as DSpace-General, a general purpose list for non-technical discussions; DSpace-Tech, offering technical support; and DSpace-Devel, a discussion group for code and feature development and release. The DSpace wiki, which has been

integrated with the main, informational DSpace website, provides a participatory forum for community members to update others on the latest DSpace news and developments.

MIT, HP and the committer group provide most of the upkeep for this infrastructure, but only at very basic levels. More sophisticated collaboration tools exist that the community could utilize. The website would benefit from restructuring and regular attention to its content. A governance structure with central resources could manage these operational and administrative aspects of DSpace.

Technical Oversight

A heavily debated topic by most open source projects when faced with the need to establish a more formal governance structure is the degree to which it should have jurisdiction over technical issues. Some open source projects strictly separate the two but other projects allow the governing body to exercise some control in areas such as release management and architectural direction. In the case of DSpace, those with specific domain expertise (but are not developers) typically define DSpace's features and functionality rather than the developers employed by DSpace's adopters. A governance structure will need to address how to bridge the gap between those two types of contributors and the degree to which a governing body facilitates and intervenes in technical issues.

Commercial service providers

A global set of for-profit companies (see Appendix C: DSpace Service Providers) has established business models around the DSpace platform, providing value-added services to the community. This is a milestone for the DSpace project because it indicates the potential that commercial companies see in the technology and signals that the platform has reached a level of stability on which a business can be built. Further, several of the businesses value the customer base that DSpace attracts.

HP, of course, has been involved from the outset as a development partner, but the **HP Global Solutions Group** in India, China and Japan have begun working with several regional clients who have chosen to use DSpace, principally universities who wish to run Institutional Repositories but do not have or wish to hire local resources to set up and operate them. HP's interest in DSpace has always been as a research platform, including the accompanying processes and procedures as well as the technical aspects, and this interest continues in activities such as the China Digital Museum project, which aims to create a large, distributed, virtual museum in China based on DSpace.

In 2005, **BioMed Central**, headquartered in England and “an independent publishing house committed to providing immediate open access to peer-reviewed biomedical research”, began offering Open Repository (www.openrepository.com), a service to “build, launch, host, and maintain institutional repositories for organizations.” The service is built upon the DSpace platform. Open Repository markets its service as a cost-

effective alternative for institutions that “could not otherwise afford to, or lack the infrastructure or technical capacity in-house to run their own repositories.”

In Italy, the **AePIC team** (<http://www.aepic.it>) at CILEA (<http://www.cilea.it>), a national consortium of nine universities devoted to digital library applications and support of open access and open archives, provides housing, hosting, setup and configuration, consultancy, and training for several e-publishing products, including DSpace. Their involvement with DSpace began a few years ago when they started to install and run DSpace for different institutions. They discovered that many universities and research centers employ a small number of IT staff and often do not have the resources to install and manage institutional repositories. With a staff of over 100 information technologies, CILEA’s AePIC team is able to quickly install DSpace for a reasonable cost. In addition to installation services, they also provided consultancy (for installation, setup, configuration, metadata, OAI-PMH, etc), training, layout customization, software development for special needs, maintenance, upgrades, and Italian interfaces. For the "full service" (installation, setup, configuration, customization, one-day training, consultancy, hosting, network connectivity, UPS, firewall, backups) they charge a nominal up-front fee plus a small yearly maintenance fee. As a non-profit, they only charge for time and a share of server mortgage and housing.

Private consultants also offer support to the community. **Carelliance** (<http://www.carelliance.com/>), located in the Netherlands, advises hospitals about their information policies and IT infrastructure for long-term information availability. The firm sees potential for use of DSpace at research institutions, particularly in the medical industry. **OneOverZero** (www.oneoverzero.com/) also offers consultancy, development and customization to DSpace adopters. The firm operates under the technical leadership of Richard Jones, a DSpace committer and lead developer on the Edinburgh Research Archive and Bergen Open Research Archive projects, both based on the DSpace platform.

