

Beyond the Repository: Rethinking Data Services at the University of Maryland

Robin Dasler, MSIS

Engineering/Research Data Librarian, University of Maryland

Trevor Muñoz, MA, MSLIS

Assistant Dean for Digital Humanities Research, University Libraries
Associate Director, Maryland Institute for Technology in the Humanities
University of Maryland

Karl Nilsen, MI

Research Data Librarian
University of Maryland

Abstract

In recent years, academic libraries have become increasingly concerned with data management and data curation. Despite the professional contributions of “documentalists” starting in the mid-twentieth century (Rayward 1985), libraries have generally approached new endeavors such as data curation through the familiar lenses of collections and user education. Initial engagements with data at many libraries have taken forms such as developing or retrofitting mechanisms like institutional repositories to collect and hold data, or offering training sessions on data management such as might be offered on bibliographic management software or copyright. When asked by campus administration to help develop support for data management and data-driven research on campus, librarians from the University of Maryland consciously sought to develop active, perhaps even interventionist, approaches to data. Planning for data management and curation support at the University of Maryland Libraries has been guided by findings from the library and information science (LIS) research literature but also, at several points, by examples and methodologies from non-traditional research organizations such as digital humanities centers and synthesis centers and, where appropriate, the private sector. This approach to new library programs is consistent with University President Wallace Loh’s desire to “nurture a culture of innovation and entrepreneurship institution-wide” (Loh 2012). This paper describes both the benefits and the challenges encountered during the development of a “business case” for the research data services program. Throughout the planning process, librarians have sought to emphasize services above collections or provision of training (though both will be significant to a complete support model for data). While the final shape of data management and data curation support at Maryland is not yet clear—cross-campus collaborations are being worked out, stakeholder consultations are ongoing, and resource investment is at an early stage—the planning team’s service-oriented approach has been a useful

spur to innovation. The libraries' ability to conceptualize and develop support for an emerging community need can only succeed if there is also outreach and marketing that helps the community to view the library as useful partner in these new areas. At Maryland, the one of the goals of a service-oriented even activist approach to engagement with data curation and management is to more closely integrate marketing and outreach with program development.

Growth of Data Management Support in Libraries

Technical advances in research computing and data production combined with social changes in research practices and scholarly communication are accelerating the growth of data management and curation services in academic libraries (Joint Task Force on Library Support for E-Science 2007; Ogburn 2010; Soehner, Steeves and Ward 2010; Heidorn 2011; ACRL 2012). This trend is most visible in the dramatic growth of services designed to help researchers comply with data management and data sharing requirements from funding agencies such as the National Institutes of Health (NIH) or the National Science Foundation (NSF) in the United States as well as various funding councils and granting agencies in the UK and Europe.

Yet data management planning represents only one aspect of data-driven research (also known as e-science, e-research). Librarians have begun to recognize that helping researchers draft data management plans for their funding proposals does not necessarily add up to a substantial service, especially as more templates and tools become available online to serve this need (Adamus et al. 2012, 3). For this reason, many libraries are expanding their service offerings to take advantage of the additional skills and expertise they have available. "Public services" or "subject liaisons" at many institutions provide workshops and training sessions devoted to data management and curation, data sharing and dissemination, data reuse and citation, and related topics (Johnston, Lafferty and Petsan 2012; Raboin 2013; Tenopir, Birch and Allard 2012; Adamick, Reznik-Zellen, Sheridan 2013). Libraries at numerous institutions are modifying their institutional repositories to accept research data for dissemination and preservation or collaborating with campus partners to build new repositories especially for research data (Tenopir, Birch and Allard 2012, 19, 32-33; Reznik-Zellen, Adamick, McGinty 2012, 30-31).

At the same time, even as libraries implement training programs and collections infrastructure to support research data management, research practices and scholarly communication continue to evolve rapidly—disciplinary standards emerge and transform, government policies grow and change, journals introduce new mechanisms for sharing research products, data sources are connected together in thematic networks, and computational or 'informatics' subfields spring up in one discipline after another. This dynamic environment means that both libraries with existing data programs and libraries just entering the area of data-driven research support are being challenged to consider how to support their researchers along multiple potential avenues of action, at different scales, and with varying degrees of technical and social engagement.

