Scientific Advances and Information Technology: Meeting Researchers’ Needs in a New Era of Discovery
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Introduction

The University of Washington (UW) has a long and proud tradition as a research leader. The UW is the top public university in annual federal obligations for research in the nation. During the 2008–2009 fiscal year, sponsored research at the UW totaled over $1 billion, and grant and contract awards funded nearly 7,400 full-time-equivalent positions. The UW recognizes, though, that past performance cannot guarantee future success. In an increasingly competitive research climate, institutions must make sound strategic decisions in order for research efforts to continue to thrive. A current and reliable understanding of how researchers do their work is essential for making informed decisions about supporting their needs for information technology (IT) and technical support. Between 2007 and 2009, the UW embarked on two large-scale investigative efforts to better understand the IT needs of its researchers. The focus on IT needs stems from the recognition that technology influences all aspects of the research process—from collecting, storing, analyzing, and sharing data to communicating and collaborating with colleagues. Across disciplines, the advancement of knowledge is becoming increasingly dependent on technology.

The first project, Conversations with University of Washington Research Leaders, was a joint effort of UW Information Technology (UW’s central IT unit) and the eScience Institute (a new center focusing on research technology needs). The goals of the project were to understand how UW researchers currently use technology and anticipate using technology in the future to support their research activities, and to identify the resources and services they need to maintain and build upon their record of success. Over the course of this project, approximately 50 IT professionals from UW Information Technology and other units met with more than 100 leading researchers to learn firsthand about current and anticipated research projects and the pivotal role that technology plays in supporting these efforts.

The second project involved the inclusion of questions on research management and collaboration in the 2008 Faculty Survey on Learning and Scholarly Technologies. Every three years, Learning & Scholarly Technologies (a unit within UW Information Technology) surveys faculty and students about their use of technologies for teaching and learning. The survey was expanded for the first time in 2008 to gather data about faculty members’ research needs due to the parallel Conversations effort, as well as the keen interest of UW administration and faculty governance councils and the accumulated...
anecdotal evidence that faculty technology needs across teaching, learning, and research were broadly similar.

Findings from both projects were used to identify resources and services that UW Information Technology, the eScience Institute, and other UW units can offer to support researchers. In this report we describe key findings and recommendations from both projects as well as the actions the UW has taken in response to these findings to expand and enhance its support of researchers. This report builds from our March 2009 ECAR research bulletin, “Information Technologies for eScience: A Preliminary Report from the University of Washington.” The projects also pointed toward a reconfigured role for IT in higher education, particularly with regard to central IT units, to ensure their relevancy and efficacy in supporting faculty as researchers and as teachers. While the issues and solutions that we describe are specific to the UW, we anticipate that researchers at other institutions are likely to have similar needs and that their central IT units will want to respond accordingly. Therefore, the types of needs assessment we employed and the discussion we provide in this report will be of use to other institutions that wish to better understand and meet their researchers’ IT needs and priorities.

Conversations with UW Research Leaders

The Conversations project included two phases: a pilot study and a formal needs assessment. In this section we describe the methods we used to conduct this research and discuss our key findings.

Methods

The project began with a pilot study, from spring 2007 to spring 2008, in which senior IT professionals at the UW began to identify the IT needs of researchers and build relationships within the research community. In individual interviews, we asked researchers general questions about their current projects, the technologies they used in their work, and likely future directions of research in their field. From late spring 2008 to winter 2009, we conducted a formal assessment of researchers’ IT needs. These interviews involved a specific set of questions derived from common themes we identified in the pilot data. Questions focused on researchers’ current research, future research, current technology use, and future technology needs.

In both phases of this project, two IT professionals met for up to one hour with each researcher. Some researchers chose to have additional members of their research team present during the interviews. Data from the pilot included both audio recordings and interviewers’ field notes. Throughout the formal assessment, interviewers also summarized key themes from each interview in an online database. The fact that IT professionals performed the interviews is important. Going out to listen to researchers talk about their work offered these professionals a far richer understanding of the role IT plays in research than they could gain from simply looking at data or reading a report. Similarly, this kind of outreach proves helpful in establishing working relationships between central IT and the research community.

Participants

During the pilot study and the formal needs assessment, we contacted a total of 290 of the UW’s top researchers at various stages in their careers and working in a wide variety of disciplines. We selected researchers on the basis of the number and monetary amount of grants received relative to others in similar disciplines, as well as on prestigious recognition by career status (e.g., Sloan Research Fellowships, Packard Fellowships, and NSF CAREER Awards for junior faculty; National Academies membership for senior faculty).
We also contacted researchers who were recommended by their peers.

- Spring 2007 to spring 2008: We interviewed 37 researchers during the pilot study. In addition, one researcher e-mailed responses to the project team, for a total of 38 participants.
- Summer 2008 and winter 2009: We interviewed 87 researchers during our formal needs assessment. In addition, two researchers e-mailed responses to the project team, for a total of 89 participants.
- Total response: Of the 290 researchers originally contacted, 127 researchers participated in the Conversations project. Twenty-six researchers on our contact list retired or left the UW during the course of the project. Our response rate was 48%.

It is important that the Conversations project interviewed a balanced cross section of research leaders, rather than only individuals who identified themselves as “computational scientists.” Our belief is that IT is becoming ever more central to the research enterprise—that the “computational scientist” label captures a decreasing proportion of those whose research competitiveness depends upon advanced IT capabilities.

