

The Data Management Village: Collaboration among Research Support Providers in the Large Academic Environment

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DATA MANAGEMENT ENCOMPASSES the practices and people that acquire, control, protect, deliver, and enhance the value of data throughout the research lifecycle.¹ Done well, data management requires that these practices and people be connected throughout the *entire* research lifecycle. However, much of this work takes place in researchers' own offices or labs or with the help of specialized support offices on campus, who only directly interact with researchers at single points in their projects. In academic libraries, a data management specialist may only interact with researchers at the beginning and end of a project, assisting with the creation of a data management plan (DMP) and preservation of the data when the research is completed. This poses a challenge when trying to help researchers integrate best practices into their workflows throughout the planning, collection, and analysis stages. Most libraries are focused on providing broad, public access to the content under their stewardship, and given this mission, libraries alone may not be able to offer all of the data services that our researchers need (for example, dark archives for sensitive or private data). Therefore, given the diverse nature of research data and the distributed support researchers may seek throughout their project, universities need a well-connected, distributed way to support data management; it is a service that "takes a village."

In this chapter, we will describe efforts at the University of Minnesota (U of M) to build our data management village, the "village" being a useful metaphor for our community of connections between researchers and staff and the infrastructure of referral networks across campus units. Part 1 of the chapter provides an overview

of some of the key offices on our campus and describes why they may be useful members of a data management village at any institution. Part 2 is an in-depth description of a collaboration between the University Libraries and the College of Liberal Arts (CLA) at the U of M that began in 2013. We describe how the collective and complementary skills of our offices provide researchers with support across much larger portions of the research lifecycle than either unit could provide alone.

Background and Context

Before we discuss what this partnership looks like in terms of collaborations and services, we should describe the context that led to these two groups coming together. While there are necessarily many players in a data management village, some may be willing to contribute more than others. This has a lot to do with university context, job roles, funding, and specific priorities set by the college or university. For example, offices that deal with highly structured, high-demand regulatory tasks, such as grants administration or human subjects oversight, may not have the bandwidth to commit to a more in-depth partnership. On the other hand, offices that work closely with researchers supporting data collection/analysis, IT, or grant-writing likely encounter needs for data management support at times in the research process where they can impact a researcher's practices, and may have more flexibility to engage in collaborative work.

Research Support Services, housed in CLA's technology office, has historically supported data collection and data analysis for faculty and graduate students. As a result of the university's push for traditional IT services to be more centralized, CLA's IT division transitioned out of desktop support and invested in specialized services for research and teaching. As part of this shift, Research Support Services expanded in 2013 to include a full-time research position devoted to developing and providing data management support for the college. A data librarian was appointed chair of the search committee, and the job description involved seeking out and forming collaborations across the university.

The University Libraries have provided support for data management for many years through training, DMP consultations, and an informational website (<http://lib.umn.edu/datamanagement>). In early 2014, the Libraries formed a data management and curation working group charged to establish formal data management services and develop an institutional data repository, the Data Repository for the University of Minnesota (DRUM; <http://z.umn.edu/DRUM>). The team was led by one of the authors (Johnston), and members included librarians, archivists, and IT experts from across the libraries; unlike prior Libraries initiative groups, the team also included an expert from outside the Libraries, the new CLA data manager (Hofelich Mohr). Meeting regularly, the working group offered structured, long-term interactions for forming these services and allowed them to shape and be shaped by services Research Support Services was providing.

Several other factors also contributed to the growing emphasis on data management. The Libraries started a university-wide Research Data Management Community of Practice in June 2013 to bring people together and foster conversations around data management. The community of practice now hosts monthly presentations and discussions around issues such as data management needs, data storage, security, visualization, access, archival, and sharing. The group consists largely of service providers from IT, the libraries, colleges, the data security office, and the Office of the Vice President for Research, as well as researchers. Now in its third year, it has provided opportunities to connect with other service providers (and potential village members) and build referral relationships.

Collaborative projects and open conversations such as these have enabled those of us developing data management services to identify and connect potential members of a data management village. The result has been increased opportunities for more formal collaborations, such as participating in communities of practice tasked with updating and communicating new policy changes around data security, and consulting on the development of a new secure data storage service. For Research Support Services and the University Libraries, these interactions have led to service-level collaborations, where together we can offer a suite of services that support researchers wherever they are in the research process.

