

Summary Report of the Scholarly Assets Management Initial Exploratory Group

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Campus cyberinfrastructure is not just about the technology. We need to understand and engage the research community, bridge the cultures, enhance the collaborative relationships on campuses and between campuses, and learn from each other. What is the process by which [we] can best continue sharing and collaboration among this community? How can we best interoperate and integrate among campus and national cyberinfrastructure efforts?

*Final Report: A Workshop on Effective Approaches to
Campus Research Computing Cyberinfrastructure*

Mike Simpson, DoIT Academic Technology (Project Manager),
Steve Krogull, DoIT Academic Technology (Project Sponsor),
Jim Muehlenberg, DoIT Academic Technology (Project Sponsor),
Jan Cheetham, DoIT Academic Technology,
Peter Gorman, UW Digital Collections Center,
Dirk Herr-Hoyman, DoIT Academic Technology,
Eric Larson, Wendt Library,
Dorothea Salo, UW Digital Collections Center,
Alan Wolf, DoIT Academic Technology.

Abstract

DoIT's Academic Technology and the Library's Office of Scholarly Communication and Publishing conducted discussion group meetings with invited participants representing a broad spectrum of faculty and administrative interests, focusing on digital asset management in the context of evolving technology-driven forms of scholarship, the re-assessment of traditional dichotomies between pedagogy and research, and rising tension between central and distributed IT. Participant feedback provided insight into several problem areas, highlighting that attempts by DoIT to assist digital resource management must take into account problems with current institutional focus and resource allocation; that the loss of the culture of curatorship in the transition to a digital scholarly record severely threatens the preservation of institutional memory; and that adoption of solutions depends upon the implementation of trusted, comprehensive, interfederated identity management and access control. To address these concerns, DoIT should promote emerging open access paradigms in publication and the open data movement in research, collaborating with campus partners to provide encouragement and education in order to promote the growth of the new culture of digital curatorship. Further, DoIT should support emerging cross-disciplinary and cross-institutional social networks, providing liaison functions and facilitating coordination between potential partners, discovering opportunities for collaboration, and providing resources to seed their growth. This activity should take place in partnership with distributed IT staff, developing solutions and services that directly address the needs of their disciplinary areas, and involving them directly through shared decision-making and collaborative work. Developed solutions should emphasize integration and interoperability as primary characteristics. Finally, DoIT should adopt open, standards-based identity management and access control mechanisms that support interfederation of credentials and access control policies.

1 Addressing the New Scholarship

The Internet has fundamentally changed the practical and economic realities of distributing scientific knowledge and cultural heritage. For the first time ever, the Internet now offers the chance to constitute a global and interactive representation of human knowledge, including cultural heritage and the guarantee of worldwide access.

*Berlin Declaration on Open Access to Knowledge
in the Sciences and Humanities*

Recognition is growing in academia of the evolution of a new kind of scholarship, fundamentally different from established norms: highly collaborative, data-intensive, and network-based. The artifacts of the new scholarship are more than just individual journal articles: they include datasets, learning objects, actualization and visualization software, and many other types of digital media. Availability and rights permitting, these heterogeneous streams of information can be assembled into aggregate objects regardless of format or origin, with any particular object recursively available for further aggregation. The composite nature of these objects drives an increasing demand for interaction and interoperability between systems and services; but the reality is that current activities in support of the new scholarship are fragmented, inconsistent, and under-resourced. The rapid increase in the volume of digital content, coupled with this lack of support, places our digital scholarly assets at risk of loss. The risk is particularly acute for smaller-scale projects.

The development of the new scholarship takes place in (and also contributes to) a context characterized by a reassessment of traditional dichotomies: the division between pedagogy and research, and between graduate and undergraduate studies, is increasingly disappearing. A study released in 2006 by the EDUCAUSE Center for Applied Research noted the rising trend of undergraduate involvement in research as part of pedagogy, a corresponding appreciation of the increased opportunities for learning by the students, and a growing institutional awareness of the competitive advantages of a strong undergraduate research program. The same study noted the rising tension between central and distributed IT services and support staff. It cited the potential risks of decentralization of services (duplication of service, diversion of staff from research, issues of standardization and security) while asserting the sensibility of providing discipline-specific expertise and service at the local level.

