Supporting Faculty Research with Information Technology
Introduction

Historically, higher education faculty engage in some combination of teaching, service, and research. How one’s time is distributed across these three roles or functions can vary considerably by a number of factors including institution type, field of expertise, career stage, and personal interest. Given that the success of students is central to the mission of any institution, much of the prevailing attention higher education IT gives to faculty focuses on the role of technology in teaching, learning, and supporting students. As a result, we often pay far too little attention to the role of technology in faculty research. We hope this report serves as a modest correction of this omission by providing institutional leaders with a better understanding of the IT experiences and needs of their faculty who engage in research or seek to expand their research capabilities.

First, we present results from the 2017 ECAR faculty survey on the technology support and services they receive from their institution for their research needs. We asked faculty about how their institution responded to their data management needs; the support they received from IT staff; and institutional support for computational resources, such as hardware and software for analysis. We also assessed research technology support and services by institution type, such as research-intensive institutions (e.g., doctorate-granting) or less intensive research institutions (e.g., associate-degree-granting). This assessment provides insight into whether faculty who need the most technological support for their research are indeed receiving it.

Second, we present findings from open-ended responses from this same survey that asked faculty what their institution could do with technology to support their faculty research role. These open-ended responses allowed faculty to provide, in their own words, a depth of response that offers insight into their most pressing IT needs. We present these findings based on the categories of responses and offer illustrative quotes from faculty responses reflective of these categories.

Third, we present findings from faculty who conduct research at data-intensive institutions and their assessment of institutional technology support for their research. These findings include faculty assessments of whether they receive appropriate IT support for their data-intensive research. Finally, we conclude this report with recommendations on how institutions can better leverage IT to support faculty research.
Key Findings

- Faculty are generally positive about their institution’s support for research, but faculty at master’s institutions tend to be less positive about research support they receive than faculty at other types of institutions.

- Faculty most frequently reported that their institution could better support their research by increasing access to analytic software, providing reliable real-time support for their technology needs, and affording access to specialized IT staff who could assist with their discipline-specific technology needs for conducting research. Other categories of need faculty identified include access to training and workshops, cloud storage, journal databases, and specialized hardware.

- Among faculty engaged in data-intensive research, adequate bandwidth, data storage, and computational resources to conduct their research are areas of need in which a majority expressed their agreement. About two-fifths of these faculty said that their research data are stored in the cloud, and about half said that IT professionals are not proactive in responding to research computing needs.
Institutional Support for Research

In 2017, we asked faculty to tell us about their levels of agreement with various statements about the technology support they receive for their research. Broadly speaking, the items on which we collected data were grouped into the following categories:

- Support for data management, use, and storage services provided by the institution for research
- Support from IT staff for research
- Support for specialized computational resources

While a majority (53%) of faculty said they are generally satisfied with their institution’s support for their research needs, the levels of satisfaction with individual items in each category vary, suggesting that there is plenty of room for improvement (see figure 1). For example, on the items asking about support of faculty data and computing needs, a plurality of respondents agreed or strongly agreed that their institution made adequate technology support provisions for putting materials in institutional repositories (45%), for grant-funded projects (44%), for research during the promotion and tenure process (41%), for data curation (40%), and for cross-institutional research collaborations (37%). The one exception from this group is that more faculty (45%) disagreed than agreed (27%) that their institutions made electronic laboratory notebooks (ELNs) available to those whose projects require them.

Generally, faculty offered more favorable evaluations of their experiences involving support from IT staff. Indeed, a majority of faculty told us they receive timely (58%) and adequate and appropriate (55%) support from IT staff to conduct their research. And, a plurality of faculty reported having access to IT staff with specialized knowledge about research computing in support of their academic discipline (44%). These results are even more impressive given that, according to 2017 CDS data, the typical institution has zero FTE dedicated to central IT research computing services.\(^2\)
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Figure 1. Faculty evaluation of institutional support for research

For the two items forming the specialized computational resources category, the results are divided between locally provided generic supercomputers and clusters on the one hand, and highly specific, offsite resources on the other. For the former, 45% of faculty reported having access to high-performance computing and research-computing services for their research; for the latter, only 28% reported having adequate support for federally funded IT and cyberinfrastructure resources (e.g., Open Science Grid, XSEDE, iPlant, EarthCube, and NCBI).