Part 1: The Data Management Village

We started our search for potential members of our data management village by looking to service providers who assist researchers across the research lifecycle and across the various levels of the university. While university-wide offices may have been the most obvious places to look, we realized that it was important to also include departments and individual colleges, as researchers may encounter these sources first. Although this review process was similar to conducting an environmental scan,² it was more focused on identifying service providers, rather than existing data types or data services. In a 2014 review, we focused primarily on social sciences, in part because of the vast number and diversity of departmental resources that could exist university-wide, but also because Research Support Services specializes in social science research support.³ Below we describe the offices that may be good members of a data management village at other institutions, based on what we found on our campus.

Collegiate Grant Consultants

Subject-specific grant consultants are located in individual colleges or departments, and work closely with researchers on finding, writing, and submitting grants. In CLA, almost all of our DMP consultations come to us as referrals from

the college's grant consultants. In a University with a high demand for DMP consultations, grant consultants may be a great resource for providing initial consultation and referral to data management specialists.

Collegiate Research Deans

Research deans are good resources for connecting researchers to services; they are aware of the research climate in their colleges, know the researchers, and typically sign off on all grant applications that come from their colleges. In CLA, we have found our Research Associate Dean to be a valuable advocate for our services and have received considerable guidance and advice from him on the specific needs of the college. Research deans can also help foster connections between other university offices, such as the grants administration office and the researchers within the college.

Commercialization Office

Technology or business commercialization offices can guide researchers on how to share their data/materials for wide research use and validation, without precluding the possibility of commercialization later on. The commercialization office can help researchers explore options, including data use agreements and licensing, and offer practical guidance, such as providing a permanent link to a questionnaire in a manuscript rather than including it in the publication, which could give the journal copyright to the instrument.

Copyright Librarian/Legal Counsel

Copyright librarians and/or legal counsel are knowledgeable not only about sharing sensitive data that fall under legally protected categories (student grades, health-care provided data, etc.), but also data that may face other kinds of legal restrictions, such as copyright. This is especially important when researchers are using data or materials that they did not generate, or when they are thinking about how to best share their produced data or materials while still retaining copyright or intellectual property rights. As specific policies on intellectual property, copyright, and data ownership vary by institution, copyright librarians and legal counsel are important resources for education on these topics.

Data Security Offices

Data security offices know the security policies and restrictions for various kinds of storage solutions and additionally create or contribute to university-wide policies on secure data practices. With data security requirements increasingly defined by US

federal granting agencies, there are opportunities to work with these offices to enact policies that make sense for research data, which often differ from the categories used to determine security risks for more administrative non-research university data.

Grants Administration Offices

In contrast to collegiate grants consultants, grants administration offices are central units where researchers are required to submit their grants before the university officially submits them to the granting agency. Typically, these offices receive grant applications late in the submission process and are more focused on whether all parts of the application are present, rather than the whether the content is strong. However, they can be a good resource for information about which grant agencies are funding research at the university and which researchers have had successful grant applications.

Institutional Review Board (IRB)

The IRB, or research ethics board, approves all human subjects research at the university. Because these offices typically require researchers to specify how data will be secured, stored, and maintained, decisions that are reported to this office can have important impacts on later sharing and archiving. Data management professionals need to openly communicate with the IRB administrators to ensure that good practices in each domain are understood by both sides, especially when trying to balance data accessibility and preservation with the protection of participant information. It is also important for curators to understand what the researchers promised to the IRB and their participants before developing or accepting a data submission for sharing or archiving.

Information Technology (IT) Professionals

IT professionals are another good route to researchers who are in the planning phase, since researchers may contact IT as they budget funds for servers, storage, or other customized technology needs. In colleges or departments, IT professionals are often well aware of their researchers' needs; centrally, IT professionals run secure storage, supercomputing centers, and other resources for research.

Library

Libraries can serve as a neutral party to connect key players across an institution and to direct researchers to services across an institution. Their open access digital archiving services, such as an institutional repository, are often available

to researchers for sharing and preserving their research data. In addition to this dissemination role, libraries offer specialized skills that are not present elsewhere on campus and are crucial to data management, especially pertaining to metadata creation and cataloging, curation, access and reuse, and archiving and preservation.

Office for Research

A university's Office for Research creates research policy, provides administrative support, and sets the agenda for university research. Often the office for sponsored projects and the IRB are located within this office, and potentially other research support offices; for example, at the U of M, the Supercomputing Institute and the Informatics Institute are housed under this office.

