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putting the pieces together: theory and practice

Forging New Service Paths: Institutional Approaches to Providing Research Data Management Services

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Abstract

Objective: This paper describes three different institutional experiences in developing research data management programs and services, challenges/opportunities, and lessons learned.

Overview: This paper is based on the Librarian Panel Discussion during the 4th Annual University of Massachusetts and New England Region e-Science Symposium. Librarians representing large public and private research universities presented an overview of service models developed at their respective organizations to bring support for data management and eScience to their communities. The approaches described include two library-based, integrated service models and one collaboratively-staffed, center-based service model.

Results: Three institutions describe their experiences in creating the organizational capacity for research data management support services. Although each institutional approach is unique, common challenges include garnering administrative support, managing the integration of services with new or existing staff structures, and continuing to meet researchers needs as they evolve.

Conclusions: There is no one way to provide research data management services, but any staff position, committee, or formalized center reflects an overarching organizational commitment to data management support

Introduction

As libraries' collective experience with data management matures (Gold 2010), the variety of approaches that an institution might adopt to support networked science continues to grow. Although there is literature describing the roles that libraries and librarians can play in the management of research data (for example, Friedlander 2006) and work detailing the competencies required by LIS professionals to undertake these roles (for example, Corrall 2012), there is less information available on how institutions can integrate those roles into their existing organizational models. One significant contribution is the 2010 Association of Research Libraries' survey of member institutions on their approaches to providing eScience and data management support services at the institutional and library level. Their findings indicate "a great diversity in the strategies employed by institutions to address the needs of their researchers. Current strategies range from a decentralized series of data support services in a variety of departments or units, to the creation of committees to discuss campus data needs and services along

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with the creation of centralized data centers to provide that support. The diversity of response reflects the needs and culture of the institutions, which is to be expected" (Soehner 2010).

The 4th Annual University of Massachusetts and New England Region e-Science Symposium[1] featured a panel of librarians from large research universities -- two public and one private -- to discuss the approaches their respective institutions have adopted to bring support for data management and eScience to their communities. Each of these panelists cite the NSF data management plan requirement as a driving factor behind their efforts to develop data support services, and they present unique service models to support this mandate based on their own institutional contexts.

Manufacturing Serendipity: Research Data Services at University of Wisconsin Madison

Background

The University of Wisconsin at Madison is Wisconsin's flagship research institution, serving over 28,000 undergraduate and 11,000 graduate and professional students. The university ranked fourth nationally among U.S. public universities in 2008-2009 for federally-funded research, and second nationally in total research expenditures. The University of Wisconsin at Madison's (UW-Madison) central IT unit, the Division of Information Technology (DoIT), began studying researcher behavior around digital asset management in 2006 with participation from the General Library System (GLS). Their first report on focus-group meetings with faculty (Simpson et al. 2007) concluded that "the loss of the culture of curatorship in the transition to a digital scholarly record severely threatens the preservation of institutional memory."

DoIT and GLS interest in institutional digital assets focused on research data in 2008, after several staff attended the Center for Library Initiatives conference, "Librarians & e-Science: Focusing Towards 20/20" symposium (Committee on Institutional Cooperation 2008). They formed a task force, the Research Data Management Study Group, to perform in-depth interviews with faculty from several disciplines about their data assets, needs, and funding situations. "The interviews revealed a broad diversity in asset content and format, a large number of disparate needs, and an inadequate funding base for many researchers" (Simpson et al. 2009). Their report recommended a one-year pilot project to create a distributed archival-storage system with appropriate training support; however, no sponsors stepped forward to implement it, so the idea was abandoned. Both reports have been cited multiple times outside UW-Madison; inside the University, however, they received little attention from high-level administrators. In 2010, due to the persistence of DoIT and GLS staff, the CIO's office finally granted these staff members a planning and pilot-project charter that ran through the end of the calendar year.