In an attempt to begin to explore these issues as they apply to the UW-

Madison campus, DoIT's Academic Technology and the Library's Office of Scholarly Communication and Publishing created the Scholarly Assets Management Initial Exploratory Group (SAMIEG) as a joint project. Three discussion group meetings were held between the SAMIEG project members and a set of twenty invited participants representing a broad spectrum of faculty and administrative interests on campus (a breakdown of discussion group attendees can be found in the appendix). Each group discussion lasted ninety minutes, with a stated general focus on the topic of digital asset management. Participants were asked to describe current activities, in terms of types of assets being managed, asset lifecycles, and content workflows, and to identify places where additional attention would be helpful. Project members acted to stimulate discussion as necessary, and took detailed notes of participant feedback. At the end of the first round of three meetings, the project sponsors expressed concern that humanities faculty were under-represented, and so a fourth meeting was held with participants drawn specifically from that area.

Outcomes from the discussion groups are described in the following sections, with a focus on common themes expressed by participants, and use cases for potential future work.

2 Common Themes

2.1 Institutional Focus and Resource Allocation

Despite the rapid pace of change, there is one point of constancy and common ground that I should emphasize at the outset of this workshop. That point is our common mission in the service of the academy. Let us be crystal clear that the digital assets of which we speak tonight and in the next few days are resources for research and teaching, and that our purpose in managing them is to advance knowledge and improve education.

Managing Digital Assets: An Overview of Strategic Issues

An observation that arose repeatedly was the perception of a misguided institutional focus on the part of DoIT (and central IT in general). DoIT, it was stated, "needs to focus on people, not technology." In asserting purely technological fixes for problems of scholarly asset management, DoIT fails to address the social context surrounding those proposed changes. A concrete example of the results of this misguided focus is the current apparent failure of self-archiving efforts: faculty perceive the self-archiving solutions

offered as intrusive, difficult to use, of marginal utility, disassociated from their current workflow, and ultimately outside of their control. A number of points made by discussion participants can serve as guidance in realigning the focus of our work. At the strategic level, DoIT should strive for better communication with the campus community as a whole: “The scholarly mission must be folded into enterprise infrastructure decisions.” DoIT must recognize that we serve an extremely diverse community, and be flexible in addressing specific needs of subsets of that community: “Problems must be defined around the work being done,” “Focus on specifications and functionalities, not specific products or technologies,” and “Allow different toolsets for different communities.” Solutions that impose additional commitments on the part of busy faculty or staff already dealing with the fallout of rapid technological change, or that introduce new interfaces and technologies not directly integrated into existing work and without any real effort towards service support and training, will fail to be adopted: “Assist the work that’s already being done, don’t introduce new work,” and “Make things as simple as humanly possible to use.” The failure to realign focus along these lines will continue propagating the perceptions of “constant re-training, constant re-formatting, too few resources, and too much stuff in too many forms.”

A second set of related issues arises from the different adoption levels of recent technological advances across the campus community. One participant stated his dissatisfaction with the insufficient capacity of his archival media, to which another responded by questioning why he was using that media format when newer, higher-capacity formats were readily available. Similarly, one participant identified problems with making offline data accessible on the network, and was answered with mild disbelief that it was perceived as that difficult to accomplish. In short, IT shops on campus vary widely in technical sophistication, and these differences must be recognized in formulating overall strategy. This problem highlights an increasing need for greater collaboration between central and distributed IT, to allow appropriate and efficient resource usage. As an example, one participant cited a grant of \$800 in funding as essential to the success of her digitization project, which was accomplished using departmental student labor. The use of local staffing was important because of the specific disciplinary expertise of the staff employed, and for furthering the academic development of the students involved. For reference, \$800 would have purchased 20 GB of Tier One enterprise storage, at current DoIT pricing, for a single year. This is not to suggest that enterprise storage is not an absolutely vital component of the enterprise infrastructure on campus, but rather to demonstrate how

much good work can be accomplished with small amounts of appropriately-directed resources acting “close to the content” in collaboration between central and distributed staff.

Any attempt by DoIT to encourage or assist digital resource management must take into account these issues of institutional focus and appropriate resource allocation, if it is to be successful in furthering the academic mission of the university as a whole.

2.2 The Loss of the Culture of Curatorship

An information architecture will have a profound impact on all areas of the institution. The ability to personalize instruction, to provide the right information to a colleague, and to make information-based decisions are just a few of the potential changes. Equally important is that information will be less likely to get lost. As a result, information can be built upon, leading to new information or knowledge; this is the concept behind a learning institution.