Analysis and Reporting

A four-member analysis team consisting of researchers and user-experience experts from UW Information Technology conducted a constant comparison analysis of needs assessment data (interview notes and summaries) to identify unique areas where researchers expressed IT needs. We developed a thorough and distinct list of codes for these needs. Examples of the codes used in our analysis include data collection; data visualization, modeling, or simulation; public access to data; labs and equipment; and videoconferencing. After developing a list of codes, we reviewed and coded all interviews. We also noted whether these needs were currently unmet or whether researchers had found an adequate solution for the problem they described. To identify the highest-priority needs, we counted the number of instances of unmet needs in each category. To complement this tally of IT needs, we also incorporated detailed accounts from the interviews into narrative descriptions of the trends we observed. Given the diversity of research projects conducted at the UW, a clear consensus on technology-related priorities and needs did not emerge among researchers. The findings in this report represent areas of convergence where significant numbers of researchers across disciplines mentioned similar needs or where a subset of researchers voiced nearly identical needs.

Findings

The Conversations project increased our understanding of the general climate for research and IT at the UW. We also discovered six distinct areas in which researchers had important IT needs.

General Research Climate

In general, UW’s researchers are pursuing their research in an increasingly competitive funding environment. Several of the researchers we interviewed mentioned the low percentage of grant applications funded annually by the National Institutes of Health (NIH) and other agencies. Although NIH was commonly cited, these observations transcend disciplinary boundaries. While many researchers expressed confidence in their ability to maintain funding levels in this environment, some acknowledged that doing so would require them to spend significantly more time applying for funds. Other researchers reported that they had sought or were considering seeking additional sources of funding (e.g., private donors, corporations, or government agencies) or a new scale of funding (e.g., funds to establish a program or center, rather than funds for individual projects). One researcher in medicinal
chemistry described how he “bootstrapped” funding from multiple sources to conduct a small-scale genome study. However, he did not feel that this financial approach was sustainable over time; ideally, he would need a program or center grant from NIH to fund this type of endeavor adequately.

Another trend among researchers is an increasing focus on interdisciplinary and interinstitutional projects. This trend is driven both by the complexity of research questions being asked and by granting agencies’ preference for funding translational and collaborative projects. A substantial majority of researchers indicated that they were reaching beyond traditional disciplinary boundaries to conduct their research. For many, these interdisciplinary partnerships were new and represented relationships they would have been unlikely to form in the past. For instance, a researcher in microbiology, whose past work on plant diseases and genetic modification had been completely lab-based, is now investigating what happens to these plants in a natural environment. Understanding the complexities of soil composition, however, required collaboration with specialists in soil science; he has found partners in the UW College of Forest Resources. Nearly all researchers we interviewed indicated that they were collaborating extensively with researchers at other national universities, and over one-third specifically mentioned international partners. Additionally, many of these researchers are working closely with local and federal government agencies and industry partners.

While at first glance the above trends may appear unrelated to technology or technology support, they provide a valuable context in which to situate researchers’ IT needs. For instance, any additional time researchers spend pursuing funding leaves less time for them to focus on IT issues or to conduct their research. In addition, researchers’ interinstitutional partnerships directly influence their needs regarding data security and access, communication, and collaboration.

**General IT Climate**

The UW was an early leader in developing and growing advanced networking on campus, in the Seattle metropolitan area, across the state and region with projects like the Washington K–20 Network and Pacific Northwest Gigapop, and nationally and internationally through efforts as diverse as Internet2, National LambdaRail, CENIC (Corporation for Education Network Initiatives in California), and Pacific Wave. From gathering data via remote sensors on the ocean floor, to downloading terabytes of data from NASA, to archiving and disseminating materials related to the Rwandan genocide, UW researchers rely upon high-performance networks to carry out their work. A researcher in oceanography observed that many in the UW research community simply assume the connectivity, computational power, and public outreach infrastructure that the UW has built will consistently be available. Without a doubt, the UW’s leadership in networking infrastructure favorably positions UW researchers as they seek grants and other sources of funding.

The term “cloud-sourced” is often applied to externally hosted applications or infrastructure offered by companies such as Google, Microsoft, and Amazon.com and to a host of innovative productivity tools provided by smaller, focused companies. The engineering and system administration expertise these companies possess as well as their ability to innovate often far outpaces what any single university can do. Several UW researchers explicitly mentioned that they already use, or would like to use, cloud-sourced technologies from these third-party providers. What is clear is that almost all researchers rely upon someone outside their immediate work group, department, or unit to provide infrastructure, IT support, collaborative applications,
and a host of other resources. In addition to the offerings of the third-party vendors mentioned above, use of infrastructure and applications provided by other universities, partners in industry, institutes, and even the government is pervasive.

**IT Needs**

The IT needs that follow are listed in order according to the frequency with which researchers reported needs in each area: (1) IT and data management expertise, (2) data management infrastructure, (3) computing power, (4) communication and collaboration tools, (5) data analysis and collection assistance, and (6) additional resources.

1. **IT and Data Management Expertise**

Interestingly, technology alone does not surface as researchers’ primary need; rather, researchers need people to provide IT support and expertise. Over one-third of researchers reported a general need for local technology support, and approximately one-quarter mentioned a specific need for expert assistance in designing and maintaining databases. Taken together, IT support and/or expertise needs were expressed by nearly half of researchers. Many researchers also desired expert advice about current and future technologies.

- Local technology support: The majority of researchers relied on departmental IT staff to support their research teams. Many of these researchers expressed a need for increased local technology support, whether at a departmental level or shared between research teams in close proximity. A few commented on needing support for Mac computers, since their departmental support focused on PCs. Many researchers had a graduate research assistant take on technology support, sometimes in place of their research work. One researcher shared a story that aptly illustrates the challenges of this support model: when his graduate research assistant could not find a driver for a new printer, it was more cost-effective to exchange the printer for a different model than to keep looking online for the solution.