Research or Survey Support Offices

Offices that provide data collection services have a unique opportunity to improve data management practices by ensuring that data collected meet expectations for good data stewardship. These offices directly support the development and implementation of faculty research projects rather than administrative or institutional research. While these offices may exist at many different levels of the university, the closer they are to the researcher, the more likely these offices are to have discipline-specific knowledge and to be able to help integrate best practices into researchers' workflows.

Statistical Consulting Offices or Statistics Departments

While statistical consulting offices are a valuable resource in analysis, connecting researchers with statistical consultation at earlier points in the lifecycle can be valuable in establishing quality data practices from the start. For example, the consultants can help researchers establish and document decisions about sample size and planned analysis, and they can help promote reproducible data practices during analysis. They may also be a good resource for the statistical knowledge needed for de-identification or assessing disclosure risk for a dataset prior to sharing.

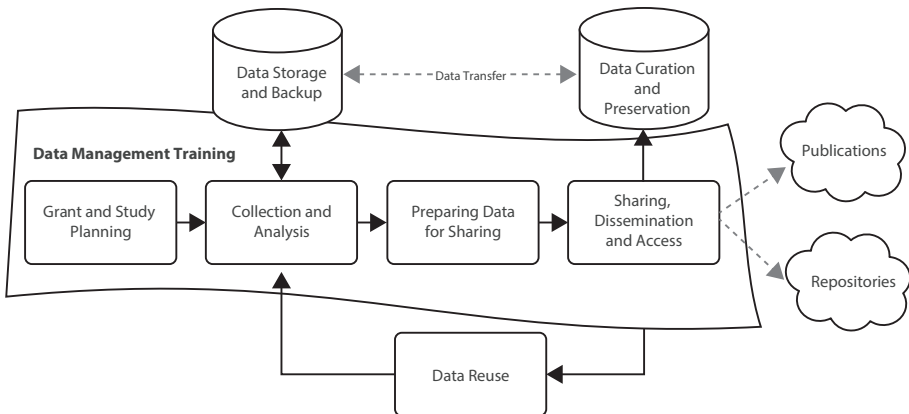
Part 2: Life in the Village: A Partnership in Data Management

Although identifying crucial resources and people at a university is an important step in assembling a data management village, it alone is not enough. To achieve the benefits of a distributed model for research data management support, it is critical to trust members of the village to be committed collaborators and not

just a passive referral network. However, Tenopir and colleagues⁴ found that outreach and collaboration with other data service providers is uncommon among academic research libraries in data services. The rest of this chapter will describe an in-depth collaboration between two members of our village, Research Support Services and the University Libraries, illustrating how we are attempting to move beyond a passive referral network and towards a partnership in providing distributed services.

In Figure 4.1 we illustrate our collaborative effort to provide data management services to our researchers across the research lifecycle, from the planning of their research project to the archiving of their data. At various points within the lifecycle researchers may need different levels of support and seek out different services. While the following overview describes an idealized situation of how a researcher might seek out data management support, in reality, we see different researchers in a variety of places and meet the needs they come with at the time. By having support set up at each point of the lifecycle, we are best able to reach people wherever they are in the process.

Figure 4.1. The Data Life-Cycle



Visualizations, such as this, of the path that data take may help define the roles and responsibilities of members in your “data management village.”

Data Management Training

Like their counterparts at most universities, researchers and PIs at the U of M take mandatory training in issues such as data security, ethical treatment of human subjects, and orientations to university policies on data retention and transfer.⁵ However, most researchers do not have available training options in other skills

and issues, such as data management best practices, data ownership, de-identification techniques, or digital preservation concerns.⁶ To help address this need, the University Libraries have been offering drop-in workshops and non-credit courses in data management topics since 2009. These sessions have reached over 800 faculty, staff, and students with an emphasis on discussion-based exercises and hands-on, active-learning activities.

The library workshop session on “Creating a Data Management Plan for Your Grant Application” has been taught to faculty and researchers since 2010, when the NSF announced that they would begin requiring DMPs for all grant applications. The session creators have determined that this content is best taught by two co-instructors, one data management specialist and one disciplinary specialist;⁷ this approach lends itself well to collaboration among campus units. For example, one pair of co-instructors includes a social sciences librarian and the CLA data management specialist for researchers in the social sciences. Here the focus of the content can point to resources and best practices within the discipline with experts who understand the nuances of data management and sharing relevant to the audience.