The Information Architecture Imperative

We are currently deeply entangled in the transition from a primarily-hardcopy to a primarily-digital scholarly record. That transition began with largely unmanaged change, continues in evolutionary and ad hoc fashion, and has a number of years left to run. Aside from the pragmatic and unavoidable problems arising out of the presence of social and logistical churn, there are a number of specific issues, mostly unaddressed, that worsen the already difficult process of transition.

Several discussion participants identified loss of access to content as an unexpected corollary to increasing digitization of the scholarly record (“the discovery problem”). Prior to the beginning of the digital transition, there were well-established conventions for finding and accessing the important “grey literature” (original data sets, self- or pre-published working papers, small conference proceedings) that provided the foundation for many aspects of scholarship. That culture largely disappeared in the move towards digital creation and distribution. As one participant stated, “We’ve actually gone backwards in our ability to share [working papers] between collaborators and colleagues.” He further specified that he estimated that he now had access to only five hundred of the ten thousand working papers relevant to his field of study, “papers where people share good thinking, share initial data, and share their ideas for emerging areas of research.” He also

stated that there was “a five-year time lag on analysis because of reliance on published documents.” Another participant identified similar concerns surrounding small conference proceedings: her hardcopy historical archive covering conferences going back to the 1950s is now effectively invisible in the new digital record, and each year several more sets of proceedings are generated. The loss of this small conference material is a general problem affecting scholarship in many fields.

A deeper set of problems involves the loss of the archival perspective in the preservation of content across the digital transition (“the archiving problem”). Participants cited a lack of good preservation guidelines for digital materials as one example of the general absence of a coherent preservation strategy. They also specified the importance of associating archival metadata with digital content, to support a manageable, automated digital content life cycle. This lack of strategic perspective and guidance leads to “academic islands” of unmanageable, inaccessible content, cut off from the larger context of scholarship. Different definitions of preservation found across academic disciplines add additional dimensions to this issue. Two specific observations made by discussion participants involved the need to address preservation of “boutique datasets,” (specialized collections of content requiring discipline-specific expertise for proper management), and the need to explore partial digitization of subsets of content from larger collections (for efficiency or appropriateness). Mechanisms for tying together these “mixed collections” of hardcopy and digital resources in preservable form are also needed.

The related problems of archiving and discovery are two of the immediately visible outcomes of the overall neglect of the culture of curatorship during the chaotic early years of the digital transition. In the words of the Digital Curation Center, established in the UK in 2004, “The increasing amount of data being created in digital formats ... means that much of it is at risk of being unreadable in the future. Someone needs to confront this problem by firstly advising on what information to preserve and then on how best to preserve it, from the beginning of the information life-cycle to the end; hence digital curation.” In the shorter formulation of one of the SAMIEG participants, “Curatorship is vital.”

The loss of this culture of curatorship has grave consequences for the preservation and sharing of institutional memory, and the passing along of knowledge to the next generation of researchers and educators.

2.3 The Issue of Access

The principal author benefits of online open access to their research pertain to enhanced professional visibility. This visibility and awareness is driven by both broader dissemination and increased use. No library can afford a subscription to every possible journal . . . rendering much of the research literature inaccessible to many researchers.

*Institutional Repositories: Partnering with Faculty
to Enhance Scholarly Communication*

One final and critical concern expressed by the discussion group participants is the issue of appropriate access to digital resources. There are at least two sides to this problem: we wish to increase access to materials as broadly as possible, while simultaneously restricting access appropriately to address issues such as maintenance of copyright and patent rights, protection of proprietary data, and the possibility of cost recovery. This concern ties directly into the broader necessity for identity management, at both the campus and peer institutional level. Proper verification of identity and authorization for access control is required to answer the two questions most likely to arise: from whom did this content originate? and with whom are we willing to share it? It was stated in no uncertain terms by one of the discussion participants that an absolute prerequisite for adoption of any offered service is a foundational trust in the identity management and access control mechanisms that answer these two questions.

3 Use Cases

Perhaps the main lesson . . . is to build those all-important relationships with faculty, student groups, IT, and other academic professionals, and maintain them diligently. When creating new IR services, we should also be mindful that no single approach works for every university. There is no need to be rigid – adopt an approach that will work on your campus, utilize your existing relationships, and deliver some small projects.