Liaison with DSpace Service Providers

The delivery of for-profit services based on DSpace drives investment in the underlying platform. Although involvement by commercial ventures has not been unwelcome by the community, no formal outreach efforts exist to develop or encourage these relationships. Formal liaisons, facilitated by a DSpace governance structure, could foster a more comprehensive support infrastructure that would meet the various needs of the DSpace community.

Appendix G: A Brief Overview of the Open Source Software Movement

The following sections contain a brief overview of open source software to provide context for the DSpace governance discussion. For more detailed information on open source software, there are many articles and books available. Appendix M contains a suggested related reading list.

A Rebellion

The official open source software movement started in 1984 with an anarchist act - bold, but simple, although some argue that the movement started quietly years before that when universities informally shared mainframe software. The official story goes, however, that Richard Stallman, an MIT researcher at the time, developed an operating system, known as GNU, to compete with Sun Microsystem's UNIX and he distributed the underlying source code for anyone to download for free and modify. Stallman embedded his rebellious ideas into the newly created GNU Public License (GPL), under which he distributed the software. The GPL requires that creators of derivative works similarly distribute using the GPL and thus makes any resultant source code publicly available.

In 1991, Linus Torvalds, a Finnish undergraduate, supported this crusade by releasing the "kernel" of an operating system which became known as Linux. Over the next few years, hundreds and then thousands of programmers began integrating GNU and Linux (Ferguson, 2005). GNU/Linux now accounts for \$4.2 billion of the \$49 billion server market, and should grow at least 15% a year for the next five years through 2010 (*BusinessWeek*, 2005). Some experts predict that it may eventually unseat Microsoft's dominant Windows platform.

Today, there are over 100,000 projects hosted by Sourceforge, the world's largest development and download repository of open source code and applications, and 1.1 million registered Sourceforge users (<http://sourceforge.net/>). Apache, a well-known open source project, powers approximately 65% of the world's web servers. Mozilla's Firefox browser has an 8% market share and continues to erode steadily Microsoft Internet Explorer's market share (*Businessweek*, 2005). The open source rebellion, once scoffed at by the proprietary software industry, has become a force in its own right.

A Challenge to Closed Source Software

The open source software movement challenges many of the established tenets of the proprietary or closed source software industry. It eschews the commercial economic model based on license fees and royalties by offering free and open access to the source code. Proponents believe that providing visibility directly into the source code, something that closed source software vendors do not offer, makes programmers more accountable and results in higher quality software. Frustrated by proprietary software of mediocre quality that often doesn't meet their needs or requires expensive customization, users have eagerly embraced the opportunity open source affords for greater control and

input in the development process. Others see open source as a way to gain leverage in negotiations with commercial software vendors.

Open source also tests copyright law with its GPL “copy-left” license and the hundreds of variants of GPL. In fact, open source licensing has become a new practice area within law firms. The Berkeley Software Distribution (BSD) is another popular license in use by many open source projects, including DSpace. Not a “copy-left” license because it allows derivative works to be distributed under a proprietary license, the BSD is considered to be friendlier to commercial interests.

Traditional corporate software development practices have been challenged and revolutionized by open source. The collaborative practices of the early contributors to GNU and Linux and other open source projects evolved into a new, decentralized approach to software development that boasts greater efficiencies over more traditional, command and control software development methods. All of the early open source projects were either operating systems, like LINUX, or middleware, like Apache’s web server software. Those that developed them were also users and vice versa. With this intimate understanding of the software they were developing, programmers were able to eliminate the usual requirements and functional specifications found in corporate structured software development processes. Unlike commercial software vendors, there is no commitment to the user base in the form of a formal product roadmap detailing upcoming features and a scheduled release timeline. Instead, open source projects release “early, and often”, incorporating whatever bug fixes and enhancements the community has contributed. There is no central organization to which users present requests for development. Rather, the assumption is that each installation site will develop aspects that are important to them and contribute those that are broadly useful to the platform. Open source projects distribute responsibility for quality assurance to the users. When a user finds a bug, he/she fixes it or notifies the community and someone else with the appropriate skills typically volunteers for the task. Programmers embrace open source ideas because they allow them to focus on the elements they most enjoy about software development and they don’t involve the trappings of corporate bureaucracy. As the movement caught hold, the development capacity of the projects expanded, enabled by the free access to the source code and the Internet as a worldwide distribution mechanism.

