Informatics and Knowledge Management for Faculty Research Data

Sarah M. Pritchard, UCSB Libraries

Smiti Anand, UCSB Libraries

Larry Carver, UCSB Libraries
Overview

The complexities of systems needed to manage research data—and the diversity of ways that faculty and researchers interact with data and systems—have led to a proliferation of techniques and approaches loosely termed “informatics.” This term is taken to include:

- tools to process and make sense of large stores of data;
- computational and semantic systems to store and process digital data objects;
- applications that integrate disparate forms of data (numeric, textual, graphic, and spatial);
- tools for modeling, trend analysis, mapping, image processing, and the like; and
- workflows in which the systems are embedded.

While the needs of biomedical informatics are the subject of an enormous number of systems and projects, fewer analyses have been done related to other scientific fields and almost none in social sciences and humanities. This does not mean that the need does not exist; in fact, in many disciplines faculty and research groups are independently designing and deploying informatics systems to meet their specific analytical and collaborative requirements. Is this because the systems work is itself central to their research, because the field seeks a customized data store, or because there is no other way to put together the right tools? Some of the questions that surface include:

- Is valuable faculty research time and funding being spent on tangential work?
- Are there commonalities across informatics applications in certain subjects?
- Is there redundancy in the efforts at tool development that could be reduced by improved coordination and support services?
- Are concepts well-known in the digital library field (for example, metadata, rights management, and archiving) relevant to and incorporated into these projects?

This research bulletin describes a recent inquiry into these issues at the University of California, Santa Barbara (UCSB). Faculty were interviewed about what has led them to develop informatics systems in support of their research and the factors at the forefront as they seek to manage large amounts of research data in a decentralized and collaborative environment. The findings are a mix of the expected and the unexpected and have laid the groundwork for new proposals in faculty IT support services.
Highlights of Informatics and Knowledge Management for Faculty Research Data

At UCSB, faculty-driven, data-intensive informatics projects have proliferated in an environment of highly interdisciplinary science and cutting-edge technology. There is no consolidated academic computing service or courseware for the campus, however, and most departments and research groups maintain their own servers and advanced infrastructure. A top-level office oversees information technology policy and networking, but communication and technical coordination at other levels is piecemeal. Combined with differing budgets and support, this has resulted in great variation in the handling of data validity, copyright, digital object standards, metadata, persistence and migration, long-term archiving, and access management across campus. Considerable work has gone into creating customized systems, but the most efficient method of deploying these tools is not obvious.

Some converging directions indicate an opportunity to better approach these issues. National projects in cyberinfrastructure, digital libraries, disciplinary informatics, and enterprise computing have elicited strong interest from faculty and staff and are stimulating support for new coordinative mechanisms. The University of California Digital Library is addressing scholarly communication, digital preservation, database management, access interfaces, and more. The UCSB Libraries have developed a robust digital library infrastructure with particular expertise in the management of heterogeneous objects related to geospatial data and imagery. While UCSB Libraries participate actively in many campus technology groups and projects, most of the faculty informatics work seemed unconnected to these trends. What were the reasons for this, what exactly constituted these informatics systems, and could such systems benefit from the sharing of expertise or tools either with each other or with campus-wide library and IT offices?

With funding from the Andrew W. Mellon Foundation, the UCSB Libraries undertook an investigation into the characteristics of faculty-developed data-intensive research systems on campus. The specific objectives of the study were to

- identify components and needs in informatics and the management of research data;
- assess the degree of commonality in informatics tools and functionality, if any;
- create stronger linkages among relevant faculty research projects;
- determine whether more support is needed for data archiving, metadata, interfaces, and intellectual property management;
- inform the design of facilities and services on campus; and
- develop a planning agenda for informatics in a distributed environment.
The study gathered information from faculty, staff researchers, and technical staff in UCSB departments through surveys, informal roundtables, and structured interviews. The target was technologically innovative faculty members who had data-intensive research systems and were known for their interdisciplinary collaborative research. While the primary focus of the study was the sciences, a small group of technology-intensive faculty from the humanities and social sciences was included. The size of the total faculty at UCSB is about 960, with 518 in sciences. After sampling and querying, in-depth interviews were conducted with 37 faculty, 30 librarians, 15 departmental systems staff, 10 administrative leaders, and 8 other specialists.