*Strategies and Frameworks for Institutional Repositories and the New
Support Infrastructure for Scholarly Communications*

The following represent possibilities for projects that came up during the course of the discussion group meetings, which would address currently existing needs and provide a conceptual and experimental ground on which to build further services.

3.1 The Data Grinder

Several different communities (genomics, high energy physics, and textiles) expressed similar workflow needs that could be addressed by a common architecture. Initial, large (“noisy”) datasets would require a large temporary holding space. Once in the holding space, grid computing resources would be available for processing the raw data into final form (“step-down”), and could also be used to generate secondary artifacts from the data. The processed datasets, along with their secondary artifacts, would then be moved into a smaller permanent store. A discovery mechanism (either newly implemented or tied into an existing protocol or system) would then provide notification, harvesting, and search/retrieval services.

3.2 The Invisible Archive

The slowness of adoption of currently available institutional repository systems suggests an altogether different kind of service: a ubiquitous (easy to integrate into, and interoperate with, other services) archival system whose operations are largely transparent (not requiring explicit extra work, occurring largely as a side-effect of existing workflows). The archive would be composed of multiple stages (from tentative hold to long-term permanent archive), with automated rule-governed movement of content between stages; the deposit of new content into the system would automatically generate initial archival metadata, and notify library staff to perform content and metadata review.

3.3 Simple Weather Data Project

The easy storage, searching, and retrieval of large volumes of historical weather data, gathered across multiple institutions, would provide great assistance to current work in weather and climate analysis. IT staff in consultation with subject experts would define a common storage syntax, and implement a service providing ingest (with format conversion and validation), querying, and harvesting of data. A basic functionality requirement of the system would be easy interoperability with similar systems, thereby significantly increasing the utility of the overall network of systems as more peer institutions adopt and contribute to the project.

3.4 The Digital Ground Project

Building on the work of the Simple Weather Data Project, additional collections of latitude/longitude-based datasets (atmospheric, flora/fauna, soil, geological) could be further incorporated, allowing a service expansion into bulk retrieval of related data, conditional searching across data types, and the possibility of visual simulations and overlay displays enabling the manipulation of all of the related data for a particular region as a whole. This could leverage existing Geographic Information System (GIS) research and tools, and would be analogous in intent to the Digital Sky Project conducted by the Caltech Center for Advanced Computing Research (which federated digital sky surveys in multiple wavelengths to support more efficient, more sophisticated analysis and visualization techniques).

3.5 Research Expertise Location Service

Locating expertise in the interest of seeking publication partnerships or in grant proposal research is an immediate need of many faculty. A social networking solution would be developed that provided easy federated or peer-to-peer searching across institutional and disciplinary boundaries. This could be used as a standalone service or integrated into existing workflows and interfaces to provide fast, efficient location of relevant expertise.

3.6 Electronic Lab Notebooks

The Collaborative Electronic Notebook Systems Association (CENSA) has developed the “Consensus Definition of Electronic Notebook Systems,” and is currently exploring the differences between Personal Electronic Notebook Systems (PENS) and Collaborative Electronic Notebook Systems (CENS). Staff from DoIT, University Archives, and WARF would collaborate to implement a standards-compliant hardware platform, backend services, and client interfaces to provide a unified, comprehensive electronic laboratory notebook system for campus.

3.7 Recovering Gray Literature

A large amount of “gray literature” (including technical reports, working papers, conference proceedings, and other content) is currently being lost, and the disconnect between current digital content and the mainly hardcopy historical record is growing. Development of “live” systems and services to facilitate the production and management of this content (integrated transparently with Invisible Archive services as described above) would be coupled with progressive digitization of historical materials, to re-join the gaps in the scholarly record and provide a basis for easily archiving future content.

4 Recommendations

These dramatic changes in the nature of scholarly research require corresponding fundamental changes in scholarly communication. Scholars deserve an innately digital scholarly communication system that is able to capture the digital scholarly record, make it accessible, and preserve it over time.

Rethinking Scholarly Communication: Building the System that Scholars Deserve

The observations of the discussion group participants suggest a number of future directions for DoIT in its role as the central IT organization for campus:

- Promote the emerging open access paradigms in publication, and the open data movement in research, as they relate to the needs and requirements of faculty and researchers. Collaborate with interested partners across the campus (such as the Library) to provide encouragement and educational opportunities. Act to promote the growth of the new culture of digital curatorship.
- Support the emerging cross-disciplinary and cross-institutional social networks by providing liaison functions and facilitating communication and coordination between potential partners on campus. Discover opportunities for collaboration between those partners, and provide resources to help seed their growth.
- Partner with distributed IT staff to develop solutions and services that directly address the needs of their disciplinary areas. Emphasize

shared decision-making and collaborative work involving both central and distributed IT staff as well as faculty and research partners.