Formation of Research Data Services at the University of Maryland

As at many peer institutions, planning for data management and data-driven research support was catalyzed by the introduction of NSF requirements that all proposals for funding be accompanied by a data management plan, which would be considered as part of the competitive peer review process. This new area of activity—data management and curation—was appropriated into several ongoing discourses at the university, such as those related to high performance computing, and new computational or e-science methodologies. Thus, engagement with data issues began from both the top down (campus administration, university task force), and from the bottom up (individual librarian or faculty member advocacy).

In the University Libraries' case, the importance of data management and data curation was first brought forward by science librarians, specifically the heads of the Chemistry and Engineering and Physical Sciences branch libraries. These librarians were responding to growing dialogue among scientists about data-intensive or data-driven science (Hey et al. 2009) and to new professional development opportunities arising in response to these disciplinary trends within professional organizations for librarians. In 2011, the Association of Research Libraries (ARL) and the Digital Library Federation (DLF) launched an "E-Science Institute" designed to help member libraries plan strategic engagement in this emerging area of library support. A team from Maryland, including two of the original science librarians who had championed the topic, participated in the ARL/DLF institute. As part of the institute, librarians drafted a set of high-level recommendations for how to develop support for data-intensive research. Chief among the recommendations were developing a strategic agenda on e-science support within the Libraries, engaging first internal library stakeholders and then campus stakeholders in that agenda, and conducting small-scale, easy-to-execute pilot projects to provide experiential feedback on new activities. At the time of the ARL/DLF institute, a number of "first mover" academic libraries (Purdue, Alberta) already had programs or units for data management or data curation. As one of the many institutions at more nascent, planning stages of e-science or data management program development, library leadership at Maryland chose to pursue the recommendations developed by the librarians who had participated in the ARL/DLF institute by charging a small team to conduct further local research and produce a business case for "research data services." According to the charge, this business case would outline a practical, productive, and sustainable role for the Libraries in data-intensive research by outlining a number of specific services and activities that the Libraries could provide to support data management and curation, describing the audience or market for those services, accounting for resource needs, staffing models, potential growth opportunities, and strategic partnerships.

To conduct research, run pilot projects, and produce from these a business case, the Libraries built a provisional team, which included librarians from different divisions of the organization. This team established a public presence on the campus as Research Data Services and began a one-year project to research and develop the new program. Three librarians and a part-time student assistant carry out the day-to-day work of Research Data Services, under the governance of an advisory group made up of key stakeholders from within the Libraries. One of the librarians is assigned to Research Data Services on a full-time basis, and the two others on a part-time basis. The librarian hired to work on this project full-time was brought on as part of a "post-MLS" program at the University of Maryland libraries, which offers two-term positions to

new professionals to work in growing or emerging areas of librarianship. This position is housed in the Libraries' Information Technology Division as part of a "Digital Stewardship" unit charged with coordinating and managing projects from across the Libraries that have a primarily digital focus. One of the librarians giving a portion of time to the Research Data Services project is a subject librarian, part of the Public Services division, with responsibilities in the sciences, and one of the librarians is also jointly employed by a research institute on campus.

While individual institutional narratives around new initiatives like research data management may be useful as points of future comparison, the broader point, which occupies the rest of this paper, is the general approach of developing and evaluating new library programs via business case planning. Research Data Services at Maryland was not constituted initially as a unit with traditional responsibilities for collections or programs, but rather as a kind of internal consulting unit charged with research and development. As components of the modern university, academic libraries reflect both academic and corporate cultures and new library initiatives may come into being in a traditional academic manner as courses or research programs might (according to shared governance, and broadly driven by scholarly imperatives under the auspices of "academic freedom") or new library initiatives may come into being in a more business-oriented manner as products—as degree programs or whole schools might (again broadly, driven by financial imperatives and shaped according to "value" and "returns"). Where the impetus for data management services may have sprung from the institutional repository (collections) or from instructional and other subject liaison activities, the course of a program's development might follow a more academic model. By proceeding into the area of research data management and curation with a heavy emphasis on services (over collections or instruction), Research Data Services at the University of Maryland Libraries is evolving under less of an academic and more of a corporate framework. This orientation has led the team to look to entrepreneurial and corporate models and processes for inspiration as well as academic ones, to embrace research and development as a core charge of the enterprise, and to pursue rapid, iterative piloting of new concepts.