Our research did not cover formal electronic publishing, courseware systems, or informatics research theory within the computer science department, nor did we try to develop a detailed set of systems “how-tos” for other faculty.

**Data Organization**

Faculty tend to use existing organization systems that are familiar and easy to use. Almost all faculty, staff researchers, graduate students, and staff in our study used directory structures to organize crucial information. Some used directory structures as their primary means of organization of information; others used databases, spreadsheets, and the Web. Faculty only stopped using directory structures when they had significant incentive for doing so (for example, if their research would be negatively affected).

Faculty moved from paper to directory structures when they considered the longevity of their research data. Databases and spreadsheets make it easier to capture large amounts of information and find patterns; the Web makes it even easier to obtain and disseminate information to and from multiple sites. These systems, however, are complementary, not supplementary. Each method has its advantages and disadvantages, but while the “new” system alleviated problems with the “old” one, it did not encompass its advantages. As the need for data organization increases, so does the complexity and time investment required for data management. Faculty members have little incentive to take time away from their research to store data, as long as their system works “well enough.”

Faculty consistently noted the following problems regarding data management:

- It is difficult to find information after a graduate student leaves and after a grant ends.
- It is critical to be able to find information after publishing it and to compare data with colleagues who are doing similar work.
- It is important to ensure that data and code are “frozen” after publication, in some cases to ensure accurate comparisons later.
- There is often no time or money for organizational systems.
Data Storage

Historically, storage has been regarded as a costly and critical commodity, especially within data-intensive research endeavors. How has the increased storage capacity available per dollar affected research data management? Faculty, graduate students, and system administrators define and approach data storage very differently. A system administrator focuses on day-to-day access; graduate students are concerned with storage only as long they attended the school; the principal investigator of a research grant wants data to be maintained for a year and a half to five years, and longer in fields where historical analysis is important; and the institution itself may have an interest in storing potentially all generated research data.

Many faculty members are unconcerned about storage issues, believing that the combination of their laptops, home and office desktops, and network services in their departments is adequate. System and network administrators, however, have a more nuanced view of the situation. Most departments do not currently set limits on storage, so people tend to use what they are given and fail to delete unnecessary or obsolete information. As a result, significant upgrades are required every eight months to a year. System administrators find little support in their departments for limits on storage and little understanding of the costs in labor, back-up tapes, and equipment. Most worrisome, some faculty believe it is “good enough” to save data on their computers and disk drives and do not back up any of their data.

While most faculty believe that storage levels and support are adequate, in departments where there is a pricing structure imposed on the researchers, the tendency is to minimize the amount of storage or backup used. When students and faculty do not have extensive back-up services available to them, they choose only to use removable media. This may be a larger problem than this study shows, in part because we targeted faculty who are already technologically sophisticated.

Several approaches to storage services were mentioned by interviewees as being beneficial:

- Creating an archive or a mirror, where in-progress and completed materials could be stored, backed up, and retrieved.
- Saving in-progress materials while limiting the portion viewable to others.
- Allowing an anywhere, anytime approach to data retrieval through using the Web as an interface for storage.

Long-Term Preservation

Long-term preservation issues have gained visibility nationally as data loss and migration difficulties have increased. To what extent do faculty members preserve their research data over the long term, and do their strategies vary by discipline? The research suggests that the perceived importance of long-term preservation varies depending on the material gathered. For researchers who operate on long-term horizons—for example, those that study a particular site within archaeology or climate
change—nearly all sound research data is continuously valuable, and data preservation is critical. For those whose data has a usable time frame of one to five years, extensive preservation is not viewed as important as short-term storage. Researchers in fields where portals or data centers exist recognize the importance of long-term preservation and prefer to use that method over others.

Concrete experiences bring home the importance of long-term preservation, for example, a publisher’s changing technology that results in a loss of interactivity in a dynamic digital work, or the inability to obtain one’s own published data. Some faculty and researchers rely heavily on removable media without realizing that as the media become obsolete, data may no longer be recoverable. Two-thirds of those we spoke to felt there was a definite need for their research to be preserved over the long term, while one-third were not able to speculate about the potential impact in the absence of specific archiving architectures.

Faculty members have many strategies to ensure “good enough,” long-term preservation. Almost a quarter of the respondents contributed to a disciplinary portal, supercomputer center, or national agency data center. These were in research areas with a determined national importance. Other researchers attempted to fill the gap by helping to maintain a portal on campus. Faculty who lacked a preservation strategy did not typically have extensive raw data. Often they had software or manuscripts that formed the basis of their valuable research and made objects easier to save, find, and manipulate. Figure 1 shows the long-term preservation needs faculty reported.