- Make integration and interoperability primary characteristics of system specification and development. The minimum acceptable scope for deployed systems should be interoperability at the regional or federation level. Work with federation partners to adopt open, standards-based identity management and access control mechanisms that support interfederation of credentials and access control policies.

Development and implementation of one or more of the documented use cases would provide the necessary proving ground on which the above general principles could be put into practice.

A Discussion Group Participants

Project Members:

Jan Cheetham, Project Manager, DoIT Academic Technology.

Peter Gorman, Head, University of Wisconsin Digital Collections Center.

Dirk Herr-Hoyman, eLearning System Architect, DoIT Academic Technology.

Eric Larson, Digital Services Librarian, Wendt Library.

Dorothea Salo, Digital Repository Librarian, University of Wisconsin Digital Collections Center.

Mike Simpson, Project Manager, DoIT Academic Technology.

Alan Wolf, Instructional Technology Consultant, DoIT Academic Technology.

Invited Participants:

Teri Balsler, Assistant Professor, Department of Soil Science, College of Agricultural and Life Sciences.

Karen Baumann, Archivist, Wisconsin Historical Society.

Bruno Browning, Director, Learning Support Services, College of Letters and Science.

Randall Dunham, Chair, Management and Human Resources Department, School of Business.

Kristen Eschenfelder, Associate Professor, School of Library and Information Studies.

Janet Gilmore, Assistant Professor, Department of Landscape Architecture, College of Agricultural and Life Sciences.

Jeff Hardin, Professor, Department of Zoology, College of Letters and Science.

Robert Hauser, Director, Center for Demography of Health and Aging, Social Science Computing Cooperative.

Lee Konrad, Director, Memorial Library.

Nancy Kunde, University Records Officer, University Archives and Records Management Services.

Carrie Laboski, Assistant Professor, Department of Soil Science, College of Agricultural and Life Sciences.

Ed Luschei, Assistant Professor, Department of Agronomy, College of Agricultural and Life Sciences.

Gregory Moses, Professor, Department of Engineering Physics, College of Engineering.

Mark Nelson, Assistant Professor, Department of Environment, Textiles, and Design, School of Human Ecology.

Ruth Olson, Associate Director, Center for the Study of Upper Midwestern Cultures.

Joe Salmons, Professor, Department of German, College of Letters and Science.

Cheryl Scadlock, Information Specialist, Wisconsin Alumni Research Foundation.

Cindy Severt, Senior Special Librarian, Data and Information Services Center.
Ron Stewart, Bioinformatics Group, WiCell Research Institute.
Chris Thorn, Director of Technical Services, Wisconsin Center for Education Research, School of Education.

Attendance By Meeting:

First Meeting: Bruno Browning, Jan Cheetham, Peter Gorman, Dirk Herr-Hoyman, Nancy Kunde, Eric Larson, Ed Luschei, Cheryl Scadlock, Mike Simpson, Chris Thorn, Alan Wolf.

Second Meeting: Bruno Browning, Jan Cheetham, Randall Dunham, Peter Gorman, Dirk Herr-Hoyman, Nancy Kunde, Carrie Laboski, Ed Luschei, Gregory Moses, Cheryl Scadlock, Mike Simpson, Ron Stewart, Chris Thorn, Alan Wolf.

Third Meeting: Teri Balsler, Karen Baumann, Jan Cheetham, Janet Gilmore, Peter Gorman, Jeff Hardin, Robert Hauser, Dirk Herr-Hoyman, Dorothea Salo, Mike Simpson, Chris Thorn, Alan Wolf.

Fourth Meeting: Jan Cheetham, Kristen Eschenfelder, Lee Konrad, Eric Larson, Mark Nelson, Ruth Olson, Joe Salmons, Cindy Severt, Dorothea Salo, Mike Simpson, Alan Wolf.

B Selected Bibliography

Anderson, Paul. "What is Web 2.0? Ideas, technologies and implications for education." JISC Tech Watch Feb/07 (2007).