We feel that not only is this business-oriented process for developing a research data program somewhat distinctive, but also that the resulting program will itself remain distinctive and valuable to the campus community because the features above are driving the emerging program to focus on library services for data while it is in active use. This active data curation as opposed to digital stewardship or digital preservation, which focus on static archival end products, is reflected most strongly in the emerging plans for Research Data Services. Data curation has been defined as "the active and on-going management of data through its lifecycle of interest and usefulness to scholarship, science, and education" (Cragin et al. 2007). The authors of this definition go on to elaborate that "[data] curation activities enable data discovery and retrieval, maintain quality, add value, and provide for re-use over time." The emphasis on curation helps to define the role of Research Data Services within the library and explain how it differs from other departments and programs already supporting scholars. The representative curation tasks described by Cragin et al., do not fit neatly under the responsibilities of existing traditional library divisions like collections, public services, or technical services. The identity of the new program is further strengthened by acknowledging that Research Data Services will need to partner with other internal library groups as well as possibly other campus and outside groups or contractors to ensure that activities like long-term preservation are carried out. As a

new unit, Research Data Services can remain small but still achieve its goals by defining divisions of labor governed by clearly-defined contracts between itself and, for example, the Collections or Digital Stewardship group. Curation as the organizing principle for the Libraries' engagement with research data derives from the business-case-driven development of the new initiative. Finding and understanding active users who can support Research Data Services depends upon targeting those portions of the lifecycle of data—curation activities—that directly involve researchers (as opposed to curators, or other secondary actors). In terms of defining its own core “market,” Research Data Services will focus on activities where the work of librarians can directly improve data use and re-use by developing services that fit into researchers' current and evolving workflows.

Process

BUSINESS CASE

The initial charge of Research Data Services was to develop a business case for data-related services and infrastructure in the Libraries. The process of writing this business case provided a framework for systematically investigating and evaluating the opportunities and risks associated with new services for research data management and, more broadly, data-intensive research (Fons et al. 2012, 5-6). The team created a business case model based on the recommendations in *Fit for Purpose*, the CLIR/DLF-sponsored business planning method, and with reference to the guidelines provided by the Small Business Administration (Fons et al. 2012; Small Business Administration). When adopted, the business case will summarize the current state of data curation on our campus and at peer research universities, assess existing services and preparedness, identify strategic opportunities and partnerships, and recommend activities, services, and technology infrastructure for the Libraries to implement over a multi-year timeline. The business case will address a number of functional areas through which the various divisions of the Libraries acting in coordination can support researchers, perform data curation, and accelerate knowledge production:

- Data collection and curation
- Data management consultation and embedded support
- Research and analytics
- Data management training for researchers
- Reference and research services
- Current awareness
- Referral systems
- Professional development for librarians

For each functional area, the business case will summarize insights from the library and information science literature, estimate the potential demand from relevant audiences based on research at the University of Maryland and at other institutions, make recommendations for the scope and scale of activities and services, describe the necessary resources, and propose methods of assessment. A provisional prospectus of the core recommendations was distributed to

stakeholders in Spring 2013 to stimulate discussion and provide a framework for thinking about resource allocation, strategic alignment, and institutional capacity.