As one might expect, for most of the statements about IT research support there is significant variation in levels of faculty agreement by institution type. The patterns, however, do not conform to the general expectation that institutions emphasizing research (e.g., DR, MA) would better meet IT research needs.
than institutions where the primary emphasis is on teaching (e.g., BA, AA). Faculty from DR, BA, and AA institutions tend to evaluate their institutional IT support similarly, but faculty from MA institutions have a tendency to rate IT research support significantly lower, especially compared with faculty from DR institutions. For a couple of items (access to staff with specialized knowledge in specific disciplines, and adequate support for data curation), faculty at AA institutions rated IT research support higher than MA faculty did, while BA faculty reported greater support during the tenure and promotion process than MA faculty. Given that these findings do not confirm what we would generally assume about which faculty are receiving adequate support, what else might explain the observed institutional variation(s)?

One possible explanation—for which we have data—relates to the institutional resources available to support faculty research. The CHEITA Global Complexity Index is a measure of institutional complexity comprising weighted index measures of student enrollment, institutional staff, and research income. The Complexity Index strongly predicts an institution’s overall IT expenditure (measured in US dollars) and serves well as a proxy for the IT resources available to support faculty research. Indeed, controlling for institution type, we find that the more complex the institution, the larger its IT budget and the better the support for faculty IT research needs. In this way, the Complexity Index may offer an alternative explanation for the institutional variation we are observing in faculty evaluation of research support; however, further research would be required to establish the contributions of the Complexity Index vis-a-vis Carnegie classifications.

Regardless, our data suggest colleges and universities are doing an “OK” job with regard to meeting faculty technology research demands but that there is significant room for improvement across the board, especially at MA institutions. Given this, IT organizations need to spend more time understanding how and where improvements can be made to support faculty research more broadly and consider increasing the meager central IT spending on research computing services such as high-performance computing (HPC). To help determine where the pain points are, we asked faculty to tell us what their institution can do with technology to better facilitate or support their research role. In the following section, we unpack the results of this open-ended question. Depending on the institutional resources available, these results may reveal opportunities for some quick wins that support faculty in their research and serve well the institutional research mission.
Faculty Research Needs (In Their Own Words)

To execute their roles as researchers, higher education faculty need to be able to access and effectively use current, reliable, and powerful computing technologies. They also need to be aware of what technologies are available to them for their research. There may be considerable variation across higher education institutions, however, in the depth of IT support provided to faculty, or in faculty’s access to needed resources such as analytic software. For example, institutional IT staff might not offer individualized research computing consultation for a wide range of faculty. Faculty who are not intensive, traditional users of high-performance computing or digital technology need help in using advanced technologies to support their research and scholarship. That creates an opportunity for IT organizations to meet these needs through IT staff with specialized research consultant roles.

Additionally, at DR or MA institutions, for example, statistical analysis software (such as SAS or SPSS) might be already loaded onto a new faculty’s laptop, which might also have been provided by their department. At BA or AA institutions, labor-saving citation software or access to journal databases might not be readily available. Or, in worst-case scenarios, faculty must use their own funds to make purchases. Furthermore, faculty vary in number, extent, type, and amount of grant awards, which subsequently affects their reliance on institutional technology resources to conduct research. Fully funded faculty might rely less on institutional resources such as laptops or analytic software than faculty who are only partially funded or funded through their institution rather than extramural grants.

To better assess faculty’s needs, we asked them to elaborate with open-ended text responses. Responses (n = 1,169) on what their institution could do to support their research role were categorized into themes across all classes of institutions and faculty types. The six most prevalent themes from faculty’s open-ended responses were:

- Making specialized research software available
- Live support from their institution’s IT department (i.e., real-time support from staff)
- Access to cloud storage
- Institutional training and workshops to facilitate the use of technology for research
- Access to online, peer-reviewed journal databases
- Access to hardware, such as computational resources
Overall Results

The themes identified in faculty open-ended responses can be organized into two larger domains. First, faculty identified technology needs that were specific to institutional services, i.e., IT staff support, data management/storage, and institutional training/workshops. The remaining themes reflect specific tools necessary to conduct research: access to analytic software and computational resources (e.g., hardware), and access to journal database(s).