- Data management expertise: Researchers asked for expert assistance in handling data management problems ranging from configuring databases, to consolidating and restructuring large data sets, to ensuring secure storage and timely destruction of sensitive data. A few research teams lacked any expertise in this area and desired assistance with the initial task of envisioning a better data management system. Some problems were basic: one researcher sought to migrate data from individual researchers’ computers (where data can be difficult to access if someone leaves the team) to a shared storage solution of some type; another was interested in upgrading from a system of storing data in three-ring binders to a digital solution. Some researchers outsourced data management to for-profit companies such as DatStat because they could not find a UW service that met their needs.

- Information: A few researchers desired more information about the technologies and technological expertise currently offered by the UW. Researchers wanted centralized access to this type of information. One researcher offered a vision of a service that would inform her of new technologies related to her work as they became available.

A common refrain among researchers was that they did not want to spend much time finding data management solutions or solving technology support problems—they would rather spend their time doing research. Many of these researchers wanted to consult with a database administrator, system administrator, or technology support person on an
as-needed basis, rather than having to pay for a permanent staff member with these skills. Several envisioned a communal solution to these problems, whereby staff with appropriate expertise would be shared among research teams or departments, or whereby the UW offered a consulting service to meet these needs.

2. Data Management Infrastructure

In many disciplines, researchers are collecting a vastly larger and rapidly increasing amount of data today than was possible to gather a decade prior, or, in some sciences, even a month ago. Researchers in fisheries, for example, have been tracking Alaska’s salmon population since 1946. However, the amount and type of data they are able to collect today is significantly more complex, detailed, and voluminous than data collected in the early decades of the project. Similarly, a psychiatry and behavioral sciences researcher reported that collecting data using eye-tracking software, rather than through detailed observational notes, resulted in an exponential increase in the amount of data collected in that field. Even more extreme, researchers in genome sciences reported that where they once ran 96 samples per DNA-sequencing machine, they can now run 10 to 20 million per machine. Researchers in genome sciences anticipate this number will increase by a power of two every few months over the next few years.

Given the large data sets described above, it is not surprising that well over a third of researchers faced challenges involving various aspects of data management and the attendant infrastructure. The most common data infrastructure needs included access to sufficient storage, reliable backup systems, and adequate security.

- Access to storage infrastructure: Many researchers reported that they need assistance with data storage, whether storing large amounts of data for current research projects or archiving data from past projects for future access. Several researchers mentioned needing terabytes of storage space, while one researcher in electrical engineering asked for petabytes. Researchers’ storage challenges involved access not only to sufficient storage capacity but also to adequate physical space to house servers for data storage. On a related note, researchers commented on insufficient power and air-conditioning in their facilities as barriers to housing servers.

- Data backup: Among researchers, the systems used for backing up data were inconsistent. Several reported concerns about infrequent and inefficient backup practices, while a few reported prior problems with lost data. As IT professionals, some interviewers were concerned that several of the researchers they met with were using inadequate backup practices, such as storing data for a project on a laptop or flash drive. These practices were not always recognized as problematic by the researchers involved.

- Data security: Security, especially in terms of access control, was a priority for many researchers, since data collected in studies are often confidential and access must be limited to the research team. The wide range of local, governmental, corporate, academic, and international partners with which researchers collaborate complicates the issue, since different institutions often rely on unique authentication systems and security protocols. UW researchers need secure options for granting their non-UW partners access to data and other research files.

Several researchers mentioned central data storage or central backup services as potential solutions to meeting their needs in these areas. While many were open to cloud-sourced options, a few mentioned the high cost of data storage provided by for-profit
companies as a reason they would like to see the UW offer a central storage option; these researchers felt that the UW could offer a similar service at lower cost. Several researchers wanted to find customized solutions that responded to their teams’ specific workflows and data management infrastructure concerns.

3. Computing Power

Well over one-quarter of the researchers we interviewed reported that their work involved computationally intensive activities, and nearly all of these researchers stated specific needs related to managing or accessing high-performance computers or computer clusters. While some researchers’ computing needs were met departmentally, others had to contract out for these services with other departments, institutions, or businesses. In addition to computing power, the importance of access to high-bandwidth networks was explicitly mentioned by several researchers.

- **Computing power:** No matter where they fell on the spectrum of overall computing power use, many researchers required increasing levels of computing power for activities such as generating statistics, analyzing data, creating models and simulations, and general “data crunching.” While these researchers expected to have an ever-increasing need for more powerful machines, they cited lack of resources, space, and funding as limitations to acquiring more computing power. Some researchers expressed frustration at not being able to realize the full potential of their work due to these needs. For instance, a researcher in bioengineering stated that his research team could do more with their data if they had more CPU power. A researcher in fisheries explained that his analysis work was limited by how long it takes to run computations: if the computational process exceeds 24 hours, he tends to run those computations less frequently.

- **Managing and housing computing clusters:** Alongside the need for more computing power, researchers described challenges in configuring, managing, and housing computing clusters ranging in size from 10 to 1,000 nodes within their research groups or departments. Most notably, one researcher told interviewers about a donation of 100 cores, which sat in boxes for nine months because his department did not have adequate electrical power to run them. Similarly, a researcher in statistics reported spending a significant amount of time trying to get air-conditioning installed in various closets in his building so that he could house 10- to 12-node computer clusters. He found this process to be inefficient and wasteful.

- **Network access:** Some researchers reported that the need for additional bandwidth is constant and will only grow in importance over time, although fewer than one-fifth of researchers specifically mentioned “high-bandwidth” network access as a requirement for their research. A few researchers cited specific needs related to network access. These researchers said that lack of bandwidth negatively impacts data transmission and analysis, collaboration, and remote access.