The student-focused workshops at the U of M have been evolving over the years to meet the urgent needs of those who are most often asked to handle the day-to-day workload of managing research data: graduate students. To introduce students to data management topics, the University Libraries developed a “Data Management Course” that has been taught online and as a hybrid online and in-person 5-week class⁸ for five semesters since 2012. The online course is open to anyone who wishes to partake in the video-based content and download a data management plan template for their own data (<http://z.umn.edu/datamgmt15>). This open educational content can also be embedded in our campus partner websites for asynchronous and time-of-need learning.

Grant and Study Planning

One of the most common needs for data management support involves assistance with DMPs,⁹ which are required for researchers applying for funding from a variety of federal and private agencies. With increasing requirements for federal data to be managed and shared,¹⁰ this need is likely to increase. Researchers may need broad education on what is required in a DMP, provided through University Libraries workshops or web resources, or specific consultation for questions related to their current grant proposal. Even if a researcher is not required to submit a DMP, she may need consultation on other aspects of study planning, such as IRB applications, file format plans, metadata schemes, or collection methods, all of which may impact the ease of sharing or archiving their data later on.

Both Research Support Services and the Libraries offer individual consultation and DMP review, which allow researchers to take different routes to these

services. We work collaboratively, using the same DMP checklist created by the libraries and sharing information when a unique grant or requirement is encountered. DMP consultations can not only help researchers write a strong DMP tailored to their project, but also connect them to the university and college resources needed to execute their plan. This is where a well-connected data management village can be very beneficial. For example, a project collecting highly sensitive data may require custom storage from IT; projects using university survey or statistical services will need tools for secure data transfer to these groups; and projects planning to deposit data in the institutional repository need to make sure such a plan is feasible. In addition to DMP consultation, the Libraries also consult on metadata schemes and file formats, and Research Support Services consult on collection methods and IRB submissions, encouraging researchers to not thwart opportunities for sharing or preserving data with overly restrictive language in their IRB documents.

Storage and Backup

Securely storing and backing up research data are critical steps in ensuring the longevity of the data.¹¹ While many universities offer multiple storage options, researchers often store and backup data using external hard-drives or other external media,¹² which may not be secure and are vulnerable to theft and failure.¹³ Therefore, data managers need to be well connected to and aware of IT and Data Security offices to provide researchers with guidance as they plan storage and backup strategies. Despite not offering this as a direct service, both Research Support Services and the Libraries consult with researchers on storage and backup options that are provided centrally.

Although much of this service involves referral to IT, many questions about tools or security may actually have deeper issues of workflow at their core. For example, if a researcher is having trouble identifying a way to share a sensitive, personally identifiable dataset with colleagues, the question may not necessarily be best addressed by finding the right tool (which may or may not exist), but rather by thinking through the workflow and where de-identification occurs. It may be possible to not collect identifiers with the data in the first place or to de-identify the data and not share the linking information. This may lead to a less expensive and less risky solution to the problem, benefiting both the researchers and the university.

Collection and Analysis

Although the U of M provides some centralized tools for data collection, and many colleges provide additional services, most researchers are not aware of the

options available to them.¹⁴ Adding to the complexity, the U of M has central tools for survey design (e.g., Qualtrics), central offices for institutional or administrative surveys (e.g., Office of Measurement Services), and department or college offices for discipline-specific survey design (e.g., Social and Behavioral Sciences Laboratory, Minnesota Center for Survey Research). Researchers and data managers alike may not be aware of all, or indeed any, of these services, making it challenging to incorporate all relevant offices in planning discussions around DMPs or human subjects protections. However, this is an important step, as data collection practices may inadvertently violate promises made, or might render data documentation much more difficult than needed.

In the last few years, we have brought many of these data collection services together, and our data management village has allowed us to clarify needs, expectations, and best practices. By helping researchers identify specific collection and analysis needs during the earliest planning discussions, and connecting them to the relevant service providers before DMPs and IRB protocols are submitted, we can often avoid later challenges from overly-restrictive protocols or unrealistic plans for data management.