Figure 1. Faculty’s Perceived Need for Long-Term Preservation

Tools and Techniques

Development and dissemination of tools for information extraction, analysis, and display are an important part of active research in many disciplines. Tools include software and middleware such as search engines, authoring and data-entry templates, data-analysis and display software, Web/navigational interfaces, and other modules that customize the ways that researchers enter, code, retrieve and interpret data. Tool development occurs within “silos” on campus and seems to be an area ripe for collaboration efforts, but we were surprised by the some of the perspectives articulated.
Many faculty members and researchers view tools and software as tangential to the research, task-specific, and not terribly relevant to others outside a given field. Lack of tools is not regarded as a major problem, and most faculty use standard tools, applications, and software. Some faculty members have problems with search and discovery of data, but they view this not as a problem that requires specialized software but as an issue of data management. Software and tools created by a research group often are publicized through the group Web site, conference papers, and journals. This is viewed as the ideal way to get the tool out to the “right” users, who by definition are interested enough to find it. The bottom line is that most faculty have little incentive to advance tool collaboration because the returns do not warrant the time invested away from research.

While our results indicate that tool sharing at the campus level is not viewed as a necessary step, there may be some change in that area. Tools are currently being developed on campus that automate some aspects of fieldwork by using templates, wireless technology, and automatic metadata capture. These may be popular among a large number of faculty members across the campus in a variety of fields in the near future.

Some faculty’s research, however, requires software modification or development, and research groups with an explicit focus on building a shared data facility have extensive software development. Almost half of those we spoke with disseminated and developed some software and tools as a key portion of their research. Faculty who produced software came from social sciences, natural sciences, engineering, humanities, and the fine arts. No longer is tool creation just a research goal of the hard sciences.

While in general access to tools is not a critical need, many faculty did not have the skills or incentive to use what is available. Some found it difficult to identify software that could be useful for their applications, typically resorting to Web search engines to find relevant material. Some possible services mentioned in this regard include a clearinghouse on tools and expertise, more support staff, and templates for common applications.

### Metadata and Terminologies

How much do faculty know about emerging standards and languages in various metadata formats? Is usage of these standards predicated on knowledge of their existence? Faculty perspectives on this issue were remarkably similar regardless of discipline, type of research data, or length of experience with metadata. Metadata use is perceived as time-consuming. It is used in those projects where it is necessary or critical for research; otherwise, it is not, regardless of whether the researcher has experience with it. It is not that a faculty member cannot technically use a particular kind of metadata—it is that there is no incentive for doing so.

Terminology differences among research groups, even within the same discipline, can be significant. Seemingly small terminology or structural differences among research fields or disciplines are often at the root of perceived comfort with one metadata standard versus another. Many faculty chose an existing, de facto standard for metadata to facilitate communication with other colleagues. Faculty members who are required to
use a particular portal or data center to obtain funding use the metadata format and terminologies mandated by that data center, even on their own site. Choosing the metadata standard of the discipline allowed those new to the standard to obtain informal and formal metadata support. Even when a standard did not have elements an individual researcher needed, less time was required to use a format already honed for a given discipline than to design something new. Figure 2 shows metadata usage.

**Figure 2. Metadata Usage by Faculty and Staff Researchers**

<table>
<thead>
<tr>
<th>Description</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current research on site and portals</td>
<td>38%</td>
</tr>
<tr>
<td>Rarely used</td>
<td>29%</td>
</tr>
<tr>
<td>Consistent use at data centers</td>
<td>21%</td>
</tr>
<tr>
<td>Assisted in development of metadata</td>
<td>6%</td>
</tr>
<tr>
<td>Used in select projects</td>
<td>6%</td>
</tr>
</tbody>
</table>

Our research found that:

- Many researchers use metadata at data centers and portals through templates in areas of study where there is considerable national support and where funding may be contingent on data deposit.
- Others use metadata as part of research Web sites on campus, typically in fields that do not have international or national portals.
- Most faculty were storing data they believed did not require metadata.
- Faculty who participated in shaping a metadata standard for their field were not themselves consistent users of metadata.