In addition to drafting business plans and service outlines, the charter group undertook a small stable of data-management (really data-rescue) projects. Hobbled by lack of working and archival digital storage on campus as well as minimal allocated staff time, the projects turned out less complete and less inspiring than the charter group had hoped, but they did provide further evidence of a campus need. Business planning and further needs assessment were also hampered by charter sponsors' reluctance to allow charter-group members to canvass deans, department chairs, and research administrators for support and partnership. Perhaps most difficult to manage was the separation of the charter group's mandate from the question of digital storage for research data, assigned to a different group altogether. In general, charter sponsors and

1. http://escholarship.umassmed.edu/escience_symposium/2012/

other campus stakeholders found the need for storage easy to understand and support; the need for expert training and consulting, considerably less so. While autonomy meant that the charter group could explore possibilities without preconceived notions, it came at a considerable cost in access to high-level stakeholders within the institution. A more assertive approach like that of Tufts (discussed later in this article) involving high-level campus stakeholders would likely have produced better results.

When the National Science Foundation issued its requirement for data-management plans, the charter group faced a serious decision: to exceed the charter's boundaries to launch a full-fledged consulting service, or to go back to administrators to ask for blessing and support for the venture. Given the history of indifferent administrative support and the urgency for outreach, the charter group decided to act, launching Research Data Services (RDS) as a website (http://researchdata.wisc.edu/) and data-management-plan consulting service. Word of the new site and service spread rapidly outside UW-Madison. UW-Madison administrators and research-computing experts first learned of RDS after it was praised by colleagues at other institutions, unaware of the previous four years of foundational work done by RDS members and in-kind sponsors.

Unfortunately, the outside praise did not lead to support within the University for RDS, but rather vocal interrogation of its institutional legitimacy. Several faculty and research-computing experts who had not been consulted about RDS (largely because of the charter sponsors' restriction against discussing the pilot project with outsiders) and were not aware of its origins attacked it on various grounds, often over lack of planning transparency. In hindsight, the charter group should have anticipated this, and communicated the planning process to key campus personnel more effectively than it did, with an eye to forming alliances.

Services

Without dedicated funding, high-level administrative champions, or appropriate underlying IT infrastructure, the fledgling RDS was starkly limited in the services it could feasibly offer. Naturally, the need to announce, explain, and support the NSF data-management plan requirement occupied most of the first half of 2011: The group aimed training sessions at faculty and graduate students, as well as meeting with the Office of Research and Sponsored Programs to explain the new requirement and RDS' available support services. For the first several months, demand for consultations held steady at four to six per week. After that, however, it became clear that face-to-face NSF consulting was a thin thread on which to hang an entire service; demand fell to fewer than three requests per month, especially after the release of the DMPTool (http://dmp.cdlib.org/) in November 2011. While RDS saw value in the DMPTool and linked it to the campus Shibboleth authentication service, it also understood that additional services would be necessary to keep RDS viable and useful.

Campus outreach became a major focus of effort. Capturing real-world experiences and opinions on video turned out to be a valuable approach. Early on, RDS asked four researchers to speak informally on camera about their data-related challenges, and then added the videos to the RDS website after superficial editing. These proved so popular (based on pageview counts compared to other pages on the RDS website) that an RDS task force secured funding to produce four more videos in the summer of 2011, one featuring new campus CIO Bruce Maas. During the 2011-2012 academic year, RDS secured support from the School of Library and Information Studies for a brown-bag speaker series, featuring topics from GIS to three-dimensional microscopy to graduate education in data management. After the initial event in the series, which drew roughly 15 people, subsequent events regularly drew

between 25 and 50 attendees, in person and online via Adobe Connect. These results were encouraging enough that the series has been renewed for a second year, with financial support from the Ebling Health Sciences Library.