Many researchers saw communal resources as the primary solution to their computational needs. Several thought that the UW could leverage its buying power and offer communal computing services or access to cloud-sourced services for less money than it would cost researchers to maintain their own computing clusters or to hire an outside service. These researchers indicated they would rather focus on their research and not worry about purchasing, housing, supporting, and securing servers. Many researchers
already paid other departments, institutions, or businesses to meet computing power needs. Some indicated that their computational needs tend to fluctuate over time, meaning they can often go for long periods without having any need at all. These hiatuses made researchers feel it was impractical for them to administer their own hardware; by the time they would need to use the equipment again, it would be outdated and underpowered. One researcher mentioned that he had looked at cloud-sourced services from Amazon and found that they might be useful if he needed a lot of computational processing done in a very short time. Another researcher, in biostatistics, said he would like the UW to provide fast, secure access to terabytes of storage. He thought the UW could offer a suite of cluster-computing environments designed and configured to provide packages of computing cycles that would meet the needs of the majority of campus research groups.

4. Communication and Collaboration Tools

More than one-quarter of researchers, particularly those with extensive partnerships beyond UW, identified real-time collaboration technologies as critical to their work. In this area, however, there was substantial variance among researchers as to which technologies they used, or would like to use, to meet their distance collaboration needs. In addition, as researchers’ technology use became more sophisticated (for instance, moving from teleconferencing to videoconferencing), their needs for financial or technical support also increased.

- Videoconferencing facilities: Approximately one-fifth of researchers expressed needs for better access to videoconferencing facilities or enhanced features for existing facilities, such as simpler technology and improved document sharing. One researcher who had already used point-to-point videoconferencing with success desired multipoint videoconferencing; another desired high-definition videoconferencing. Several other researchers felt that current videoconferencing technology lacked sufficient reliability, ease of use, adoption levels, and local availability to be worth the effort. Some researchers anticipated using videoconferencing more in the future once these issues were resolved.
- Web-conferencing solutions: Not all researchers with real-time collaboration needs wanted to use videoconferencing facilities to meet those needs; several researchers found web-conferencing solutions to be more effective. Solutions used by researchers ranged from Skype, to web-based videoconferencing, to desktop-sharing technologies (web-based collaboration tools allowing participants to see others’ desks in real time). Some researchers expressed interest in using web-conferencing solutions in the future but needed more information about their options, as well as better access to desktop-sharing technologies. One such researcher reported wanting to perform complex computations in real time, rather than present models that were already created; others wanted to share documents and formulas. For some researchers, the cost of this technology can be prohibitive: a research team in psychiatry and behavioral sciences reported paying $20,000 for a year of access to software that allowed them to simultaneously chat, use a wiki, and share PowerPoint presentations. Other desktop-sharing technologies that a few researchers mentioned were WebEx and GoToMeeting.
- Teleconferencing: For the biostatistics department, advanced teleconferencing is essential, but expensive; researchers in that department reported spending $50,000 to $60,000 a year.
Additionally, despite the high-tech focus of our inquiry, researchers repeatedly discussed basic communication and collaboration technologies. Researchers often found it easiest to use generally available technologies when multiple institutions and organizations collaborate, since sophisticated technological solutions were not always available to all partners.

- **Phone and e-mail**: Most researchers identified telephone and e-mail as “critical” technologies. These technologies were often the primary mode of communication and collaboration; more than half of the researchers indicated that e-mail and phone alone met most of their needs. Researchers use e-mail for communication but also for writing papers; they and their collaborators e-mail drafts back and forth to each other. A few researchers encountered problems e-mailing large attachments, due to e-mail providers’ limitations on file size.

- **Remote desktop access**: Several researchers expressed a need for remote desktop access. A few were already using this technology for access to software with limited licenses, high-powered computers, and the servers and configurations to which they were accustomed.

- **Wikis**: A couple of researchers mentioned successfully using wikis to collaborate with their teams; others had not yet tried wikis but mentioned that they were interested in technologies that would allow them to post, edit, and share notes, or share the analysis and results of a study with their teams. Researchers also mentioned a need for access control.

- **Public access**: Researchers reported sharing lectures, articles, and raw data with the public through websites, blogs, Slashdot, and UWTV. While there were not many needs expressed in this area, a few researchers mentioned that they could use help with blogs or website design and development, and they expressed the desire to acquire more skills with these technologies. One researcher pointed out the universal challenge of regularly maintaining a website and keeping materials up to date.

Some researchers desired ubiquitous, local videoconferencing options and felt that the UW should expand its videoconferencing facilities accordingly. However, the most common request researchers made of the UW regarding communication and collaboration technologies was for more information about what is already available to them at the UW. Many of the researchers who relied exclusively on phone and e-mail to meet their communication and collaboration needs were interested in using other technologies (from wikis to desktop-sharing technologies) but indicated that changing their current practices would require more information about their options and greater access to easy-to-use technologies.

5. **Data Analysis and Collection Assistance**

Just as researchers’ data management and infrastructure needs represent the necessity of integrating human know-how with the hardware to handle research data, so do their needs regarding data analysis and data collection. Nearly one-quarter of researchers expressed a need for either data analysis expertise or for technologies to support data analysis through visualization, modeling, and simulation. A smaller group of researchers expressed similar needs regarding data collection.

- **Analysis**: As the amount of data collected increases, so do researchers’ data analysis needs. Nearly all of the challenges researchers reported regarding analysis stemmed from the need to make sense of vast amounts of data. Here, researchers reported wanting specialized expertise—people with computational skills as well as familiarity with the research being
conducted. One medical researcher reported that bioinformatics skills were a “must” in his field, but finding expertise in this area was a challenge. A researcher in immunology described a problem finding programmers able to write customized analytical software to address frequently changing analysis needs.