LITERATURE-DRIVEN SERVICE DEVELOPMENT

The Research Data Services team's approach to research in developing support for data-driven science also reflects the influence of models from industry. As for any new initiative, resource allocations for Research Data Services are low (1-2 full-time equivalents plus a part-time student assistant and accompanying funds for professional development to attend professional meetings and training). Yet the scope of issues surrounding data curation and data management are both large and still changing. The Research Data Services team is small, composed of members who also have other duties related to established library programs and services. The ability to gain a sense of a new discipline, research group, or university division, design potential services, and then quickly move to piloting a new service is crucial. As in any startup enterprise, the challenge is to deliver a large impact with relatively small resources and many unknowns. Yet, as the fate of startup enterprises in other fields—such as Internet companies—would suggest, for this methodology to be successful, the service development process must still be evidence-based. The goal is to collect sufficient evidence to justify a candidate service to stakeholders without spending too much time on surveys, interviews, and focus groups. The Research Data Services team has chosen to pursue what might be termed “literature-driven service development” (here meaning something like what “literature-driven discovery” means in the biomedical fields) to address the challenge of bootstrapping research and development for a new program.

Early in its work, the team made a strategic decision not to invest many resources into local studies of research data-related behaviors and needs. Instead, Research Data Services decided to work from the substantial and growing body of research literature on data management and data curation in many different disciplinary communities and at many different institutions (e.g., Carlson and Brandt 2013). This strategy does not deny that local variations are significant or that new services need to be customized to a local campus community and culture. Taking advantage of the readily available literature avoids the repetition of conducting surveys and focus groups largely similar to those already documented on institutional user groups that are likewise largely similar to those the literature already describes. Better understanding of data practices and user groups is still desirable, but for a small team at an institution that is still exploring data services, there is an advantage to working from the published literature rather than investing resources in more studies. Building on the work of others allows the team to present a level of specificity in proposed service offerings that may not have been possible without synthesizing findings from multiple institutions. To maximize the impact of a low-resourced startup initiative the overriding goal should be to rapidly generate potential services that can then be tested with local user populations but to do so in a manner that is still evidence-based not purely speculative.

The “scholarly primitives” framework (Unsworth 2000; Palmer, Teffeu, and Pirmann, 2009) has been employed to organize literature searches supporting a process of “literature-based service development.” Though the categories of “scholarly primitives” differ slightly between Unsworth's original paper and the Palmer, Teffeu, and Pirmann report, there is considerable

overlap, and no matter which set of categories is chosen, the framework serves to focus attention on concrete activities that recur as part of research across disciplines. In other words, the “scholarly primitives” framework helped the Research Data Services team to harness exploration of the growing literature on data curation to specific elements of research practice for which scholars and scientists might need support in working with data. The team could isolate a primitive or small set of primitives for analysis—for example, looking specifically at “reading” and “assessing” then explore data curation and management literature related to these topics and look for potential service opportunities. Throughout the course of the literature analysis, three areas emerged as promising candidates for new service offerings: 1) current awareness services (related to searching and assessing); 2) data rescue (related to collecting and organizing—and a point of connection between active research support and long-term preservation); and 3) linking visualization and preparation of charts and tables to micro-publishing services for data, particularly to support graduate students presenting research posters (registering and disseminating). Without a guiding structure, iterative brainstorming, rapid piloting, and similar design exercises (as described below) the team runs the risk of either wholly outpacing actual researcher needs or collapsing into purely reactive exercises responding only to external conditions (like the establishment of a significant but undefined mandate for data management planning from a major funder). Establishing the conceptual framework of scholarly primitives helped the Research Data Services team target literature analysis for service development while maintaining a solid theoretical and evidential basis for new offerings.

ITERATIVE BRAINSTORMING AND RAPID PILOTING

In the context of this broad service category framework, the Research Data Services team worked to identify specific service offerings, focusing initially on one potential service per category. As follows from a research and development approach, any potential services would need to be testable, necessitating that they be small in scale and narrowly defined in order to minimize possible test variables. By piloting narrower, more specific services, rather than surveying researchers on their general workflow preferences, the team hopes to gather more specific feedback to be incorporated into future refined narrow pilot services, continuing in an iterative fashion until levels of service reach a balance between broad local impact and resources (staffing, capital expenditure) needed for support. The model of a “minimum viable” service is borrowed from entrepreneurship, specifically, a certain management philosophy common to Internet startup companies (Ries 2011).