RDS co-lead, Dorothea Salo, started part-time as an adjunct in the School of Library and Information Studies (SLIS) in 2007, and tranferred to SLIS from the General Library System in 2011. In 2010 she proposed and designed a topics course in digital curation, and starting teaching that course in the spring semesters of 2011 and 2012. In addition to producing SLIS graduates who have secured data-curation and digital-preservation jobs in academic libraries, government, and industry, the course has furthered RDS' objectives via a service-learning component that has aided campus and community researchers in assessing, describing, and preserving research data. In groups, students perform a data-curation profile modeled after Purdue's (Witt et al. 2009) to elucidate their client's needs, turning in a project plan and semester project schedule alongside it. Over the course of the semester, they work on the client's project, renegotiating deliverables and deadlines as needed. Finding suitable projects for student groups has become steadily easier since the course's inception; the project list for the spring 2013 semester was full (four full projects; two standbys) by late September 2012.

UW-Madison's Master of Fine Arts program demonstrates a typical student project: students rescued digital photographs of MFA exhibitions from a file drawer full of CD-ROMs, secured display permissions from as many exhibitors as possible, and deposited photographs for which permissions had been granted into the University of Wisconsin Digital Collections (UWDC, http://uwdc.library.wisc.edu/collections/Arts/StudentArt). In collaboration with MFA program administrators, the students also revised exhibition-deposit procedures to secure permissions and facilitate deposition of future exhibition photographs into UWDC, thus rescuing future digital assets as well as past ones. Institutions without attached library schools could accomplish similar projects with sufficient dedicated time from liaison librarians and student staff.

Workshops, bootcamps, and other training opportunities have taken over from data-management planning as RDS' bread-and-butter work. When RDS co-leads reached out to NSF grantees in spring 2011, they learned that no one on campus had included a data-management component in graduate science curricula, despite widespread reliance on graduate students. Several workshops affiliated with various Graduate School and library seminar series have introduced graduate students to the changing data landscape and the skills they will need to navigate it. In summer 2012, SLIS inaugurated a one-credit, one-week bootcamp-style course; while registration red tape seriously hampered enrollment, nine students completed the course, one of whom is redesigning his entire engineering laboratory's practices based on course content.

Training and outreach within the libraries has had limited success, however. While a day-long data-management workshop for science liaison librarians was well-attended, a few participants expressed significant doubt afterwards about whether librarians should be involved in research-data management at all. Nonetheless, chemistry liaison librarian, Ariel Neff, will sponsor an information-literacy practicum student from SLIS in fall 2012 whose special project will be designing data-management education materials specific to chemistry. RDS hopes that this project and similar small-scale project work will help win liaison librarians' endorsement of and assistance with campus data management.

Challenges and Opportunities

Every institution pondering data manage-

ment support will have a different mix of staff, administrative and grassroots support, technology infrastructure, and opportunities from which to build. Not every institution has a nearby library school, for example. This suggests that there is no single foolproof template that will produce a successful service everywhere. RDS is in no way a paradigm success; it has lived on the razor's edge since its founding and continues to do so.

RDS demonstrates that a small, opportunistic group can make real inroads into intractable problems. It also demonstrates, however, that the absence of an administrative champion creates funding, staffing, and image challenges that hamper progress and demoralize staff, especially when the service is standalone rather than mainstreamed into regular IT and library processes. Mainstreaming data-related work among liaison librarians will not happen in the absence of political capital and confident direction from library administrators; it will require the same style of clear expectation-setting and support provision that Karen Williams employed at the University of Minnesota to mainstream scholarly communication advocacy (Malenfant 2010).

The Data Working Group at the University of Massachusetts Amherst Libraries

Background

The University of Massachusetts (UMass) Amherst is the flagship public research university in Massachusetts serving over 21,000 undergraduate and 6,000 graduate students with 1,174 full-time instructional faculty and offering a combined 138 masters' and doctoral degree programs in eight schools and colleges. The UMass Amherst Libraries supports this diverse research and teaching environment in a multitude of ways and strives to meet the changing needs of its community, including the need for research data management support services.