- Visualization, modeling, and simulation: Almost one-fifth of researchers used visualization, modeling, or simulation to display and analyze their data. A smaller number of these researchers expressed the desire for additional resources to meet needs specific to their projects. While the use of visualization and modeling does not presently appear widespread among those we interviewed, these needs may grow in the future as the volume and complexity of data collected continue to increase.

- Collection: Overall, researchers were making efforts to streamline their data collection process. Many reported moving to electronic data collection exclusively. Most of the researchers we spoke with either already input and access data via the web or are trying to establish these systems. Obstacles to creating online databases were both technology- and personnel-related; researchers reported difficulty finding people with the appropriate “know-how” to assist them. Researchers also desired greater flexibility and capacity for gathering data in the field. Mobile and remote devices were becoming increasingly important to researchers for this purpose. A few researchers who were currently using mobile devices reported that they wanted to do more with the technology (for instance, conduct simple analyses or collect and store more data).

Just as many researchers wanted to consult with a database administrator or a technology support person on an as-needed basis, many researchers wanted similar access to individuals with data analysis expertise. Several of these researchers envisioned the UW helping them to make connections across departments and research teams so that they could easily locate people with these skills.

6. Additional Resources

In previous sections of this report we articulated researchers’ needs for a variety of communal services and resources, ranging from data storage services to computing clusters. In addition to those needs, several researchers expressed a desire for communal laboratories that would provide access to high-cost equipment. Researchers also reported needs related to educational technologies and centralized information to support research administration. A few researchers noted the value of leveraging the UW’s buying power to obtain discounts on software licenses or other purchases.

- Labs and equipment: Nearly one-fifth of researchers reported needs related to labs and equipment. Several researchers mentioned that as the cost of laboratory equipment increases, so do their difficulties purchasing such equipment on individual grants. Several researchers observed that shared access to equipment and common facilities presented a potential solution to this problem. In approximately one-fifth of the interviews, researchers reported they would like to use or were currently using communal labs and equipment to support their research. Specifically, researchers in several fields would like more access to analytical ultracentrifuges and equipment for single-molecule spectroscopy and whole-genome analysis.

- Educational technology: The link between research and education was strong, and researchers were continuing to look for innovative uses of technology to
support learning among both students and colleagues, within and outside the classroom. One-quarter of researchers expressed needs in this area, particularly with technologies that would allow for visual presentation of, and interaction with, information; technologies could include smart boards, tablet PCs, online simulations and animations to illustrate complex concepts, clicker technology, streaming videos, blogs, wikis, and e-portfolios. For some, access was the issue: one researcher in medicine wanted access to the slides and curricula of other faculty so he could build on them in his courses. Others advocated for student access to core modeling software such as MATLAB, and for broad access to videotaped campus seminars.

- Centralized information: Approximately one-fifth of researchers wanted access to centralized information. The types of information they desired ranged from a central database of research subjects who had given general consent to participate in certain types of research (and thus could potentially be used in other UW medical studies), to a center that would provide grant-writing information and support, to a database of projects that would make it easier to learn about other UW researchers and research projects.

- Group pricing: A few researchers remarked on the importance of software licenses to their work and the significance of obtaining discounted rates on expensive products like ChemDraw. On a similar note, a group of researchers wanted help in negotiating discounts with cell phone vendors.

Although the areas of need described above are disparate, all ask the UW to coordinate resources and information. Since many of these needs extend beyond the IT focus of this project, additional investigation may be necessary.

The 2008 Faculty Survey

The qualitative interview process used in the Conversations project proved incredibly useful for gathering data about how researchers do their work. Just as important as the data were the deeper understanding and relationships the process afforded UW’s central IT professionals. Still, we have found that multiple ways of knowing the IT needs of members of the UW community are essential for setting the right support strategies in place. As a result, we decided to add a research dimension to a hugely successful ongoing quantitative survey that was originally intended to uncover instructional technology needs.

Methods

The 2008 Faculty Survey on Learning and Scholarly Technologies included a new section on research management and collaboration. This section expanded the survey beyond instructional contexts (the original focus of the survey) to the research activities in which most UW faculty are also engaged. Questions in this section asked faculty how they used technology to manage their research and collaborate with colleagues. We specifically focused on these activities because they transcend disciplinary boundaries.

Participants

Our recruitment for the faculty survey included all individuals listed as an instructor of record during summer 2007, autumn 2007, and/or winter 2008, excluding UW graduate and undergraduate students. Since faculty members from Health Sciences are not always listed as instructors of record, we collected names of faculty directly from Health Sciences departments. Our final recruitment sample included 3,499 faculty members. We contacted all faculty members in our sample by e-mail, which included a link to the online survey, sending an initial recruitment e-mail and two reminders. We had invalid e-mail addresses for 119 of the individuals in our
recruitment sample. While the 2008 Faculty Survey had a different target population (all instructional faculty) and recruitment model than the Conversations project, there is likely some degree of overlap in respondents to both studies.

- Total survey response: 547 individuals responded to the survey, for a response rate of 16.2%.
- Research section response: 446 individuals completed the research section of the survey. Faculty respondents who indicated that they had not been involved in a research project in their response to the first question skipped the remaining research questions.

Analysis and Reporting

In addition to reporting basic frequencies for all research questions, we compared the responses of faculty who indicated that they had been involved in collaborative research projects and those that had been involved in solo research. We also reviewed the write-in responses for long-response questions about unmet needs and priorities for the future, summarizing the predominant themes faculty discussed in response to each question.