Not surprisingly, given open source’s origins in higher education, a number of open source software projects at universities around the world challenge established software vendors. The academic market space, small compared with the mass-market, comprises universities operating within tight budget constraints. These two factors make higher education an unattractive market for most software vendors. Software monopolies or oligopolies are common. The lack of competition often results in mediocre software and poor customer service.

Sakai, an example of a higher education open source project, presents new competition among course management systems. Faculty, students and academic computing departments felt frustrated with the poor quality of commercial systems like Blackboard

and WebCT. The Sakai project began when the University of Michigan and Indian University decided to create a new, open source collaboration and learning environment, developed and guided directly by academic computing departments.

Another consequence of academia's small market size is that commercial vendors often do not address niche software needs. Open source software could provide a solution in those areas, if the user community can gather together the necessary programming resources. DSpace, Fedora and ePrints, for example, have emerged to address the previously unmet demand for a system for open access and archiving of scholarly research.

A Disruptive Force in the Software Industry

Fortune 500 companies, such as IBM and Hewlett-Packard, have rushed to develop strategies that embrace open source, viewing it as a significant disruptive force that may dislodge the dominant software vendors such as Microsoft, SAP and Oracle by commoditizing the software upon which these firms' profits depend (Ferguson, 2005). Most open source companies, including venture-backed start-ups, have a two-tiered licensing model in which they give away a free basic version of their software and then charge for a premium version or for support services. A few, however, have innovated outside the norm. "SpikeSource, and competitor SourceLabs, both act as a go-between for big corporations and open-source projects, finding, testing, and evaluating ideas by the hundreds. Then they consult with companies on how to implement them, and provide support if something goes wrong. For legal safeguards, there are even startups like BlackDuck, a Waltham (Mass.)-based company that digs into whatever open-source code a company has downloaded to make sure the licenses are all in order to avoid liability issues" (*BusinessWeek*, 2005).

Venture capital firms have invested nearly \$400 million in 50 open source companies in the 18 months between April 2004 and September 2005 (*BusinessWeek*, 2005). Although this may not sound like a significant amount of money given the overall size of the software industry, venture capital goes a long way in organizations that don't need to support heavy overhead costs such as a sales force. To screen for promising opportunities, venture capitalists identify a strong, vibrant community as the number one criteria. Enthusiasm for this market space may have inflated an investment bubble, critics say, given that highly profitable revenue models remain difficult to build around free software.

In higher education, organizations like the Andrew W. Mellon Foundation and the Hewlett Foundation invest in open source projects such as Sakai, Fedora, DSpace, uPortal, and Quali. In addition, universities devote resources to open source projects, as do corporate partners such as DSpace's Hewlett-Packard relationship and the various Sakai Commercial Affiliates.

Navigating Uncharted Waters

Critics cite a number of unproven aspects of open source. There persists a “lack of case law analyzing the open source license agreements”, which brings into question these agreements’ enforceability (Schwartz, 2005). License proliferation also causes concern. Organizations that use open source software need to be careful about how they integrate it with proprietary software, as the viral nature of the GPL license, for example, can “infect” proprietary software code, rendering it subject to the requirements of the GPL license. An open source software project must also worry about mixing incompatible licenses in the same source code. The Apache project, among others, alleviates this concern by requiring every contributor to sign a Contributor License Agreement, stipulating that all contributions donated to the Apache Foundation adhere to the Apache license. These legal issues exist as much in higher education as they do in the mass-market software industry.