As suggested above, this entrepreneurial model stands in contrast to many typical approaches to studying and developing library services, which rely on a managerial, top-down narrowing of a project’s scope in a pre-planning phase prior to ultimate project execution and launch. Research Data Services’ process is designed to rely on a bottom-up building and refinement of a service in an iterative mid-planning cycle with multiple pilot project launches. Successful service components can be identified rapidly without the planning overhead typically associated with launching a new service, and service components that fail can fail quickly with hopefully lower costs in either time or other resources.

To construct narrow, testable project definitions, the Research Data Services team employed project development and design processes again inspired by business. In exploring

how to apply such approaches to a library context, the project team encountered some false starts experimenting with different development strategies and tactics. The use of project management tools and workflows (such as project charters and gantt charts) in academic libraries is not new, particularly for systems and technology projects. As part of a focused design process intended to exploit insights from research literature on data management and consulting, the University of Maryland Libraries team first set out to create project “one-pagers” (Sierra 2011) for each small scale project from the identified service categories that would be of interest to researchers based on the previous literature review. These “one-pagers” define project scope, personnel involved, and criteria for considering a project “successful” or finished. Using Sierra’s model, “one-pagers” also indicate objectives that are explicitly out of scope for a particular project. The “one-pager” is thus a scaled-down version of the checklists and project plans used in many industries— from engineering to construction and aerospace (Gawande 2010). In industry, the main function of this type of planning is to keep costs down, hold various parties accountable, and prevent errors. The constraint of capturing so much information about the management of a project in a one-page document proved a useful discipline for winnowing down general concepts to specific “minimum viable” services. However, what the team quickly realized is that such tools are indeed tools for management—emphasizing consensus, control, and clear criteria for success or failure. While these are each important, the team needed to turn to other models, also drawn from business and industry, to facilitate both idea generation and implementation.

The Research Data Services team turned to an alternative tactic drawn from more entrepreneurial business models: a strategy alternatively called variously “working from the outside in” (at Amazon.com) and generally focusing on promoting idea generation (or product development) via writing customer-focused outreach, publicity, and documentation material, for example “frequently asked questions.” Using this method, the aim is to write the press release for a new service or product as part of developing the idea for that new product or service. As a press release is intended to announce a product’s core functionality and describe the benefits of that product over another, writing the press release first is a way to zero in on the key components of a product or service, allowing the project team to focus on those aspects that most need to be accomplished, as well as to anticipate the questions and clarifications that key stakeholders or consumers might require. In the case of Research Data Services, this tactic helped the team to more clearly connect findings from literature searches, to specific scenarios of researcher need, narrow the scope of pilot project descriptions and work on turning key components identified through this process into testable entities. If the final pilot project cannot keep the promises of the press release, further refinement is necessary.

Progress and Challenges

The brainstorming tactics described above were in fact extremely helpful in narrowing the scope of proposed pilot projects. However, by aiming to be as specific as possible, developing even a minimal viable testable service took a great deal of refinement and revision. Even though frequent iteration is at the core of the Research Data Services operations model, starting with a base testable service is essential. It is impossible to move immediately from first draft to testing if it is not yet clear what is being tested. While the process is intended to be rapid, it seemed more to foster rapid idea generation rather than rapid project acceleration.

At this point, the Research Data Services team has examined the current literature and has used the findings to inform the creation of a business case, a final version of which will be delivered in Summer 2013, and to identify three main areas of service, for which the refinement of pilot services is ongoing. While progress is not insignificant, this is not the rapid timeline originally planned. This delay is due not to a loss of project momentum, but rather due to the introduction of unforeseen challenges. Fortunately, the flexibility of this iterative approach has allowed the team to address the challenges as serendipitous opportunities without interrupting long-term planning.