Findings

The 2008 Faculty Survey included questions about (1) the research contexts, whether solo research or various types of collaboration, in which faculty worked and the types of management and collaboration tasks for which they typically were responsible within those contexts; (2) the technologies faculty currently used to complete these tasks; and (3) additional research technology needs.

1. Research Contexts and Tasks

Survey respondents were asked to select one research context that described their activities managing or participating in a research project from summer 2007 to winter 2008. The contexts described included working alone on research or in various collaborative arrangements. Overall, 17.3% of faculty respondents indicated that they had been engaged in no research during the period specified, while 26.7% selected the “solo project” context. Most faculty (54.9%) selected a collaborative context of some type, such as collaborating with a “UW departmental team,” a “UW interdisciplinary team,” or an “interinstitutional team.”

We next asked faculty to indicate all research management and collaboration tasks that were among their responsibilities in the context they had selected (see Figure 1). By far, the most common tasks selected by faculty involved “managing versions of files,” which was selected by 63.3% of respondents. Other common tasks included “tracking progress toward milestones” (45.6%) and “archiving files” (43.3%). Several of the communication-related tasks were toward the bottom of the list, with only 8.7% of faculty “enabling synchronous online communication” and 13.1% “recording/archiving online communication.”

2. Technology Use for Research

We also asked faculty to indicate any technologies they had used to complete their selected research tasks. Figure 1 describes researchers’ data management and collaboration tasks, and Table 1 illustrates the top-five tasks for collaborators and for solo researchers. Figure 2 describes the technologies researchers used to complete their tasks, and Table 2 illustrates the top-five technologies used by collaborators and by solo researchers. An analysis of the findings indicates that e-mail was the only frequently selected technology: 88.6% of faculty reported using e-mail. The next most commonly used technology was teleconferencing, at 27.5%. Most technologies were selected by relatively low percentages of respondents; 16 of 22 technologies listed had a reported use of below 10.5%. When we break out collaborators from solo
researchers, the patterns change somewhat; as Table 1 indicates, more collaborators than solo researchers reported being responsible for completing a range of research management tasks. With the exception of teleconferencing, however, they primarily used the same technologies as solo researchers to complete these tasks (Table 2).

This pattern of results is consistent with findings from our *Conversations* project, which found that most researchers primarily relied on e-mail and teleconferencing—simple and easy-to-use technologies—to meet their research communication and collaboration needs. Faculty members’ responses to other questions on the survey provide potential explanations for this pattern. In a question about obstacles they encountered to using technology in their teaching, for instance, faculty reported a lack of time to learn technologies, as well as a lack of knowledge about how to apply those technologies to achieve their instructional goals; the same may well be true for their use of technology for research.

### 3. Research Technology Needs

At the end of the research section, we asked respondents to identify how the UW could best support their research collaboration and management activities over the next three years. Not surprisingly, the top needs faculty members expressed were increased technical support, including assistance selecting and applying technologies; greater access to and

![Figure 1. Researchers’ Data Management and Collaboration Tasks](image-url)
information about collaborative technologies; and streamlined administrative processes for grant management and human subjects review. Write-in comments from faculty in this section again emphasized how a lack of time and knowledge impeded technology use. As one faculty member stated, “I think I just need to be aware of what’s out there and find the time to learn how to use them.” Some faculty members directly asked for assistance in identifying useful technologies and learning how to apply them to meet their goals. In discussing collaborative technologies, faculty mentioned the importance of finding technologies that could be used for both instruction and research activities. According to one faculty member, it is important to ensure that collaborative tools are “very easy to pick up and use and are extremely flexible.” These findings also echo data from the teaching section of the survey, suggesting that some technology needs transcend domains of activity. Combined with findings from the Conversations project that suggest a strong

**Figure 2. Technologies Researchers Used to Complete Tasks**

![Bar chart showing the percentage of researchers using various technologies](chart)

**Table 2. Technologies Researchers Used to Complete Tasks (Top 5)**

<table>
<thead>
<tr>
<th>Collaborators</th>
<th>Solo Researchers</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-mail</td>
<td>E-mail</td>
</tr>
<tr>
<td>90.5%</td>
<td>84.4%</td>
</tr>
<tr>
<td>Teleconferencing</td>
<td>Web-based file storage</td>
</tr>
<tr>
<td>34.6%</td>
<td>17.2%</td>
</tr>
<tr>
<td>Web-based file storage</td>
<td>File-sharing software</td>
</tr>
<tr>
<td>45.2%</td>
<td>13.1%</td>
</tr>
<tr>
<td>File-sharing software</td>
<td>Budget-tracking software</td>
</tr>
<tr>
<td>29.5%</td>
<td>9.8%</td>
</tr>
<tr>
<td>Project web page</td>
<td>Desktop synchronization software</td>
</tr>
<tr>
<td>22.9%</td>
<td>9.0%</td>
</tr>
</tbody>
</table>
link between education and research, it seems especially important to consider these areas of faculty work in tandem.

Overall, the survey findings make clear that research is highly collaborative—within a department, between disciplines, and among institutions—and simple data management activities are also the most widespread research tasks. The communication and collaboration technologies with the lowest barrier to entry were most widely used for collaboration, even when other technologies had expanded features that better suited researchers’ needs. At the same time, researchers wanted help in choosing what technologies to use, they needed a bit of support in learning how to use them, and they wanted to use the same ones across their domains of activity.