The Libraries' awareness of and initiatives for research data management began in 2008. After attending the Association of Research Libraries 2008 Fall Forum on Reinventing Science Librarianship,[2] the University of Massachusetts System Library Directors convened with their Science Librarians to discuss the role that libraries might play in data management. Outcomes from this *Ad Hoc* group developed into an ongoing suite of regional professional development initiatives related to eScience and data management.[3] These initiatives are successful in exposing individual librarians to the information and skill sets they need to participate in data management. At the UMass Amherst Libraries however, limited resources and a small cohort of liaisons assigned to science, engineering, and health science disciplines[4] made a dedicated organizational path to research data management support services difficult to envision.

In 2009, in a separate but parallel effort, the UMass Amherst Libraries established the Digital Strategies Group (DSG) to coordinate library activities involving the creation, collection, and curation of unique digital content. The DSG is an advisory committee to the Director of Libraries. This group includes representatives from all areas of the library and governs the activities of two working groups dedicated to issues relevant to digital content, namely the Metadata Working Group and the Digital Creation and Preservation Working Group. These groups work collaboratively to develop the cultural and technical environment to enable digital content to thrive in the Libraries and on campus. As research data was becoming an increasingly visible part of the scholarly record, data was seen as a good candidate to join this

2. http://www.arl.org/events/fallforum/forum08/
3. http://library.umassmed.edu/escience_initiatives
4. UMA Libraries staffs 42 librarians; of those, 18 are liaison librarians; of those, 4 are dedicated to science, engineering, and health sciences.

effort. The structure of the DSG--essentially a network of committees--would enable the Libraries to focus on research data management while distributing the work across the organization. The working group approach would also provide the most immediate path toward data management support, by leveraging the Libraries' existing organizational structure.

In 2010, the Data Working Group (DWG) was formally established as part of the Digital Strategies network. Consisting of staff with experience in scholarly communication, science and social science librarianship, systems, archives, project management, and repository development, the DWG's task is to facilitate the curation of research data and to develop meaningful resources on data management for the University community. This two-fold approach enables the group to not only create a long-term vision for data management but also to meet the immediate needs of researchers who are faced with federal mandates to manage and share their data.

Services

The first year and a half of the group's work was focused on understanding both the local research culture and nation-wide data management support trends. Environmental scanning activities identified local data management needs and categorized three broad groups of data management support activities. Based on this preliminary work, the DWG crafted a heavily service-oriented vision statement for the Libraries with respect to research data: "The DWG envisions the library as a full partner in the campus-wide research enterprise by offering, independently and in collaboration with other campus entities where appropriate, the full spectrum of data management services to our community and by building in-house expertise in data management." (UMass Amherst Libraries' Data Working Group 2011)

The full spectrum of campus-based data management services includes educational, consultative, and infrastructure activities. For example, educational activities provide informational resources and offer tutorials or instruction on data management; consultation activities include one-on-one or group meetings with researchers on data management plans or planning; and infrastructure activities include providing, alone or in collaboration with others, the storage and/or access facilities required by researchers (Reznik-Zellen et al. 2012).

Working toward fulfilling this vision, the DWG actively provides the following educational and consultation activities:

- Online resources: The DWG has created and actively maintains a suite of web pages dedicated to data management planning resources as well as a LibGuide on data management best practices. The web pages are aimed toward faculty and researchers who must meet federal mandates for data management and sharing. It offers general information on federal mandates, a data management plan template, and links to additional data management planning resources. The LibGuide is geared toward graduate students and focuses on best practices for data management, including overviews of repositories, data citation, research ethics, and data management basics.

- Workshops: The DWG began offering voluntary workshops on data management best practices for graduate students and data management plan preparation for faculty in fall of 2011. The graduate workshops focus on fundamentals for data management geared to major discipline groups while the data management planning workshops address faculty concerns for compliance. Five workshops were offered during the 2011-2012 academic year and have been well-received both by students and faculty.