The economics of open source also remain untested, and there are “scarce experienced or knowledgeable business resources” (Dow Jones). MySQL, which offers customers basic and premium versions (the latter for a fee) of its open source database as well as support services, generated \$40 million in annual revenues last year, with projections to double revenues annually. (*Businessweek*, 2005) It represents one of the few successful and potentially sustainable business models. Open source ventures that offer services based on independently developed open source software have found it difficult to differentiate their service offerings from other similar ventures. They also have discovered that a service-based business requires a large user base to obtain profitability.

As the leaders of the “free” software movement, the open source community experiences a constant tug-of-war between commercial and not-for-profit objectives. Within higher education, the inclination toward free and open access has even deeper roots and skepticism prevails toward the creation of for-profit business models. Attempting to find sustainable alternatives to for-profit business models, most higher education open source projects rely on fee-based membership consortiums.

The pool of available programmers also poses a potential limitation on the open source software movement. Large projects like Apache depend on a vast number of contributors to mitigate the ebbs and flows of participation. All open source projects face a challenge to recruit skilled resources, but higher education, with its narrower resource pool and focus on more niche applications, faces a particular problem. Undergraduate and graduate students expand that programming workforce but provide the added challenge of a more transient development group.

Open source faces another challenge in the development of application-level software. The pioneering open source projects like Linux, Apache and MySQL are either operating systems or middleware applications, and their users are programmers and systems administrators. For these projects, the user is the developer and the developer is the user, meaning that those individuals who contribute to the project understand intimately and first-hand what needs to be improved and how to do so. The popularity of open source

has spread to end-user applications, an environment where the developer is not necessarily an end-user. A gap inevitably forms between these two groups that must be spanned. Traditional software development methods strove to address this problem, but never managed to effectively. A number of open source, application-level projects appear to operate successfully but documentation does not exist about how they have adapted their methods. Mass-market applications such as software for web browsers (e.g. Mozilla), handheld devices (e.g. Chandler) and office productivity tools (e.g. OpenOffice) may avoid the issue because they can model their software after existing commercial software, the features for which are generally well understood. For software like DSpace, Sakai, Quali and many of the other higher education applications, the development of which requires input from those with specific expertise, how to best apply the full benefits of open source remains unclear.

The Future?

Open source has started an ideological and economic revolution within the software industry that likely has just begun. Although many companies embrace the movement, vendors that stand to lose the most, such as Microsoft and even niche players like Blackboard, will not surrender without an epic battle. Predicting their strategies for preserving market share and profitability will be instrumental in determining the future of open source.

Does open source represent the future for the software industry? Will commercial software vendors prevail? Or will a model emerge that is a hybrid of the two? Considerable uncertainty exists in this highly competitive market space and the ability of open source to develop sustainable governance and business models that keep total cost of ownership below competitor's commercial licensing fees and other costs related to the use of commercial software will be the determining factor. BusinessWeek magazine describes open source as needing an ecosystem of many users, active contributors, and invested commercial vendors to thrive. Meeting the needs and providing value to each of these stakeholders more effectively than commercial software vendors have will be critical. Effective governance provides the mechanism that will allow open source communities to deliver against this vital need.

OSS Project Case Studies

Appendix H: The Apache Foundation

(www.apache.org)

The Apache Software Foundation (ASF) manages some of the best-known and most established open source software projects. The Apache Web server software powers 65% of the web sites in the world. The project began when a group of individuals independently became interested in some freely available source code of the HTTPD web server written by the National Center for Supercomputing Applications (NCSA) and decided to contribute to its support and maintenance. As the project grew larger, more individuals became involved, and related “sister” projects were undertaken, and it became clear that the project would benefit from more structure and organization. Additionally, as commercial interest in collaborating with the project increased, a formal legal entity to represent the individuals working on the project became necessary. In 1991, a group of Apache volunteer developers created ASF as a 501(c)3 non-profit organization to:

- “provide a foundation for open, collaborative software development projects by supplying hardware, communication, and business infrastructure
- “create an independent legal entity to which companies and individuals can donate resources and be assured that those resources will be used for the public benefit
- “provide a means for individual volunteers to be sheltered from legal suits directed at the Foundation's projects
- “protect the 'Apache' brand, as applied to its software products, from being abused by other organizations “

Membership

Only individuals can be members of the Foundation. Individuals may represent the interests of the companies that employ them, but the status of Apache contributor or committer is the individual's. If an individual contributor leaves his or her employer, he or she continues to be an Apache contributor. The employer can only continue its work with the Apache Foundation if another of its employees has or subsequently reaches similar contributor status.