Not all members of the village are directly involved in the various data collection and analysis processes. However, when service providers know how their services may affect or be affected by preceding or following stages, they are able to prevent unnecessary problems for the researcher. For example, while University Libraries staff are unlikely to be directly involved with the collection and analysis details of a project, their knowledge of how data should best be preserved or shared can help shape decisions on file formats used in collection to ensure they will be sustainable over the long-term. Even within collection and analysis, coordination among providers allows prioritization of analysis goals during data collection, and integration of good data management practices from the start. The village approach also means that data can be documented during collection and analysis to meet expectations for later sharing. For example, Research Support Services is working to provide scripts, codebooks, and enhanced variable-level metadata along with data collected from all self-response surveys to meet data-sharing expectations for the Libraries' data repository.

Preparing Data for Publishing and Sharing

Many of our recent user-needs assessments have shown that researchers want additional support in preparing data for sharing.¹⁵ As there are many considerations when preparing data depending on the type, sensitivity, and reasons for sharing, support for this is provided collaboratively by the Libraries and Research Support Services. Data preparation is an undertaking that requires considerable time, effort, and expertise, and a data management village can help reduce the burden on any individual office to accomplish it. A researcher needs

to consider the different options for sharing, such as a repository that provides restricted data sharing, a more open repository with a de-identified version of the data, or both. The Libraries offer consultation and training on these options, as well as templates for documentation and information about negotiating data licensing when sharing.

Research Support Services provides consultation to help de-identify data and to examine possible concerns from direct or indirect identifiers. While software is available to automate checks of identifying numeric codes (Social Security numbers, credit card numbers, ZIP codes, etc.) and other regularly occurring patterns, it will not detect unique combinations of indirect identifiers or other data or documentation that may be linked to produce unique identifiers. This kind of consultation requires discipline-specific knowledge, understanding of the sample and population, and analysis of the dataset to identify unique or small-count cross-sections.¹⁶ A data specialist from Research Support Services and a library staff member might meet with a researcher to ask about his goals for sharing, help identify the best home for the data, and guide him through the needed preparation.

At the University of Minnesota, this has been one of the most successful areas of collaboration between our two groups. We believe this is due to a variety of reasons. First, data sharing is an emerging area that, until recently, many researchers have not had to think about as part of their research process, and therefore one where they are likely to need assistance. Second, this area is within both the Libraries' and college's missions and a clear part of data management service, giving both our groups equivalent motivation. Finally, because data preparation requires disciplinary expertise as well as knowledge of general dissemination avenues, the Libraries and the college can jointly provide best practices for preparing data for sharing.

Data Sharing, Dissemination, and Access

Researchers are faced with increasing requirements to share the underlying data from their research. These include new mandates from federal funding agencies to comply with the Office of Science and Technology Policy (OSTP) guidelines on public access to data,¹⁷ journal requirements to provide access to data,¹⁸ and institutional policies for data management that include appropriate long-term archiving.¹⁹ All of these pressures are combined with the individual's goals as a scholar to create better transparency for her results and allow others to discover, use, and cite her work.

Our data management village helps researchers provide broad access to their data through a digital repository called the Data Repository for the University of Minnesota (DRUM, <http://z.umn.edu/DRUM>). DRUM was developed as a joint collaboration between the Libraries and Research Support Services to meet specif-

ic needs related to dissemination and access to data. In addition, DRUM provides the mechanisms for proper citation of data (e.g., a digital object identifier, or DOI, is generated for every dataset) and additional indexing services to disseminate the data beyond the university.

Because sharing data in an institutional data repository is just one avenue our researchers may take to comply with their requirements and meet their goals, we also provide consultations for individuals to help them find the most appropriate place or method to share. Many offices at the U of M provide options for sharing data less broadly. For example, researchers may use our institutional Google Drive to share data by request with other users and potential research collaborators. By keeping aware of various options and solutions that exist across the university, we can help meet the variety of needs researchers may have.

Data Curation and Preservation

In our village, we have found that partnerships for curating and preserving research data are important for two reasons. First, not all research data should be made open and available through the broad data access mechanisms described above (which the libraries might provide) and therefore may require special storage services to protect data for the long-term (which the college might provide). Second, all data should be curated before archiving regardless of the destination; this is a task that “takes a village,” given the diversity and size of potential datasets.

Defining what curation means for a particular dataset also requires a village. Our criteria for curation were jointly developed by information experts, curators, digital preservation specialists, and data management staff in a 2013 pilot of data curation services, and are published online.²⁰ To preserve the data long-term, it is important to understand whether the dataset is appropriately described and documented to remain useful over time, who is responsible for questions about the data, how long the data should be retained, and whether the data are valuable enough to be preserved indefinitely through potentially costly digital preservation techniques. Before any actions are taken to archive or preserve the data, these questions should be well understood by all parties.