**Meeting Researchers’ IT Needs**

Together the Conversations project and the 2008 Faculty Survey improved our understanding of how researchers use technology to support their research activities, the infrastructure they rely upon, and their unmet and anticipated future needs. In the final pages of this report we share the primary recommendations that emerged from these two investigative efforts and the steps UW has taken over the last year to address researchers’ needs in these areas. While the steps taken at the UW are particular to the university’s circumstances, the recommendations themselves likely apply to the research context throughout higher education.

**A New Data Management Paradigm**

Findings from both projects point to the need for a new data management paradigm that integrates human know-how with technical infrastructure. Researchers generate more and more data than ever before; simply housing it is not enough. Many researchers need assistance with data management, including data schema design, database design, and parallel computing tasks, as well as with data analysis and data mining. This know-how must be in place together with a range of secure data management infrastructure options. Researchers need access to both short-term and long-term backup options, as well as high-availability data management infrastructure. A key recommendation for meeting these needs over the long term is to pursue cloud-sourced solutions whenever they are suitable.

Pursuing this new data management paradigm has been a major focus of the eScience Institute. The institute has brought on board consultants and research scientists who can work with researchers to meet a variety of data management needs: creating databases and managing data from multiple sources; creating queries to extract and analyze data; developing algorithms for specific problems; advising on the best tools, languages, frameworks, and platforms for specific data problems; and helping leverage cloud computing and other external resources. To help meet the infrastructure needs related to data management, the eScience Institute and UW Information Technology are working together to build “Hyak,” a scalable high-performance computing cluster. The Hyak cluster will provide a safe, accessible storage system to support the data archiving requirements of its users. UW Information Technology will leverage Hyak and modify existing enterprise storage systems to offer a general-purpose storage solution for research data and to meet a variety of other campus needs for basic data storage, backups, and web presentation of multimedia data. Finally, the UW is brokering and negotiating relationships to make the use of cloud-sourced solutions easy and cost-effective, and is working to increase awareness and provide expertise in using these solutions to the advantage of UW researchers. Among these efforts are consulting services to individual researchers and a series of hands-on
workshops to introduce cloud-based solutions to broad groups of researchers.

Episodic IT Expertise

Both the Conversations project and the 2008 Faculty Survey revealed a widespread need for on-demand IT expertise and consulting across several domains. In addition to help with data management, researchers need assistance with security issues as well as with the design and administration of networks, server clusters, and storage systems. Researchers also need increased technical support, including assistance selecting and applying technologies. Finally, end-user support for common technologies and technology tasks is often lacking. One way the UW could meet needs of this type is to provide “rent-an-expert” services.

The availability of episodic IT expertise is central to UW’s new data management paradigm, and UW Information Technology staff members are now more available to consult on a host of technology issues as needed. Just as important, UW Information Technology has worked to add visibility to other units on campus that can provide IT services—for example, highlighting how the Health Sciences Academic Services & Facilities computing unit can provide assistance to researchers in Health Sciences and across campus for computer selection and technology assessment and planning. The UW is also encouraging partnerships with and among colleges, schools, and departments to provide expertise and services collaboratively. Finally, through its global support initiative, UW Information Technology has enhanced its ability to provide a wide variety of technical support for researchers working internationally, with an emphasis on phone service, computer connectivity, and e-mail services.

Advanced Networking Infrastructure

The Conversations project demonstrated researchers’ heavy dependence on the UW’s leadership in networking infrastructure, and it is vital that the UW sustain and advance these resources. The UW research community relies upon this infrastructure to be competitive. Future innovations in advanced connections, LambdaRail infrastructure (a fiber-optic computing network that enables researchers to build application-specific networks with large capacities), and research and development networks will favorably position UW researchers as they seek funding and collaborators. While many researchers’ work is directly dependent on this infrastructure, most assumed that sufficient network power was a given, due to the UW’s strong historic record of support in this area; therefore they did not directly discuss network needs in interviews.

Maintaining and advancing UW’s networking infrastructure during fairly dour economic times has necessitated aggressive streamlining of operations, as well as pursuing new partnerships. As part of campus planning for business continuity, UW Information Technology has made the role of campus networking and telecommunications paramount and has initiated several organizational changes to ensure operational excellence, beginning with implementing Information Technology Infrastructure Library (ITIL) concepts and practices for handling service management and request fulfillment. UW Information Technology has partnered aggressively with the campus research community to attain American Recovery and Reinvestment Act funds through the National Science Foundation (NSF), most prominently on a $126-million award for the Regional Scale Nodes project within the NSF’s Ocean Observatories Initiative, which has a substantial networking component. To improve the cellular network increasingly utilized by researchers, UW Information Technology has forged partnerships with cellular service vendors to enhance campus coverage and to provide discounted rates to campus users.
Computing Cycles for Hire

Researchers require increasing levels of computing power regardless of where they fall on the spectrum of overall computing power use. Findings from the Conversations project indicate that researchers need access to both sustained and dedicated computing infrastructure and episodic, on-demand computing power. Computing power can be made available through hosted services at the UW and/or the computing cloud. Centralized computing clusters can address issues related to space, electrical power, air-conditioning, and technical support with more efficiency, since decisions are made and infrastructure implemented for a few large spaces rather than for multiple small ones. Ultimately, this means that facility planners and IT experts can address these needs without researchers needing to spend their time on infrastructure concerns. In addition, partnerships with cloud services can allow the UW to provide computing power to researchers without the physical constraints of hosting the infrastructure.

When it launches later this year, Hyak will allow UW researchers to deploy personal supercomputers in a UW-operated cloud where individual researchers or research teams can purchase one or more nodes. Hyak is designed for workloads that are a poor fit for cloud or other remote platforms, especially for tasks requiring very high-performance network fabric to transfer data between storage and CPUs. It will start with a capacity for 500 nodes and grow to support roughly 1,500 nodes in response to campus demand.