Governance and Staffing

The ASF operates as a meritocracy and its structure reflects those ideals. Those new to Apache begin as contributors, offering bug fixes, code enhancements, and documentation. Individuals earn the privilege to commit changes to the code base through longstanding participation and significant contributions to an Apache project and become what Apache refers to as a “committer”. Committers who provide particular support for the activities of the ASF earn membership rights. Peers reward longstanding

service to the ASF through election to the ASF Board of Directors. Committers also can assume leadership roles on one of the Project Management Committees guiding each of the thirty Apache projects. The ASF Board establishes, by resolution, new Project Management Committees, and bases its decision on a project's fit with Apache ideals and processes rather than on technical merit. The Board also appoints a Project Management Committee Chair from among the ASF officers.

Governance of the foundation does not include technical management of the projects. The project management committees, which operate fairly autonomously as their own decision-making entities, assume responsibility for project oversight, including legal issues and overall adherence to ASF principals. Apache board members only become involved in projects if social dynamics or legal issues crop up that require intervention to resolve. In very rare instances the Apache board can dissolve a project altogether. The ASF does not pay staff, not even an executive director or the Board of Directors. There have been recent discussions among the ASF Board about hiring an executive director to manage fundraising and resolution of legal issues, but ultimately that proposal was

Role	Number	Responsibilities
Board of Directors	9 Directors	Responsible for: <ul style="list-style-type: none"> management and oversight of the business and affairs of the corporation management of the corporate assets (funds, intellectual property, trademarks, and support equipment) allocation of corporate resources to projects.
Project Management Committees	Approx. 30 projects	Responsible for active management of one or more communities, which are also identified by resolution of the Board. Each PMC consists of at least one officer of the ASF, who shall be designated chairman, and may include one or more other members of the ASF. The chair of the PMC is appointed by the Board and is an officer of the ASF. The chair has primary responsibility to the Board, and has the power to establish rules and procedures for the day to day management of the communities for which the PMC is responsible.
ASF Members	Approx. 130	Person nominated by current members and elected due to merit for the evolution and progress of the foundation. They have the right to elect the board, to stand as a candidate for the board election and to propose a committer for membership. They also have the right to propose a new project for incubation.
Committers	Approx. 800	A committer is a developer that was given write access to the code repository and has a signed Contributor License Agreement (CLA) on file.
Contributors	Approx. 10,000	Contributes to a project in the form of code or documentation. They take extra steps to participate in a project, are active on the developer mailing list, participate in discussions, provide patches, documentation, suggestions, and criticism.

overruled. The board is now in the process of hiring a systems administrator to help with technical management of the community support infrastructure, but overall governance still lies with an unpaid group of volunteers.

Funding

The ASF operates on a budget of approximately \$60,000 per year, funding for which primarily comes from donations from individuals and corporations, including in-kind gifts such as hardware. Additional sources of revenue include sales of Apache gear via the ASF website and fees from Apache conferences, which operate on a cost-recovery-plus basis.

To put this in perspective, although Apache and many other projects promote the fact that only volunteers staff them, in reality, corporations pay many of these volunteers to contribute to the projects and represent corporate interests. This situation serves both sides optimally because open source benefits from a free but high-quality, committed programming pool and companies have influence over the direction of a platform without the capital-intensive investment of building it in-house. Rough, informal estimates suggest that, on average for a given sub-project, outside organizations employ 60% of Apache contributors full-time to support the project and, for some sub-projects, that number reaches 100%.