These findings suggest that faculty need not only software, hardware, and access to research literature but also access to IT staff familiar with their research computing needs to facilitate the use of these research tools. Figure 2 presents faculty respondents’ most frequently reported “one thing” that their institution could do with technology to better facilitate or support their research role. Fourteen percent of faculty didn’t answer, reported that they did not know, or said that the question was not applicable to their role (e.g., nonresearch role). Rather than reporting on what their institution could positively do to improve their research experience, faculty pointed to institutional factors, policies, and processes that they felt were not supportive. For example, faculty identified institutional factors that inhibited research, such as the limited capacity of their IT department to assist with discipline-specific technology needs for research, and lack of cloud-based data storage. These responses reflect key needs in technology service delivery—increased staff capacity, processes, and policies—rather than solely access to technology.

![Figure 2. What institutions can do with technology to support faculty research role](image)

Make Software for Research More Available

The most frequent response from faculty on how their institution could support them in their research role centered on increased accessibility to software for
conducting research. Faculty reported that they want their institutions to provide

- Funding to purchase analytic software or provide site licenses for software
- Remote access to analytic software
- Administrative rights to university hardware (e.g., laptops) to make updates or install analytic software
- Simple availability of discipline-specific software from their institution (e.g., qualitative analysis software)

Faculty raised concerns about how lack of funding or lack of access to software necessary to conduct research impedes research progress. Software included analytic packages such as SPSS or data management software such as EndNote. One faculty member reported, “Actually offer some means of purchasing some of the software that I need instead of me purchasing it out of pocket.” Another respondent stated, “Ask me what I need and help me get it. I applied for one grant and received it, but that only bought the software for one year. I don’t know how or who to ask in order to continue the software license agreement.” These statements suggest that faculty need institutional support to fund their software purchases, but it also reflects the need for institutions to sustain faculty’s access to analytic software once it is acquired. Faculty may not be aware of the availability of analytic software or how their institution can facilitate extension of software licenses. Even if such licenses are available at an institution, the latter quote reflects a lack of knowledge about which institutional departments (e.g., IT department or academic department) can license software.

This suggests the need not only for software but also for specific communication to ensure faculty are aware of the potential licensing limits and the resources they need to continue using it for their research. One respondent told us that adopting site licenses might be a solution to the expense of single licensing for their institution. This recommendation reflects a sustainability strategy used by institutions to increase access to software. Decreased availability was also linked to wait times for software. A faculty member comment summarized issues of access and cost as creating barriers to conducting research: “Be more responsive. Understand that waiting weeks or even months for essential technology items means researchers can’t work for weeks or months. Provide services and equipment at least as rapidly and at costs competitive with local electronic/computer stores.”

The lack of remote access to software was also identified as an obstacle to research. One respondent commented, “Have reliable and universal access to data analysis and citation software that can be used on campus and off campus—SPSS, NVivo, SAS, EndNote, etc. The current ‘apps anywhere’ system is not reliable and is extremely slow, and, of those software packages mentioned above, [the institution] only offers SPSS.” This quote reflects a deficit in this particular
institution’s remote access infrastructure that consequently limits faculty’s access to analytic software.

Additionally, a small percentage of faculty respondents (2%) reported needing more control or administrative rights on university computing hardware. A respondent reported, “The concern about security is hypersensitive to the point it hinders productivity.” Another stated, “The biggest negative issue I have is that because we do not have administrative control over our computers, when I am traveling and need to install a program vital to my research or to my collaboration, I am unable to do so.” Another respondent described the challenges of using university-provided hardware whose use was hampered by institutional security procedures:

I am very seriously considering “opting out” of owning and using a university laptop and purchasing my own to avoid staggering, archaic and never-ending security updates. I have administrative access, and it’s still nearly impossible to get my work done. I can’t imagine what a pain it is for those poor people who have to call in every time Adobe needs an update.

This quote reflects how institutional security practices or policies may be perceived as unwieldy when they require IT staff to intervene frequently to update software. This impedes progress on projects and was further identified as a probable drain on IT staff resources.