Though still in development, in time this model might allow the curators and data storage providers to work together to create a safe, redundant, long-term digital archive for the data and actively manage it over the course of the data’s life expectancy, using techniques such as access controls and digital preservation guidelines. Once a workflow for curation has been established, the process of curating a dataset will also require input from the researcher, data managers, data collection offices, and others to capture all relevant information.

Reuse

The fundamental principle of data management is the potential for reuse.²¹ Therefore every aspect of the research data lifecycle must be employed with reuse in mind. Reuse of data comes in many forms and for many purposes, such as validating the results in a published paper, mining the data for new results, asking different questions, combining data with other sources to create a new dataset, or simply allowing the data author to revisit and understand his data years later. Given the diverse nature of data reuse, services to aid researchers in data discovery should benefit from the diverse and varied perspectives of the data management village. For example, updating and collaborating with partners on data indexes and guides offered by the library can help researchers find and make better use of existing data.

Understanding the benefits of reuse might also help researchers create better-described data. This includes the ability for data custodians to track the use and the impact of the data.²² Impact can be tracked through the number of citations to the dataset, often most easily done when the dataset is granted a persistent URL, such as a DOI. Data citation formats are increasingly gaining acceptances in professional societies, such as the American Chemical Society journals,²³ or through guidance of citation standards, like the APA citation style for data.²⁴ Collaborative data villages can use subscription-based services, such as DataCite.org, to mint DOIs for datasets from their institution. This service should be backed by trusted storage and preservation protocols to prevent any DOIs from breaking or degrading over time if the data were to move from location to location. Our library uses these services for DRUM; however, we have not fully utilized the citation tracking features of the service to demonstrate impact.

Another mechanism for tracking the impact of reuse might be through monitoring requests to the data, either through mediated access or digital download counts for the dataset, or through altmetrics. As web statistics for the number of times a dataset is downloaded are problematic due to bots and malicious gaming of the system,²⁵ we might implement other ways to assess quality. Alternatives include follow-up surveys to data requestors or implementation of online shopping tools, such as rating systems or customer reviews, in a data repository. These are ideas that our data village should explore and implement with the combined resources of experts from a variety of campus units.

Conclusion

Overall, supporting researcher needs in data management has been a major focus at the U of M. Many campus players have come together to advance the goals of promoting and supporting good practices; specifically, CLA and the University Libraries have established more formal collaborations. Although environments

vary across campuses, we emphasize the importance of reaching out across organizational and college boundaries and believe this is key for supporting diverse data management needs (see Table 4.1 for takeaways and lessons learned). While the collaborations described here might be considered among the more developed partnerships, there is still much work to be done. One of the main challenges that we face is scale: there are many moving parts at a large, distributed university such as the U of M. Therefore, learning about all the services, people, offices, and initiatives on campus, and attempting to connect and fill gaps (rather than replicate work) is a large, ongoing task for the service providers.

Table 4.1. Takeaways and Lessons Learned from Our Experiences

Suggestions for starting a “Data Management Village” on your campus

- Connect with other people on campus interested in data management through groups dedicated to discussing these topics (such as informal communities of practice). Start a group like this or join existing groups on campus.
- Research community-based groups at your institution. Are there ways to connect to existing groups already focused on issues relevant to data management, such as IT or security?
- Think about collaboration from the start. Write collaboration into new positions and have interviewees meet with diverse candidates across the university. If possible, have interdisciplinary search committees. One of the best ways to be better connected is to have never experienced disconnection.
- Consider bringing in cross-campus experts for workshops and courses. For example, involve IT or a Data Security office in presentations on data storage and backup. You will make connections with their office and everyone will learn about the available options.

Researchers have an even greater challenge: to be aware of and easily navigate these distributed resources. This is where the strength of the village can be felt. With enough awareness of services both within the village and among researchers, we hope to keep researchers at the center and provide seamless support for data management around their workflows and across the research lifecycle. Our work so far has reaped rewards by elucidating research support options and by providing a way to conceptualize and advance services as part of a coordinated approach to university support for research data management. As a data management village, service providers who are otherwise disconnected come together to provide researchers with a broader range of services than each could provide alone.

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