Apache Incubator

The ASF hosts an Incubator project, responsible for helping new software projects join Apache. The Incubator does not select projects based on technical merit. Instead, it requires that projects have a diversity of participants (must be 3 or more individuals actively involved), a working codebase, an ASF member sponsor, and the intention of donating the software copyright. Once the Incubator selects a project, it helps establish any necessary infrastructure and supervises and mentors the incubated community to operate in accordance with the philosophy of the ASF. A project then either reaches a point of maturity (as determined by a Project Management Committee that oversees all the incubating project), at which time the ASF promotes it to official project or sub-project status, or it is retired.

Appendix I: The Sakai Foundation

www.sakaiproject.org

The Sakai Project began when the University of Michigan, Indiana University, MIT, Stanford, the Open Knowledge Initiative (OKI), and the JA-SIG uPortal Project was funded to develop a new, portal-based Course Management System by combining their in-house projects into a new version of CHEF from the University of Michigan. Subsequently, greater importance has been attributed to the groupware features of CHEF and the software is now described as a Collaboration and Learning Environment (CLE). Sakai has designed, built and deployed the CLE as the main production system in 5-10 large institutions and is being piloted/evaluated by 30-50 more large institutions. (sakaiproject.org) The project described itself as a community-source software development effort to emphasize the (paid for) contributions of large institutions compared to the individual contributions of many open source projects:

“Based on the goal of addressing the common and unique needs of multiple institutions, community source relies more on defined roles, responsibilities, and funded commitments by community members than some open source development models.”

Initially funded by a \$2.5 million grant from the Andrew W. Mellon Foundation with matched funding from the ‘core’ institutions, the Sakai project grant came to an end in

January 2006. The Sakai Foundation, established in 2005, provides continuity and a governance structure and funding mechanism for the future development of the platform. Each of the founders of Sakai granted copyright license to the Sakai Foundation to establish clear rights to distribute the code and the Foundation follows the Apache practice of requiring a contributor agreement that grants copyright license to the Foundation.

Membership

While the Sakai Foundation supports an open community of active contributors and users at no charge, there is also a paid membership available to anyone who subscribes \$10,000 per annum and is accepted as a member by the Sakai Board. Currently, there are only Institutional and Commercial Affiliate paid members of the Foundation, no individual members.

Governance and Staffing

The Board of Directors, comprised of leaders from the Sakai community, guides the Sakai Foundation. “The Foundation will manage a small staff to coordinate evolution of the Sakai software, provide advanced developer support for members, conduct quality assurance work on Sakai releases, track contributor agreements and manage the Sakai IP, and manage conferences and meetings for the Sakai Community. Much of the innovation and tool development will continue to be done where it is best understood – among the distributed community of Sakai users and developers.” (Sakai website/press release)

Funding

The grant funding from the Mellon Foundation ended in January 2006 and membership fees now fund the Sakai Foundation’s activities. Membership requires a contribution of \$10,000 per year (\$5,000 for colleges with less than 3,000 students) for a minimum of three years. There are currently 100 Sakai Partners and Commercial Affiliates, resulting in approximately \$1M in Sakai Foundation membership revenue per year guaranteed through 2008.

Appendix J: The .LRN Consortium

(www.dotlrn.org)

The .LRN Consortium is a non-profit, 501(c)3 organization based around the .LRN open source software platform. “.LRN is the world's most sophisticated enterprise-class software for learning and collaboration. Originally developed at MIT, .LRN is used worldwide by over half a million users in higher education, government, non-profit, and

K-12.” As the .LRN user community grew, MIT decided to start a non-profit to reduce the project’s dependence on one organization for platform development and investment.

Membership

User of .LRN software and participation in its worldwide open source community does not require membership in the Consortium. Members receive their principal benefit through their ability to set priorities and influence consortium operations and goals. Approximately 25 sites participate in the .LRN Consortium of the 120 registered users.