Faculty who cannot afford software or extended software licenses need institutional support. Among impediments to research, respondents identified a lack of institutional resources to supply SPSS to all faculty or to acquire site licenses for software. Additionally, faculty reported that discipline-specific software was often not available (e.g., qualitative analysis software). Given that grant funds are often a source for acquiring software and associated licenses, many faculty without these funds reported purchasing the software themselves or simply not having access.

**Access to Support Staff**

Respondents also reported that having access to IT staff to meet their technology needs is crucial for their research role. Many responses solely focused on the need for responsive, rapid, appropriate, and knowledgeable IT support. One faculty member reported that her institution needed more IT staff to address institutional needs: “The institution should hire more individuals to actually provide this support; too many support staff are spread thin for helping faculty.” Another response reflected frustration with the perceived limitations of what the IT department could do for faculty: “I can’t overstate how terrible IT support is. The only thing they do well is send emergency people to fix internet connections at teacher stations.”
Many faculty recommended having IT staff trained or experienced in specific disciplines to assist with issues related to faculty’s research and their disciplines’ IT needs. A respondent suggested, “Have a dedicated research-focused IT staff. College IT staff are too focused on administrative computing, advising, and basics to develop knowledge, experience, and values needed to support research.” These comments describe IT departments with broad capacity to aid general campus needs but limited capacity to aid faculty in specific research computational needs. These suggestions reflect a staffing need that has also been acknowledged by the IT community: research computing (RC) facilitators.

RC facilitators are specialized, collaborative IT staff who can translate and tailor computational options for researchers across a range of disciplines. This specialized IT staff role is based on an NSF-funded approach implemented at a small number of institutions through the staffing of Advanced CyberInfrastructure–Research and Education (ACI-Ref) Facilitators. As this grant ends, ACI-Ref efforts are continuing—for example, in the Campus Research Computing Consortium (CaRC), which seeks to identify how to maintain and sustain these specialized roles. The RC facilitator role in IT departments has gained traction across campuses. IT’s role as an agent of institutional transformation and innovation is reflected in RC facilitators’ outreach strategies, collaboration, and education activities to increase faculty research capacity (see the "Research Computing Facilitators" sidebar).

Research Computing Facilitators

Research computing (RC) facilitators provide personalized, domain-specific computational options for individual researchers. They are complementary to existing research computing staffing models and are expected to have research experience with integrating applicable computational tools and systems. Rather than a one-size-fits-all approach, RC facilitators use a bottom-up, needs-based approach that provides multiple, adaptive computing solutions. This needs-based approach also enables engagement with nontraditional users of a strategic technology such as high-performance computing configurations (HPC).* By engaging with life and social science researchers, RC facilitators can contribute to methodological innovation, research transformation, and increased research productivity. Their activities include outreach to promote awareness and point out the impact of resources; engagement, support, and education of researchers; liaising research connections; and advocating for the needs of researchers to inform research IT design and institutional support. Learn more at https://library.educause.edu/~/media/files/library/2016/5/erb1602.pdf.

* For more on the strategic position of HPC among research and scholarship technologies, see “Higher Education’s 2018 Trend Watch and Top 10 Strategic Technologies.”
Faculty comments reflect a deficiency of university resources to provide intensive, discipline-specific IT support for faculty’s research. A respondent reported that having increased dialogue with the IT department staff, combined with IT staff’s deeper understanding of their technological needs, could be a valuable starting point toward ensuring successful partnerships that meet faculty’s research needs: “I would love to have people that I take ideas to, and then they tell me how it will get done and the time frame for the project to get done.” Although a majority of faculty reported that they receive adequate and timely support from their IT department, and 44% reported having access to IT staff with specialized research computing knowledge, 10% of the open-ended responses indicated that the limited capacity of their institutional IT department restricted their ability to do research.

Accessing Databases/Peer-Reviewed Journals

Faculty respondents also reported that institutional access to online databases of peer-reviewed journal articles and faculty research repositories could facilitate their research role. In regard to online databases, a respondent commented, “I can typically find the books or articles I am looking for in the databases, but the problem is actually getting the articles or books [i.e., electronic or hardcopies]. The library is horrible at getting what I need. Sure, the technology is there, but it is quite pointless when I can’t actually get the resources I need.” This suggests that although institutions have access to sources for research, significant limits remain on what is actually available for faculty to use. Along with their recommendation of prioritizing institutional resources to increase access to software, faculty also suggested increasing institutional resources to enhance the library’s function as a research hub. A respondent observed, “The library budget is abysmal. The university absolutely needs to invest in the library, where they should make available collaborative space, grant specialists to help with deliverables, and spaces to collect, preserve, and share faculty research.” This comment reflects a perceived larger institutional need for increasing investments in the library. As a conduit for faculty research, an institution’s library should be more strategically leveraged via partnerships or collaborative initiatives to enable rapid access to resources.