- Data management plan consultations:

The DWG offers to review—for no fee—any data management plan being submitted by a faculty member to the NSF, NEH, NIH, and other funding agencies. Though a week is requested for turnaround time, most requests are time-sensitive to two or three days. The DWG collaboratively reviews draft plans and returns targeted feedback to faculty with recommendations for clarity or improvement.

- Consultations on metadata and standards for data format and content, policies for data sharing and accessibility, and plans for long-term access to data sets: Much of this type of consultation is provided indirectly to faculty through feedback on investigators' data management plans. This service is offered as a stand-alone service through the DWG's web pages for no fee.

To promote and increase awareness of these education and consultation services, the DWG has reached out to the University's Research Council and has established a relationship with the Office of Research Development, which directs investigators to the Libraries for assistance with their data management plans and helps to promote workshops.

Importantly, the services of the DWG are not offered in isolation; as with efforts of all the Working Groups, these activities fall under the auspices of the DSG. Capitalizing on the idea that research data management is but a part of the overarching digital scholarly life cycle, the DSG has packaged these education and consultation services offered by the DWG with existing digital scholarship services offered by the Libraries. In this way, data management support services become part of a larger and more systematic effort of the Libraries to support new modes of digital scholarship.

Challenges and Opportunities

While developing services to support data management on campus has been exciting, there are significant challenges as we move ahead, namely scale, infrastructure, and institutional visibility.

The DWG functions as a team; this requires coordination as well as a high level of commitment from each Working Group member, who already has a full plate of regular job duties to contend with. As demand for trainings and consultations increases and the work of maintaining online resources continues, the capacity of the team to manage and evolve services will be stretched. The question of how to further integrate the responsibilities of data management beyond the group is an important one. Liaison librarians are invaluable partners for the DWG, particularly for outreach and engagement on data management. Although the DWG has made preliminary efforts to raise awareness of data management services among liaisons, a more concerted effort needs to be made to educate both internal and external stakeholders on the role and importance of research data management in the scholarly lifecycle.

Providing infrastructure support is a much more complex challenge. Currently, the Libraries provide a discovery and access point for research outputs through its open-access Institutional Repository, ScholarWorks, but it cannot accommodate all campus research data. The University's Office of Information Technology offers a limited amount of storage space to the community members, but it is insufficient for even modest research projects and is not designed with data curation or sharing in mind. At the same time, a large-scale data storage and versioning platform is a pressing need for researchers, as identified during environmental scanning exercises and confirmed in DWG interactions with faculty and graduate students. Infrastructure of this scale requires the support of multiple administrative entities on campus including

the Libraries. In the meantime, the DWG is investigating microservices to facilitate data sharing, such as the California Digital Library's EZID Service, but the absence of a centralized, supported, and comprehensive infrastructure solution is widely felt.

Research data management services have been a library-driven initiative to date. Despite outreach efforts, several faculty and administrators are unaware of the services that are offered by the Libraries. This lack of administrative awareness, and consequently support, hampers the Libraries' visibility as a vital partner in the research lifecycle. Going forward, collaboration with entities such as the Graduate School, the Office of Information Technology, and the Office of Grants and Contracts Administration will help to cement and evolve the services that the Libraries have worked hard to launch. For example, data management workshop evaluations indicate that incorporating data management into the curriculum for first-year graduate students would be desirable in the humanities and sciences alike. Similar to large-scale infrastructure, this kind of systematic programming can only happen at an institutional level.

Data Management Services Support for Arts, Sciences, and Engineering at Tufts University

Background

Tufts University is a private, co-educational university in Massachusetts, with more than 9,600 undergraduate and graduate/professional students.