Numerous challenges must be overcome if campuses are to make extensive use of repositories and data archives. Few incentives exist for faculty to use metadata, possibly hampering cross-disciplinary collaboration and long-term archiving. And at present, no single metadata standard can support the various needs of all of the researchers on campus. Repositories need to be “metadata agnostic” and make extensive use of crosswalks that map different metadata formats to each other. Metadata capture needs to become more automated, and support is needed to minimize the learning curve. Automated deposit into well-used databases may encourage more use of standardized metadata.
Digital Rights Management

Reforms of copyright are reshaping academic scholarship and the digital exchange of information. Rights management issues have profound significance for preservation, collaboration, and dissemination of scholarly work. While these are sensitive, complex, and important issues, most of the intricacies are beyond the scope of this study. The project focused on the issues associated with the sharing and dissemination of research products and on the general viewpoints of the faculty regarding intellectual property issues. Possible implications of campus data archiving were not explored.

Most faculty seemed aware of copyright issues associated with data ownership, digitization, and referencing of and linking to documents. Portals and data centers on campus typically have legal waiver forms specifying release of the data to other researchers as part of the process to ingest the data. Unlike other categories in this analysis, however, intellectual property practices revealed disciplinary clusters.

- Faculty in the sciences produced open source software. They found that they avoided intellectual property issues and were better able to collaborate.
- Faculty who dealt with manuscripts, texts, images, and artwork, as in the humanities or fine arts, had strong feelings about intellectual property issues, especially about the difficulty in digitization of important literary and social work.
- Faculty in fields with significant funding were often quite comfortable with the data-sharing procedures already in place, but in insufficiently funded fields where collaborations were not common, there were more concerns.

Just over one-third of researchers had never, or only tangentially, experienced an intellectual property issue. These researchers often disseminated their work only through established conferences and journals, and their collaboration did not involve extensive sharing of data. Another third of the researchers felt that digital rights management and intellectual property played a significant role in their research endeavors. In many cases these were faculty who extensively shared material through portals or Web sites. While most faculty had a general understanding of the digital rights associated with their documentation, many were not aware of publisher policies regarding particular journals and articles on their Web sites. Some faculty had difficulty conducting research where digitization of primary and secondary materials was required and where intellectual property rules were unclear.

Data Sharing and System Cooperation

Even on a “collaboration friendly” campus, faculty viewed such relationships through the lens of return on time investment, without which a particular partnership does not happen. Combined with terminology disparities, these challenges make cultural and process differences seemingly insurmountable. For a small number of faculty we spoke to, the field itself discouraged collaboration with other faculty. This was often in fields where data gathering is very labor-intensive. Another quarter of the faculty collaborated on large issues where researchers did not need to share raw data. Fifteen percent of faculty actually shared data; however, typically it was minor amounts of data easily sent
through e-mail or file transfer protocol. Faculty in disciplines where data gathering is somewhat automated and collaboration is positively viewed either deposited in, or helped create, a portal or data center. Figure 3 shows how faculty and researchers share data.

Figure 3. Data Sharing by Faculty and Researchers

<table>
<thead>
<tr>
<th>Category</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contribute to a nongovernmental portal</td>
<td>15%</td>
</tr>
<tr>
<td>Contribute to agency data center or portal</td>
<td>11%</td>
</tr>
<tr>
<td>Collaborate does not include digital data sharing</td>
<td>21%</td>
</tr>
<tr>
<td>Run and maintain portal</td>
<td>8%</td>
</tr>
<tr>
<td>FTP data files to one another</td>
<td>11%</td>
</tr>
<tr>
<td>E-mail attachments as primary means of data sharing</td>
<td>4%</td>
</tr>
<tr>
<td>Disseminate data objects through Web page</td>
<td>18%</td>
</tr>
<tr>
<td>Field and colleagues discourage data sharing</td>
<td>4%</td>
</tr>
<tr>
<td>Contribute to the National Supercomputer Center</td>
<td>4%</td>
</tr>
<tr>
<td>Contribute to agency data center or portal</td>
<td>11%</td>
</tr>
</tbody>
</table>

Some faculty were not aware of pertinent research on campus and incorrectly assumed little commonality. Many faculty found collaborations on tools and metadata too time-intensive, and did not benefit from existing research. Other faculty ran into problems regarding collaborators, especially in fields new to data sharing.