Other Areas of Support for Research

Faculty also reported that receiving training or attending workshops, addressing issues with cloud storage, and having access to hardware are all crucial to supporting their research. Faculty said that training opportunities or workshops could focus on what institutions provide in terms of technological support for research, or for training on specific software. As one respondent suggested,
“Inform and provide training on the resources available considering the field (i.e., social studies, education). Provide training to use specific tools such as Qualtrics (online survey software).”

Faculty also reported that they need data storage capabilities at their institution or an improved data storage infrastructure. A respondent reported, “I have inquired about faculty access to server space for data storage/backup and have been told that this is not something my college supports. This is a huge need. I have been using other tools such as Dropbox and Google Drive on my own, but this is not sufficient.” However, having access to a university’s cloud storage does not necessarily facilitate ease of research, either, as this respondent reported: “Find ways to allow us to store information locally that may be sensitive. As it is now, all [data] must be stored in the cloud, which is inconvenient since editing an Excel file online is highly limited.” This reflects the often challenging task of editing and using software to analyze data on a network.\(^\text{11}\) Hanging software, disconnection from the server, storage limitations, or inconsistent access to the server can be confounding for faculty researchers and their collaborators when attempting to access, share, and analyze large data sets from cloud storage.

These challenges can be addressed, for example, with institutional investments and implementation of appropriate infrastructure solutions such as the strategic technology ScienceDMZ\(^\text{12}\) for high volumes of data transfer. Or institutions can use a hybrid cloud, which utilizes both private and commercial cloud services for periods of high demand.\(^\text{13}\) When using cloud services, faculty and research administration should also be cognizant of whether data will be adequately safeguarded by commercial cloud vendors or other nonacademic partners via institutional contracts and agreements. Faculty should also be aware that cloud computing effectively supports some types of computational research, such as Monte Carlo simulations. However, challenges remain in cloud computing, specifically for computing requiring large storage capacity (above 6 terabytes, TB) and transport of large or big data between institutional partners. The most prominent trends in strategic technology, as it relates to research and scholarship, indicate that in 2018 institutions are planning to deploy and maintain institutional support for public-cloud storage, and institution-wide data management and integration is taking hold.\(^\text{14}\) This may increase faculty capacity for leveraging cloud storage or computing and decrease private use of personal cloud storage for data archiving.

Finally, faculty also reported that they need access to hardware, such as laptops, or improved hardware, such as monitors. A respondent reported that “budgets for regular computer upgrades for all university researchers” is a key institutional support requirement to meet their research needs. Faculty also reported that their research could be facilitated by having access to hardware outside their institutional setting. A respondent suggested, “Offer laptops or tablets that
can be borrowed to take into the field, so we can implement electronic, rather than paper-based, recording procedures.” BYOE (bring your own everything) mobile data collection (MDC) strategies that leverage mobile devices may offer some solutions for faculty who prefer field-based electronic data collection. For example, crowdsourcing is a data collection strategy that leverages large numbers of general public or online community members to contribute (without compensation) small amounts of collected data. This type of strategy may be particularly salient for faculty or staff conducting institutional research, for example, because of students’ familiarity and comfort with sharing their daily activities. Moreover, crowdsourcing has also been used for environmental studies aimed at identifying invasive species, which demonstrates MDC’s utility beyond research that relies on student contributions.