The UW has also pursued relationships with cloud providers to offer on-demand cycles to researchers in a more accessible manner. One example is the BioFlex project, whereby eScience Institute and UW Information Technology staff have piloted a web application that allows researchers to dynamically create clusters on Amazon’s EC2 and S3 services to process large genomic data sets. This application will be extended to researchers in physics and oceanography in the near future, and then to anyone needing clusters on demand for handling large data sets.

Communication and Collaboration Tools for Any Domain

Both investigative efforts point out that a few basic enhancements to the UW’s communication and collaboration toolset would go a long way toward improving the way researchers work with their students and with colleagues outside the UW community. Though most researchers are happy with the web-based tools available to them, the UW needs to address the very real difficulties in collaborating with people and groups beyond the UW. A natural way to do this is to take advantage of the affinity for web-based tools and to pursue and provide guidance for using cloud-sourced solutions that simplify access. We also recommend embracing standards such as OpenID and federated authentication/authorization solutions that enable wider access to existing UW web-based tools. Greater availability of drop-in video-conferencing facilities and a ubiquitous and supported web-conferencing solution would also benefit researchers.

Through a relentless advocacy of single sign-on technology, pursuit of federated authentication—with tools such as Shibboleth and organizations such as InCommon—and promotion of web-based communication and collaboration that can be used for multiple activities, UW Information Technology has lowered the barrier of entry for using communication and collaboration tools in the research process. With credentials from ProtectNetwork or a new low-assurance UW NetID service, collaborators from beyond UW can now use online tools in conjunction with UW researchers much
more easily. Cloud-sourced collaboration tools from Adobe, Google, and Microsoft are available at low or no cost to faculty, staff, and students for use across activity domains. UW’s Catalyst Web Tools are used for courses, research projects, and data collection and even have recognition through our Human Subjects division for research use. Finally, in addition to offering an inexpensive and easy-to-use web-conferencing suite, UW Information Technology is planning to offer consulting services to support department-level videoconferencing facilities. We expect this kind of partnership, bringing together central expertise and departmental capital expenditures, to become more and more common.

Greater Availability of IT Information

Findings from both investigative efforts emphasize the benefit of bringing together researchers, the staff who support them, and central technology units to share information and identify collaborative opportunities. Indeed, both projects represented important first steps for such collaboration. Too many researchers and their teams are simply unaware of the technology tools, resources, and expertise already offered by the UW. An important initial step toward meeting this need is for online resources that support researchers to be described and accessed in one place.

The simple act of outreach to the research community, seeking to understand the needs of researchers through the Conversations project and the 2008 Faculty Survey, was a great initial step at uncovering the affinities and connections that can build this community. And this outreach continues: staff from the eScience Institute and UW Information Technology continue to work with researchers and their IT teams to learn about their needs, to identify solutions, and to form connections between researchers and projects. A nascent project to build a more flexible online portal will initially focus on the information and research management needs of the research community. Finally, the recently released IT Connect portal (http://www.washington.edu/itconnect/) offers researchers and the campus a comprehensive web presence listing the technology basics, available resources, and means for getting help at the UW.

Conclusion

Innovation in research and the technologies that drive it are both incredibly fast-paced, yet the central funding available to support the technology needs of researchers is on the wane in many institutions. Meanwhile, vendors and open-source communities offer technologies that universities once provided themselves, often much more cheaply and with greater features or functionality. As a result of these trends, central IT units cannot serve as an arbiter or initiator of technology innovation to the extent that they once did. Instead, central IT units must reach beyond their traditional organizational boundaries and partner with researchers to help fund the things that neither can fund alone and to provide expertise and services that researchers do not have. Developments such as the new data management paradigm can demand that central IT units enter entirely new domains; flexibility, agility, and entrepreneurship are crucial to innovation in this environment. Indeed, these new domains often reach beyond campus, requiring partnerships with other universities and institutions and with a set of cloud providers.

Though researchers can and should provide some of their own IT infrastructure and support in ways that make sense, central IT has a huge role and responsibility as a partner in research innovation. With regard to infrastructure, for example, building shared storage and computing platforms connected to research teams and the larger Internet by fast, reliable networks reduces
the need to deploy hundreds of experts to solve thousands of small data storage and computational issues in hundreds of separate research labs. Instead, a few experts can design and operate resources to benefit thousands of users. This is true whether using cloud-based or centrally hosted campus resources. On-demand data management expertise from central technology units can serve as an incredible catalyst for innovation, helping researchers tackle problems in new ways. On-demand IT expertise frees up researchers and their teams from low-level technology tasks to focus on the research. Partnership now entails novel configurations of staff and infrastructure, with central IT enabling and even following rather than leading.

Partnership also requires listening, and central IT units need to have multiple channels and ways of finding, knowing, and discovering researchers’ technology needs. Surveys, interviews, focus groups, and direct outreach to individuals have all worked well at the UW, but, regardless of the method employed, what is most important is that the listening is ongoing. Building successful partnerships requires central IT units to engage in intentional discovery and relationship-building with researchers, research teams, and IT staff across their institutions. Working in such partnerships, central IT can be a key player in helping the university fulfill its research mission.

Where to Learn More


Acknowledgments

We would like to acknowledge the more than 50 colleagues who helped with various aspects of these two large-scale investigative efforts. Their efforts greatly contributed to the success of both the Conversations project and the 2008 Faculty Survey.
Endnotes


5. The UW is addressing these grant management needs through the Office of Research Information Services, which is creating an integrated information management system that will enhance the ability of faculty, administrators, and staff to procure and administer research grants and contracts.

Citation for This Work