<<http://www.jisc.ac.uk/media/documents/techwatch/tsw0701b.pdf>>

ARL Workshop on New Collaborative Relationships. "To Stand the Test of Time: Long-Term Stewardship of Digital Data Sets in Science and Engineering." Association of Research Libraries (2006).

<http://www.arl.org/bm_doc/digdatarpt.pdf>

Atkins, Daniel E., et al. "Revolutionizing Science and Engineering Through Infrastructure: Report of the National Science Foundation Blue-Ribbon Advisory Panel on Cyberinfrastructure." National Science Foundation (2003).

<<http://www.nsf.gov/od/oci/reports/toc.jsp>>

Blustain, Harvey, et al. "IT Engagement in Research: A Baseline Study - Key Findings." EDUCAUSE Center for Applied Research (2006).

<http://www.educause.edu/ir/library/pdf/ecar_so/ers/ers0605/EKF0605.pdf>

Braman, Sandra. "What Do Researchers Need? Higher Education IT from the Researcher's Perspective." EDUCAUSE Center for Applied Research (2006).

<<http://www.educause.edu/LibraryDetailPage/666?ID=ECP0601>>

Edwards, Paul N., et al. "Understanding Infrastructure: Dynamics, Tensions, and Design (Final Report of the workshop on History and Theory of Infrastructure: Lessons for New Scientific Cyberinfrastructures)." University of Michigan (2007).

<<http://hdl.handle.net/2027.42/49353>>

Johnson, Richard K. "Institutional Repositories: Partnering with Faculty to Enhance Scholarly Communication." D-Lib Magazine 8/11 (2002).

<<http://www.dlib.org/dlib/november02/johnson/11johnson.html>>

Joint Functional Sponsors Group-Technical Sponsors Group. "Focusing Resources and Fostering Creativity: Group Report to the Faculty Committee on Education Technology on the Common Collaboration and Learning Environment." University of California, Los Angeles (2006).

<<http://www.oit.ucla.edu/ccle/docs/JointFSG-TSGreporttoFCET.pdf>>

Klingenstein, Ken at al. "Final Report: A Workshop on Effective Approaches to Campus Research Computing Cyberinfrastructure." Pennsylvania State University (2006).

<<http://middleware.internet2.edu/crcc/>>

"Our Cultural Commonwealth: The Report of the American Council of Learned Societies Commission on Cyberinfrastructure for the Humanities and Social Sciences." American Council of Learned Societies (2006).

<<http://www.acls.org/cyberinfrastructure/OurCulturalCommonwealth.pdf>>

Prosser, David C. "Scholarly Communication in the 21st Century: the Impact of New Technologies and Models." *Serials* 16/2 (2003).

<<http://eprints.rclis.org/archive/00001180/>>

Salaway, Gail et al. "The ECAR Study of Undergraduate Students and Information Technology, 2006." EDUCAUSE Center for Applied Research 2006/7 (2006).

<<http://www.educause.edu/ERS0607>>

Spicer, Donald Z. and Harvey Blustain. "Digital Humanities at the Crossroads: The University of Virginia." EDUCAUSE Center for Applied Research (2005).

<<http://www.educause.edu/LibraryDetailPage/666?ID=ECS0506>>

Steinbrenner, Karin. "The Information Architecture Imperative." *ECAR Research Bulletin* 2003/2 (2003).

<<http://www.educause.edu/ir/library/pdf/ERB0302.pdf>>

Van de Sompel, Herbert. "Rethinking Scholarly Communication: Building the System that Scholars Deserve." *D-Lib Magazine* 10/9 (2004).

<<http://www.dlib.org/dlib/september04/vandesompel/09vandesompel.html>>

Van de Sompel, Herbert, et al. "An Interoperable Fabric for Scholarly Value Chains." *D-Lib Magazine* 12/10 (2006).

<<http://www.dlib.org/dlib/october06/vandesompel/10vandesompel.html>>

Waters, Donald J. "Managing Digital Assets: An Overview of Strategic Issues." *Managing Digital Assets: Strategic Issues for Research Libraries*, Council on Library and Information Resources (2005).

<http://www.clir.org/activities/registration/feb05_sprkrnotes/waters.htm>

Walters, Tyler O. "Strategies and Frameworks for Institutional Repositories and the New Support Infrastructure for Scholarly Communications." *D-Lib Magazine* 12/10 (2006).

<<http://www.dlib.org/dlib/october06/walters/10walters.html>>