Summary of Faculty Open-Ended Responses

Faculty expressed hope that their institution would increase IT support for and access to software and online databases to facilitate their research role. A majority of faculty pointed out that analytic software and peer-reviewed journal articles (or other databases) are crucial to university researchers but that often these tools are not available to them. Humanities faculty also identified these necessities for research, which reflects IT’s increasing role in humanities research. For example, digital humanities (DH) refers to a broad array of research practices that harness digital resources and tools to enable researchers to perform novel types of analyses in the humanities disciplines. These analyses may include data visualization, text mining, statistical analysis of humanities data, and analysis of large data sets and digitized content. However, DH technology needs may be diverging from the campus IT research computing services that are typically available. Libraries may offer the majority of DH services and tools, with IT departments providing technology infrastructure. In the absence of intentional coordination across areas that support researchers, this siloing of services may contribute to a lack of awareness of these digital tools or hamper faculty’s recognition of the applicability of digital tools to humanities research. Institutions can effectively address faculty’s DH needs by using software licensing purchases to leverage bulk discounts or by identifying digital tools that may be applicable to humanities research. Building capacity for DH relies on interdisciplinary collaborations, leveraging institutional library resources, and IT infrastructure.

Additionally, faculty said they need responsive, live IT support to help them in their research role, including assistance in using research software. In particular, many faculty respondents highlighted the need for IT staff familiar with and responsive to specific disciplinary research needs. These faculty responses reflect a need for RC facilitator staff who can offer collaborative solutions to a broad
range of faculty computational research needs. Faculty reported that institutional resources are also needed for workshops that could focus on software training as well as provide information on what technology is available for research. They also viewed access to hardware as important, and responses appeared to reflect a scarcity of up-to-date and reliable computers and laptops on campus to conduct research. Most, if not all, of these needs identified by faculty appear to be linked to allocating resources to support research. Without adequate budgets for software licensing, hardware, increased IT staff capacity, increased access to databases, or implementation of data management infrastructure, faculty (at any institution) will continue to face substantial barriers to implementing, conducting, and completing research.
Data-Intensive Research

While most faculty engage in some form of scholarship related to their discipline, a subset of faculty engage in data-intensive research. Such research generates and/or uses vast quantities of data and requires extraordinary computing power to analyze those data.\textsuperscript{17} In 2017, a quarter of our faculty respondents said that they conduct what they consider to be data-intensive research.\textsuperscript{18} As one might expect, institution type is strongly associated with faculty engagement in such research. Sixty-eight percent of faculty who conduct data-intensive research are at DR institutions, 21% are at MA institutions, 5% are at BA institutions, and 3% are at AA institutions. Nearly half (46%) of the faculty doing data-intensive research generate less than a terabyte of data per year; 36% of faculty produce between 1 and 10 TB of data each year as part of their research programs. To gauge how well higher education IT is serving data-intensive research faculty, we asked faculty to tell us about their institution’s support for their projects (see figure 3).

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<th>Item</th>
<th>Percentage of respondents</th>
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<tr>
<td>I have adequate network bandwidth available to conduct my research activities.</td>
<td>Disagree — Agree</td>
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<tr>
<td>I have adequate data storage for my research initiatives.</td>
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<tr>
<td>I have enough computational resources at my disposal to conduct my research.</td>
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<tr>
<td>The wait time for research computing consultation assistance is satisfactory.</td>
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<tr>
<td>I am generally satisfied with the provision of research computing technologies at my institution.</td>
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<tr>
<td>My institution provides adequate resources for data backup and data restore in the event of loss or corruption.</td>
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<tr>
<td>Most of my research data are stored in a cloud-based/virtual environment.</td>
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<tr>
<td>IT professionals play an integral part in providing research computing services for me/my research team.</td>
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<td>IT professionals are proactive rather than reactive in responding to my research computing needs.</td>
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\textbf{Figure 3. Faculty evaluation of institutional support for data-intensive research}

The items we asked about fall into one of two broad categories:

- The provision of research computing technologies
- The support of IT professionals to research computing needs
On the former, a plurality of faculty (45%) are generally satisfied with the provision of research computing technologies at their respective institutions. With the exception of having research data stored in a cloud-based or virtual environment, which is more a statement of practice than one of satisfaction, faculty evaluation of the provision of research computing technologies is more positive than negative. Indeed, a majority of faculty agreed or strongly agreed that they have adequate bandwidth available to conduct their research activities (65%), adequate data storage for their research initiatives (58%), and enough computational resources at their disposal to conduct their research (54%). On average, faculty who are engaged in data-intensive research appear to have the technologies they require to perform their research.