With campuses across the Commonwealth, it offers liberal arts and engineering undergraduate/graduate education and professional studies in law and diplomacy, medicine, dentistry, veterinary medicine, and occupational therapy. Tufts is recognized for both teaching and research, including vast opportunities for undergraduate research. Tisch Library, the Arts, Sciences, and Engineering Library for Tufts University, provides services and collections that meet the diverse research, teaching, and learning needs of the Schools of Arts and Sciences and the School of Engineering (A, S & E). There are five additional libraries serving the student, faculty, and research needs of Tufts: Lilly Music Library (A, S & E), Edwin Ginn Library (The Fletcher School of Law and Diplomacy), Hirsh Health Sciences Library (Tufts Schools of Medicine and Dentistry), Webster Family Library (Tufts School of Veterinary Medicine), and Tufts Digital Collections and Archives (Tufts University).

Like the University, Tufts' libraries are decentralized, sharing a catalog and some additional library services. While there isn't a Dean of Libraries, the University Library Council (ULC) is designed to investigate how the libraries can provide unified services, and continue to serve its unique population of users. Sitting on the ULC are the library directors, Digital Collections & Archives Director (DCA), University Library Technology Services Director (ULTS), Associate Provost, and Director of Educational & Technology Services (University Information Technology/UIT).

Tufts University Information Technology (UIT) service provides information technologies for teaching, research, and administration across the University. Research and Geospatial Technology Services (RGTS) supports research storage, high-performance computing (including bioinformatics), visualization center, and GIS.

In May 2010, the National Science Foundation (NSF) instituted a requirement that all NSF grant proposals include a two-page Data Management Plan (DMP). This was in response to the U.S. Government's Open Government Directive requiring that publicly funded research must be more transparent, collaborative, and open or accessible to the public.

Tufts Office of Research Administration

(ORA) convened a meeting of all departments involved with NSF proposals to discuss support scenarios for the new requirement. Also invited were Tufts Libraries, DCA, and UIT. Although Tufts' Digital Repository (TDR) could provide metadata support and some open access, neither they nor ORA were prepared to assist faculty with developing data management plans. Tisch Library's Head of Technical Services and Metadata suggested that Tisch Library would be able to provide this support.

Not long after this meeting, Tisch Library's Research & Instruction and Collections departments met to discuss how to provide this new service. Regina Raboin, Science Research & Instruction Librarian, volunteered to coordinate Tisch Library's response with the Head of Technical Services and Metadata. The response evolved into Tisch Library's Data Management Services Team, led by Regina, with librarians from Cataloging and Metadata Services, Research and Instruction, Collections, and Tufts Digital Collections and Archives.

Services

One of the first goals of the team was to create a Data Management Guide for Tufts A, S & E researchers. Reviewing and borrowing from some established data management guides (MIT, University of California's Digital Library) they designed pages addressing the NSF DMP requirements, repositories & services, metadata & documentation, and ethical and legal issues surrounding research data management.

The next step was to create a very simple, generic data management plan pulled from NSF guidelines. With these tools, the team met with the Associate Director for A & S Research Affairs and Grants Administrator, School of Engineering Research Administration, to design a workflow for identifying faculty submitting NSF proposals. Approximately every two-three months these departments send lists of faculty submitting NSF proposals or other grants from organizations requiring data management plans. The proposals are assigned to team members based on subject expertise: the Engineering librarian conducts the outreach to Engineering and Math with assistance from other team members depending on the proposal's research focus. When necessary, two team members are assigned to proposals; at any time there can be several data management plans in development.

Each researcher is contacted by the subject specialist via email with an attached DMP template (modified if the researcher's NSF Directorate has specific data management requirements). The email template introduces the subject specialist, provides information about the DMP requirement and directions on how to use the grant proposal in writing the plan. The subject specialist asks the researcher to send their proposal summary/prospectus, so that they have the in-depth information in order to better understand the grant's requirements. An invitation to meet in person to assist with writing or reviewing the DMP is also offered (in the second year of providing this service most faculty will send the DMP draft by email for review). Any last-minute proposals or those submitted without a DMP will be directed to the team by the A, S & E research directors. While reading DMPs, the subject specialists will review for data formats, description, and collection; data storage and access, including short-term and long-term issues such as archiving and preservation; legal and ethical issues; and metadata. The draft DMPs will be sent to the team's metadata specialists for review and suggestions.