Governance and Staffing

The University of Heidelberg, the MIT Sloan School of Management, and the E-LANE (European and Latin American New Education) project founded the .LRN Consortium. The Consortium formed a board with representatives from those three organizations and two additional representatives, for a total of five board members. The membership of the board has changed since the founding, but the total number of members remains consistent. The bylaws, deliberately lightweight, enable the Consortium to remain nimble and unencumbered by bureaucracy. The .LRN Consortium has a leadership team, a technical advisory board, and a user advisory board to steer the platform development and manage community activities.

The .LRN Consortium pays a ¼-time Release Manager and hopes to hire a permanent Executive Director in the next year if funds become available. The current volunteer Executive Director formulates technology strategy, recruits consortium members and partners worldwide, coordinates the software development process, manages partnerships with complementary software projects, leads fund-raising efforts, assists companies with developing business models around .LRN, coordinates web site development and maintenance, develops marketing strategy, and promotes .LRN software world-wide. Volunteers staff the leadership team, including the roles of Director of Research & Development, Director of Visual Design, Director of Enterprise Architecture, Director of Product Development, and Director of Learning Design. The executive team meets once a month remotely and the Board of Directors meets twice a year with interim communications by email.

Funding

Funding for the .LRN Consortium comes from membership fees which cost \$250/year for an institutional membership. Individuals can contribute to the source code but cannot join the consortium as members. The membership fees, kept deliberately low to be affordable for all-comers, encourage participation by institutions in developing nations. This funding manages to cover the cost of the part-time release manager as well as the legal and accounting fees associated with incorporation. The executive director goes directly to member institutions and requests additional investment to cover situations requiring larger capital infusions. To introduce a more consistent revenue stream without sacrificing the freely available software and low-cost admission to the .LRN Consortium,

the executive director plans to start an affiliates program for corporate sponsorship similar to Sakai's.

.LRN focuses on making its software accessible to universities at all economic levels. To that end, .LRN obtains the funding for and issues micro-grants (approximately \$5 - 10K) with the aim of providing community members and contributors, particularly from developing nations, with a small capital infusion to work on specific development projects.

Appendix K: My SQL

My SQL

(www.mysql.com)

MySQL offers a for-profit business model representative of many of the open source ventures in the marketplace today. The open source software platform is a multithreaded, multi-user Structured Query Language (SQL) Database Management System (DBMS). The Swedish for-profit company, MySQL AB, owns the copyright to the software code and the trademark, and reports an estimated eight million installations. MySQL AB employs more than 275 people around the world to do the core work on database platform development. The open source community participates in the project by providing help with tasks such as debugging and testing.

MySQL AB distributes the software under a dual license: users can choose a free GNU Public License (GPL) or a proprietary license for a fee. The proprietary license fee includes software, support and services. There are four different service levels available from MySQL AB's MySQL Network, progressing from the Basic level providing software and web-based support for a limited number of inquiries (2 per year) to a Platinum level offering a premium set of customized support and consultation services. Additionally, My SQL offers for-fee training and certification to developers and database administrators.

The company announced in February 2006 an \$18.5 million third round of venture capital, bringing its total venture capital investment to date to \$39 million (Lacy, 2006). In 2005, MySQL generated \$40 million in annual revenue through three main sources:

- “Online support and subscriptions services sold globally over the My SQL.com website to all users of the MySQL server.
- Sales of commercial My SQL licenses to users and developers of software products and of products that contain software.
- Franchise of MySQL products and services under the My SQL brand to value-added partners.”