The first challenge arose in spring 2013, when Research Data Services was approached by a researcher looking for a long-term custodianship of an online research database. While collection and curation of this database offered an exciting opportunity and could serve well as a case study for exploring the active data curation services proposed as part of the Research Data Services business case, it also raised a number of issues that we had not anticipated addressing prior to launching pilot services. These included the absence of a collection development policy for research data objects, technical logistics of maintaining an externally-created database on a library server, as well as questions of how to address code quality and native creator-supplied metadata. While these technical issues can be largely answered by library staff, issues of content quality and enduring research value are more appropriately answered by disciplinary experts. To support a selection decision in regard to the online database, the Research Data Services team created an informal peer review survey based largely on publication criteria from the Public Library of Science (PLOS 2013) and review criteria from Lawrence, et al (2011). Survey results and our ultimate collection decision are pending. A separate library task force was charged to investigate and draft a collections policy for data. The task force is composed primarily of the members of the Research Data Services team, with the addition of two other members each representing selectors and special collections and archives, respectively. The policy resulting from the work of this group will address selection criteria and workflows, and it will serve as a companion to current and future library division- and subject-specific collections policies.

An ongoing challenge for the team is addressing additional data service requirements that arise from the work of other groups elsewhere in the Libraries that may seem tangential to the original goals of Research Data Services. In the course of ongoing library service evolution, multiple library task forces have proposed changes in services that will require greater overall staff knowledge of issues surrounding data curation and management. Whether or not it is explicitly stated, Research Data Services, as the primary team investigating programmatic data curation services in the Libraries, will have a role in providing the services and skills proposed by these task forces.

Research Data Services at the University of Maryland Libraries adopted a research-driven entrepreneurial process of project planning in order to facilitate the rapid, iterative piloting of new service concepts. While adopting this process has served Research Data Services well insofar as the creative phase of planning, and will continue to be the modus operandi of the program, the ultimate speed of service creation is still heavily dependent on available resources. Despite this, the rapid piloting process has likely led to a greater rate of progress and achievement of project milestones given our available resources that would have otherwise been

possible. Other institutions attempting to jump start a data curation services program quickly may wish to consider these tactics as an alternative to traditional library project management methods.

References

ACRL Research Planning and Review Committee. 2012. "2012 Top Ten Trends in Academic Libraries." *C&RL News* 73, no. 6: 311-320 Accessed February 4, 2013.

<http://crln.acrl.org/content/73/6/311.full>.

Adamick, Jessica, Rebecca Reznik-Zellen, and Matt Sheridan. 2013. "Data Management Training for Graduate Students at a Large Research University." *Journal of eScience Librarianship* 1, no. 3. <http://dx.doi.org/10.7191/jeslib.2012.1022>.

Adamus, T., J. Cheetham, D. Salo, R. Schryver, and A. Wolf. 2013. "Campus Level Research Data Management Services at the University of Wisconsin-Madison: Past, Present, Future." Experience and Position Paper presented at Research Data Management Implementations Workshop, Arlington, Virginia, March 13-14. <https://rdmi.uchicago.edu/page/submitted-experience-and-position-papers>.

Carlson, Jacob, and D. Scott Brandt. "Data Curation Profiles Directory." Accessed May 3, 2013. <http://docs.lib.purdue.edu/dcp/>.

Cragin, Melissa H, P Bryan Heidorn, Carole L Palmer, and Linda C Smith. "An Educational Program on Data Curation." In *American Library Association Conference, Science and Technology Section*. Vol. 25. Washington, DC, 2007.

Fons, Ted, Mike Furlough, Elizabeth Kirk, Judy Luther, and Michele Reid. 2012. *Fit for Purpose: Developing Business Cases for New Services in Research Libraries*. Washington, DC: Council on Library and Information Resources. <http://mediacommons.futureofthebook.org/mcpres/businesscases/>.

Gawande, Atul. *The Checklist Manifesto: How to Get Things Right*. New York: Picador, 2010.