Challenges and Opportunities

Going into its third year, the Tisch Data Management Team continues to provide data management services for faculty, graduate and undergraduate students. The team also continues to work with library, A, S & E, and University administrators to determine the future goals of this service. While this per-

sonalized process has been very successful, there are some sustainability and scalability challenges the team is looking to address:

Subject Specialists: Should all of Tisch Library's subject specialists be NSF grant reviewers? At this time Tisch only has three-four specialists who participate in this service. What are the ramifications for the Research & Instruction department if this is required for all the subject specialists?

Metadata Services: This library service faces issues similar to Tisch's Research & Instruction department. At this time there are only two metadata specialists available to work with Tisch's Data Management Services Team. As metadata services grow, how will the department head manage and build the service with the current staffing structure? Are there re-training opportunities for technical services staff? Will library administration recognize this as an opportunity to evolve this department's direction? Are there opportunities in partnering with other Tufts services such as DCA and Research & Geospatial Technology Services (RGTS)?

Providing Service Beyond Tufts Arts, Sciences & Engineering: Currently, Tisch is the only Tufts library providing this service. However, as other granting agencies require open access and data management plans, will the team become a ULC or Tufts team? Are there advantages to remaining decentralized, with Tisch providing support and training for other Tufts Libraries?

Online Data Management Plan Template: One of the team's goals is to provide an online DMP that is linked to the grants administration's workflow. Advantages to this would be increased accessibility and convenience for researchers; the disadvantage would be less one-to-one contact with them. While the form can be designed and made available, at this time it can't be linked to the workflow. Are there benefits to participating in other institution's data management initiatives, for example Purdue's Data Curation Profiles? (Purdue University Libraries, 2012)

Size, Scale, and Costs: While Tufts has an excellent digital repository, it doesn't have the capacity to accept all Tufts research data for storage and curation. Tufts Research Storage has more than enough storage capacity, but it isn't designed for open access. These issues create confusion on the part of Tufts researchers as they don't necessarily differentiate between the two services. Researchers want one place where they can go to manage access to their data. How are these issues going to be addressed across the University? It is imperative that the Tisch Data Management Services Team continues to educate Tufts University faculty researchers about the services Tufts currently provides and to ask what types of data services would be important for their future data management needs. The group also needs to continually educate and discuss changes to overall data management requirements with those Tufts administrative departments that are charged with pieces of data management.

At this time the costs incurred by Tisch Library are in staff time and educational opportunities for the team. Data Management services have been incorporated into existing job responsibilities and no additional professional or support staff has been hired to support these services. If the service grows beyond Tufts A,S&E, then Tufts University Libraries will need to determine if they will institutionalize and financially commit to supporting the team.

Influencing Institutional Research Data Infrastructure: Recently, representatives from Tisch Library, ULTS, Educational & Scholarly Technical Services (ESTS/UIT), ULC, RGTS, and DCA formed the Digital Asset Stewardship Working Group, producing a report entitled "*Coordinated Data & Metadata Storage, Management & Access Strategy for Tufts Libraries and Allied University Digital Asset Stewards.*" This report addressed needs and solutions for Tufts' current and

future digital management and will hopefully spur meaningful and future actions in data management, including small- and large-scale data storage and curation.

At this time the Tisch Library Data Management Team has excellent, collaborative relationships with UIT's RGTS and A & S's Research Affairs, School of Engineering's Research Administration and Tufts University's Office of Vice Provost. The team continues its roles as consultants and educators to these administrative departments. However, sustaining these roles, while important, is time-consuming, and as demands on the team increase, is this a sustainable outreach model?