Appendix L: Related Reading List and Information Sources

DSpace

DSpace website: www.dspace.org and <http://wiki.dspace.org/>

Robert Tansley, MacKenzie Smith and Julie Harford Walker. [□The DSpace Open Source Digital Asset Management System: Challenges and Opportunities](#). In *Lecture Notes in Computer Science 3652: Research and Advanced Technology for Digital Libraries: 9th European Conference, ECDL 2005, Vienna, Austria, September 18-23, 2005. Proceedings* pp. 242-253. (http://dx.doi.org/10.1007/11551362_22)

[Eternal Bits: How can we preserve digital files and save our collective memory?](#) by MacKenzie Smith in the July 2005 issues of [□IEEE Spectrum](#). (<http://www.spectrum.ieee.org/jul05/1568>)

[The Fading Memory of the State](#) by David Talbot in the July 2005 issue of [□Technology Review](#). See Simson Garfinkel's sidebar called [□MIT's DSpace Explained](#). (http://www.technologyreview.com/articles/05/07/issue/feature_memory.asp?p=1) and (http://www.technologyreview.com/articles/05/07/issue/feature_mit.asp)

Open Source Software

The Cathedral and the Bazaar by Eric S. Raymond:
(http://www.firstmonday.dk/issues/issue3_3/raymond/)

[Open Source Software: Risks and Rewards](#) (2004) by Gary Hein, ECAR
<http://www.educause.edu/ir/library/pdf/ECR0405.pdf>

Open Source Governance

O'Mahony, Siobhan. "[Guarding the Commons: How Community Managed Software Projects Protect Their Work](#)." *Research Policy* 32, no. 7 (July 2003): 1179-1198.

O'Mahony, Siobhan. "[Non-Profit Foundations and Their Role in Community-Firm Software Collaboration](#)." In *Perspectives on Free and Open Source Software*, edited by Joe Feller, Brian Fitzgerald, Scott Hissam and Karim Lakhani. Cambridge, Mass: MIT Press, 2005.

West, Joel, and Siobhan O'Mahony. "[Contrasting Community Building in Sponsored and Community Founded Open Source Projects](#)." Paper presented at the IEEE 38th Annual Hawaii International Conference on System Sciences, January 2005.

Open Source in Higher Education

[Collaborative Open Source Software: Panacea or Pipe Dream for Higher Education?](#)

(2005) by *H. David Lambert, Georgetown University*

(<http://www.educause.edu/ir/library/powerpoint/LIVE053.pps>)

[Open Source 2007: How Did This Happen?](#) (2004) by *Brad Wheeler, EDUCAUSE*

(<http://www.educause.edu/ir/library/pdf/ERM0440.pdf>)

[Open to Open Source](#) (2006) by *Elia Powers, Inside Higher Ed*

(<http://www.insidehighered.com/news/2006/03/01/open>)

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Ferguson, Charles., "How Linux Could Overthrow Microsoft", *Technology Review Magazine*, June 2005.

Johnson, Richard K., "Institutional Repositories: Partnering with Faculty to Enhance Scholarly Communication", *D-Lib Magazine*, November 2002, Volume 8 Number 11

Lacy, Sarah, "MySQL Answers Back with \$18.5 Million", *BusinessWeek Magazine*, February 13, 2006.

"The New Software Paradigm: How to Avoid the Risks of Open Source Software", a virtual presentation given by Dow Jones and Venture One, October 6, 2005.

O'Mahony, Siobhan, "Non-Profit Foundations and Their Role in Community-Firm Software Collaboration", in *Perspectives on Free and Open Source Software*, edited by Joe Feller, Brian Fitzgerald, Scott Hissam and Karim Lakhani, Cambridge, Mass: MIT Press, 2005.

"Open Source: Now It's an Ecosystem", *BusinessWeek Magazine*, October 3, 2005.

Radtke, Janel M., "How to Write a Mission Statement", in *Strategic Communications for Non-Profit Organizations: Seven Steps to Creating a Successful Plan*, 1998, <http://www.tgci.com/magazine/98fall/mission.asp>.

Schwartz, Daniel J., "Open Source: Paper Tiger, Hidden Problems?", May, 2005, http://www.jenner.com/files/tbl_s20Publications/RelatedDocumentsPDFs1252/1029/ACCA_Open_Source_Hidden_Problems_05.05.pdf.

Tansley, Robert, Moving DSpace Forward, a presentation at the DSpace User Group meeting in Sydney, Australia, January 31, 2006.