Systemic Characteristics

It is easy to assume that disciplinary culture plays a determining role in informatics arrangements for faculty; however, as much variation exists within one discipline as among different disciplines. Surprisingly, we found that informatics components cluster into groups based on data-collection practices. The method by which faculty collect data affects how they feel about their data and sharing it, as well as what their needs are regarding short-term storage, long-term preservation, metadata, tools, and digital rights management.

- Faculty members who primarily use sensors or automated data collection, and who have software analysis tools, are faced with enormous amounts of data. Their primary labor-intensive problems are managing, organizing, and making sense of these data; they attached less importance to the raw data and individual data points than to the synthesized information. Some examples are genomics and oceanography.

- Faculty who have labor-intensive data preparation but automated production have problems ensuring that the software is generating what was intended. While software itself may be shared, benchmarks and simulations that frame the analyses may be closely guarded.
Faculty in fields where some automated components exist in early fieldwork stages, but who also have labor-intensive fieldwork practices (such as marine biology), tended to have more data than they could handle but were faced with issues of quality assurance, management, and preservation of their materials. These faculty members tend to attach some importance to each point and to the raw data, and took longer to share it than faculty who used automated data collection exclusively.

Faculty in research areas where there are few automated components, or in fields where data are highly guarded, rarely share. These fields tend to involve labor-intensive data preparation, analysis, and production. Faculty members in these fields (for example, historical archaeology) tend not to trust that they will receive proper credit if their data are shared. Since the relevance of this information only grows through time, they tend to attach a great deal of importance to every piece of data, raw or synthesized.

Table 1. Matrix of Informatics Components

<table>
<thead>
<tr>
<th></th>
<th>Automated Data Collection and Analysis</th>
<th>Automated Production/Labor-Intensive Preparation</th>
<th>Automation in Field, Some Components; Labor-Intensive Collection and Analysis</th>
<th>Labor-Intensive Collection, Analysis, and Production; Little or No Automation</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Long-term preservation</strong></td>
<td>Data center</td>
<td>Data objects</td>
<td>Portals</td>
<td>Complex</td>
</tr>
<tr>
<td></td>
<td>On-site archival measures</td>
<td>No raw data</td>
<td>Outdated media</td>
<td>Ancient</td>
</tr>
<tr>
<td></td>
<td>Extensive setup</td>
<td></td>
<td>Historical analysis</td>
<td></td>
</tr>
<tr>
<td><strong>Short-term storage</strong></td>
<td>Back-up common</td>
<td>Back-up common</td>
<td>Back-up common</td>
<td>High space needs</td>
</tr>
<tr>
<td></td>
<td>Viewed as important</td>
<td>User know-how</td>
<td>User know-how</td>
<td>Facility dependent</td>
</tr>
<tr>
<td></td>
<td>Extensive</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Data sharing</strong></td>
<td>Raw data shared</td>
<td>Data/benchmarks shared</td>
<td>Raw data shared</td>
<td>Data closely guarded</td>
</tr>
<tr>
<td></td>
<td>Analysis shared</td>
<td>rarely</td>
<td>Analysis not shared</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Large research groups</td>
<td>Software shared</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Digital rights</strong></td>
<td>Open source</td>
<td>Open source</td>
<td>Public access portal</td>
<td>Minimal sharing</td>
</tr>
<tr>
<td></td>
<td>Agency funded</td>
<td>Some patents</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Metadata</strong></td>
<td>Metadata used</td>
<td>Little metadata used</td>
<td>Metadata used</td>
<td>No metadata used</td>
</tr>
<tr>
<td></td>
<td>Most raw data</td>
<td></td>
<td>Most raw data</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Extensive</td>
<td></td>
<td>Extensive</td>
<td></td>
</tr>
<tr>
<td><strong>Tools</strong></td>
<td>Use tools</td>
<td>Use tools</td>
<td>Use tools</td>
<td>Don’t use or make tools</td>
</tr>
<tr>
<td></td>
<td>Share tools</td>
<td>Make tools</td>
<td>Share tools</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Share tools</td>
<td>Don’t make tools</td>
<td></td>
</tr>
</tbody>
</table>

Faculty tend to look at possible new ventures and changes in terms of what the return of investment of time is for the primary research. This strategy cuts through all the components that are described here. Faculty will not preserve, manage, store, and especially collaborate unless it is found to be beneficial to their research.
What It Means for Higher Education