Expanded Data Management Instruction Opportunities: Currently, Tisch's Data Management Team is providing instruction outreach to graduate students and faculty through mostly individual and some group presentations. Instruction opportunities for graduate students have occurred in workshop presentations; undergraduate outreach opportunities haven't been available. The team will be expanding its educational outreach by participating in a spring 2013 Tufts University education program for new grants applicants called AAPLS (Applicants & Administrators Pre-award Luncheon Series). Also, Tisch Library is partnering with University of Massachusetts Medical School, University of Massachusetts Amherst, Northeastern University, and MBL/WHOI Libraries on a National Network of Libraries of Medicine, New England Region Grant (NN/LM NER), *Development and Implementation of a Data Management Curriculum for Undergraduate and Graduate Students in Sciences, Health Sciences, and Engineering Programs.* This proposal is the second phase of the data management education framework created in the IMLS planning grant, *Planning a Data Management Curriculum and Requirements for a Collaborative Data Repository,* by University of Massachusetts Medical School and Worcester Polytechnic Institute (WPI). The current grant's goals are to develop best practices in data management curriculum development, implementation, and assessment. This will establish a framework by which libraries can further develop data management educational outreach to faculty, students, and grants administrators. The curriculum could also be used to train much needed data management subject and metadata librarians.

Professional Development for Strategic Positioning: In the past few years more professional development opportunities in data management are available for librarians and information professionals. The Association for Research Libraries (ARL) and Association of College & Research Libraries (ACRL) provide educational, professional development and resources support for eScience and data management. Other organizations such as the Coalition for Networked Information (CNI), and American Society for Information Science & Technology (ASIS&T) also provide data management education opportunities via conferences, symposia, and professional development days. Library and Information Science schools are beginning to recognize the need for professional development, certificate, and graduate programs in data management and eScience. For example Syracuse University's School of Information Studies offers a Certificate in Advanced Studies (CAS) in Data Science, the Graduate School of Library and Information Science at the University of Illinois has specializations in bioinformatics and data curation and University of North Carolina's School of Library and Information Science offers certificate programs in bioinformatics and digital curation. Most schools provide these programs as online experiences. For New England science and data librarians, support for data management resources, education, and professional development is provided by the e-Science Portal for New England Librarians.

Conclusion

The path to providing successful data management services is unique to an institution. While each case above was driven in some part by the National Science Foundation mandate for data management, institutional context flavored the local implementations of research data management services. The three approaches outline two library-based, integrated service models and one collaboratively-staffed, center-based service model. While no approach is without challenges, common themes among these models are garnering institutional support, managing the integration of services with new or existing staff structures, and continuing to meet researchers' needs as they evolve. Particularly, the critical role of institutional support can be observed both by the Tufts' success with outreach to faculty and by the challenges faced by UW-Madison and UMass Amherst. Other common issues are the need to bring additional library staff into the data management fold, whether they are liaison or metadata librarians, and the challenge of providing consultative services with varied infrastructure scenarios for data curation in place.

Libraries or other information professionals contemplating building a new or revised data management service should consider surveying their institutions for current data management strategies and goals, conduct outreach to those departments that are charged with digital/data management, and find institutional partners interested in creating solutions to complex issues. Being invited or inviting oneself to the table will provide unforeseen collaborative opportunities, allowing for a library's strengths to be maximized thereby providing a service with minimum impact to existing services and policies. Attending conferences, workshops, seminars, and other educational opportunities will provide forums to exchange information on how best to develop data management strategies that are manageable and sustainable within an institution's political framework. Libraries can face these challenges and be successful by encouraging and supporting staff who understand the importance of data management and recognize the need to make changes in old service models in order to pave the way for new ones. With libraries leading the way, sharing challenges and maximizing opportunities will translate into new collaborations that will grow into dynamic, flexible, and valued services for their faculty, researchers, staff, and students.

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