Heidorn, P. Bryan. 2011. "The Emerging Role of Libraries in Data Curation and E-science." *Journal of Library Administration* 51, no. 7-8: 662-672. <http://dx.doi.org/10.1080/01930826.2011.601269>.

Hey, Tony, Stewart Tansley, and Kristin Tolle. *The Fourth Paradigm: Data-Intensive Scientific Discovery*. Redmond, WA: Microsoft Research, 2009.

Johnston, Lisa, Meghan Lafferty, and Beth Petsan. 2012 "Training Researchers on Data Management: A Scalable, Cross-Disciplinary Approach." *Journal of eScience Librarianship* 1, no. 2. <http://dx.doi.org/10.7191/jeslib.2012.1012>.

Joint Task Force on Library Support for E-Science. 2007. *Agenda for Developing E-Science in Research Libraries*. Washington, DC: Association of Research Libraries.
<http://www.arl.org/storage/documents/publications/escience-report-final-2007.pdf>.

Lawrence, Bryan, Catherine Jones, Brian Matthews, Sam Pepler, and Sarah Callaghan. "Citation and Peer Review of Data: Moving Towards Formal Data Publication." *International Journal of Digital Curation* 6, no. 2 (July 26, 2011): 4–37. <http://dx.doi.org/10.2218/ijdc.v6i2.205>.

Loh, Wallace. "Turning Research into Jobs in Maryland." *Baltimore Sun*, February 13, 2012, online edition. http://articles.baltimoresun.com/2012-02-13/news/bs-ed-university-innovation-20120210_1_universities-funding-for-basic-research-federal-funding.

Ogburn, Joyce L. 2010. "The Imperative for Data Curation." *Portal: Libraries and the Academy* 10, no. 2: 241–246. <http://dx.doi.org/10.1353/pla.0.0100>.

Palmer, Carole L., Lauren C. Tefreau, and Carrie M. Pirmann. *Scholarly Information Practices in the Online Environment*. OCLC Research, 2009.

PLOS. "PLOS ONE : Publication Criteria." Accessed May 3, 2013.
<http://www.plosone.org/static/publication>.

Rayward, W. Boyd. "Library and Information Science: An Historical Perspective." *Journal of Library History* 20, no. 2 (1985): 120–136.

Raboin, Regina, Rebecca Reznik-Zellen, and Dorothea Salo. 2013. "Forging New Service Paths: Institutional Approaches to Providing Research Data Management Services." *Journal of eScience Librarianship* 1, no. 3. <http://dx.doi.org/10.7191/jeslib.2012.1021>.

Reznik-Zellen, Rebecca, Jessica Adamick, and Stephen McGinty. 2012. "Tiers of Research Data Support Services." *Journal of eScience Librarianship* 1, no. 1.
<http://dx.doi.org/10.7191/jeslib.2012.1002>.

Ries, Eric. *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*. New York: Crown Business, 2011.

Sierra, Tito. "The Project One-Pager: A Simple Tool for Collaboratively Defining Project Scope." 2011. <http://www.slideshare.net/tsierra/the-projectonepager>.

Small Business Administration. "Create Your Business Plan". Accessed November 20, 2012.
<http://www.sba.gov/category/navigation-structure/starting-managing-business/starting-business/how-write-business-plan>.

Soehner, Catherine, Catherine Steeves, and Jennifer Ward. 2010. *E-Science and Data Support Services: A Study of ARL Member Institutions*. Washington, DC: Association of Research Libraries. www.arl.org/bm~doc/escience_report2010.pdf.

Tenopir, Carol, Ben Birch, and Suzie Allard. 2012. *Academic Libraries and Research Data Services: Current Practices and Plans for the Future*. Chicago, IL: Association of College and Research Libraries. <http://www.ala.org/acrl/issues/whitepapers>.

Unsworth, John. "Scholarly Primitives: What Methods Do Humanities Researchers Have in Common, and How Might Our Tools Reflect This." In *Humanities Computing, Formal Methods, Experimental Practice*. King's College London, 2000. <http://people.lis.illinois.edu/~unsworth/Kings.5-00/primitives.html>.