Several factors are likely to increase demand for informatics support in the next few years. The number of complex data objects is projected to continue to increase. Simulations, three-dimensional representations, increased automation and data capture, and improved data-mining and search techniques have changed the ways faculty undertake research in many fields. Existing support issues on campus are likely to increase due to new academic programs and technologically advanced buildings. Research centers will be expected to persistently maintain digital research objects and store, manage, and share them with collaborators around the globe. Even as digital data increase exponentially, support personnel numbers are likely to remain constant, yet major funding agencies have begun to require that institutions demonstrate proper long-term preservation of research data before disbursing funds to them. Informatics services will become critical to the success of research. Future solutions must respond to faculty needs for data preservation, management, and reuse and must consider infrastructure, technical, and service aspects.

Infrastructure requirements include:

- Preserving valuable research
- Enabling greater collaboration, cross-discipline data search and discovery, and easy-to-use rights management
- Providing clearinghouse and consultation services

Technical considerations include:

- Flexibility to customize control, interfaces, and security options
- Secure access worldwide
- Metadata-agnostic design
- Interoperability with scholarly communication, publication, archiving, and rights management systems

Service components include:

- A technology clearinghouse to assist faculty, staff, and librarians in finding information on tools and services, with an interactive Web site
- Services in database architecture and metadata support
- Technology consultation for preparing proposal and grant-system configurations and estimating expenditures
- Rights management policy support for faculty, staff, and administration
- Advanced services on migration, emulation, and long-term digital preservation
- Ongoing technical support to refine services and infrastructure
Implications for Data Systems and Repositories

This research project was designed not to propose specific solutions but rather to develop an understanding of the roots of systems development and, by extension, faculty needs and opportunities for services. It was apparent that many faculty members anticipate the benefit that, among other services, institutional repositories could bring. Their specific difficulties with data and concerns for research integrity, however, lead to a series of recommendations for those in the process of developing such repositories. Eliciting faculty and graduate student support to deposit data before students leave the university may prove essential to attain systematic preservation of critical data.

There is a need to overcome the perception that data backup is equivalent to long-term preservation. Faculty who already contribute to data portals or national centers within their own discipline may not deposit locally unless it also facilitates uploading to their external portals. Conversely, faculty who lack such data centers yet are doing data-intensive work may be especially open to depositing in campus-based persistent archives. Data archives that facilitate collaboration with experts around the globe in a timely and efficient manner would likely increase deposits, while archives that limit the ability to share data across institutions may be a strong disincentive in some fields. Faculty whose data-gathering techniques are extremely labor-intensive may be more interested in data archives retrievable only to preselected collaborators. Campus policies developed with faculty, staff researcher, and graduate student input regarding appropriate citation, security, support, and collaboration procedures are essential to ensure fruitful use of a data archive.

Key Questions to Ask

- What are faculty preferences and priorities for advanced information technology services, and what are disciplinary and departmental differences?
- Can faculty save time by leveraging informatics tools developed within other disciplines?
- What are the kinds of faculty research data that should be a campus priority for preservation, and how much data is really at risk?
- Do we have adequate tools to deal with the proliferation of metadata schemes in building decentralized, heterogeneous data systems?
- What are the incentives for faculty participation in a data repository?
- How do centralized versus decentralized models of IT organization on campus help or hinder the development of advanced informatics-support services?
- What is the impact of tenure and promotion structures in encouraging or discouraging work on research data maintenance, maintaining research Web sites, or promoting deposit in a quality-controlled repository?
What roles do funding agencies, national data centers, and disciplinary societies play in issues related to archiving, metadata, and data sharing?

Where to Learn More


About the Authors

Sarah M. Pritchard (pritchard@library.ucsb.edu) is University Librarian, Smiti Anand (smiti@library.ucsb.edu) is formerly Research Analyst, and Larry Carver (carver@library.ucsb.edu) is Director of Library Technologies and Digital Initiatives at UCSB Libraries, University of California, Santa Barbara.

Copyright 2005 EDUCAUSE and Sarah M. Pritchard, Smiti Anand, and Larry Carver. All rights reserved. This ECAR research bulletin is proprietary and intended for use only by subscribers. Reproduction, or distribution of ECAR research bulletins to those not formally affiliated with the subscribing organization, is strictly prohibited unless prior permission is granted by EDUCAUSE and the authors.