Unfortunately, faculty do not feel as positive about the support they receive from IT professionals for data-intensive research projects. Although a plurality of faculty said that the wait time for research computing consultation assistance is satisfactory (46%), faculty are otherwise dissatisfied with the data-intensive research computing support they are receiving. A majority (51%) of faculty disagreed that IT professionals are proactive rather than reactive in responding to their research computing needs; nearly half (46%) of faculty disagreed that IT professionals are playing an integral part in providing research computing services for them and their research teams.

Breaking down this latter finding by Carnegie class, we note again the familiar pattern of MA research faculty having more negative experiences with IT research computing support than faculty from other institution types. Significantly more data-intensive research faculty from MA institutions (55%) disagreed that IT professionals play an integral part in providing research computing services than faculty at DR (45%), BA (31%), and AA (28%) institutions. The moderate levels of disagreement with this statement at DR institutions are likely the result of having more faculty engaged in data-intensive research than there are IT support staff for said research; the lower levels of disagreement at BA and AA institutions are likely due to the fact that so few faculty are engaged in data-intensive research at their institutions that IT units can simply be more engaged and responsive. MA institutions, however, appear to be caught betwixt, with more faculty engaged in data-intensive research than at BA and AA institutions but with fewer resources available than at DR institutions.

It is also noteworthy that while IT staff are rated positively for general research support, faculty engaged in data-intensive research projects do not rate IT staff as highly. Indeed, on the adequacy and appropriateness of IT staff support, the availability of IT staff with specialized knowledge about research computing, and the timeliness of IT support, regular research faculty rate IT professionals significantly higher than do data-intensive research faculty.
Conclusion

Overall, faculty are generally positive about their institution’s technological support for research. Faculty generally reported having support for their research in terms of data management, use, and storage, as well as support from IT staff. Less than half of faculty reported having access to appropriate computational services for their research (45%) or support for federally funded IT and cyberinfrastructure resources (28%).

Our findings also suggest that some particular institution types could improve technology support for faculty research. Specifically, MA-level institutions’ faculty rated IT research support significantly lower than did faculty from other institutions, especially DR institutions. This may reflect the nature of MA institutions, which might strike more of a balance between the research and teaching roles expected of MA faculty than of their research-focused DR institutional counterparts.

A majority of faculty who engage in data-intensive research at DR-level institutions were generally satisfied with the computing technologies available for their research. However, faculty still had concerns and suggestions about data stored in a cloud-based or virtual environment. For example, some faculty respondents suggested developing clearer security policies regarding cloud storage. Several respondents reported that their institution did not have a dedicated data repository system. Open-ended responses across all institution types also reflected a need for access to cloud storage and more effective infrastructure to conduct research. Many faculty also said they need easier options to back up data and procedures that make it easier to share data with student research assistants and colleagues.

In regard to IT staff, a little more than half of the faculty respondents reported that they receive timely, adequate, and appropriate support from IT to conduct research. Additionally, 44% of faculty reported that they have access to IT staff with discipline-specific knowledge about research and computing for their research needs. However, faculty who engage in data-intensive research are less satisfied with the computing support they are receiving, regardless of institution complexity or type. Themes identified in open-ended responses reflect faculty’s suggestions on how their institution could more effectively address their computing needs. These suggestions include increasing the availability of software, live IT support, training/workshops, and cloud storage.

Faculty reported that they needed more intensive support from their IT staff in order to conduct research, including discipline-specific technology support, technical training or workshops for analytic software, and increased communication about available technological resources. In open-ended responses faculty identified additional needs to support their research. These
included sustained access to analytic software, increased access to peer-reviewed journal databases, and access to hardware (e.g., dual monitors, laptops) to engage in research. Faculty also reported that IT security procedures (e.g., software updates) are a barrier to using analytic software on institutional hardware.

Although faculty are generally satisfied with the technology support they receive from their institutions to engage in research, our findings identify a gap between faculty research computing needs (not being met elsewhere at the institution) and the research-specific support capacity of institutional IT departments. The IT community has also identified this as a need, as evidenced by the growing interest in RC facilitators. RC facilitators may increase the research capacity of faculty who may not currently use HPC for their research or of humanities faculty who might benefit from adopting digital humanities methods for their research and scholarship. Faculty responses reflect a need for an RC facilitator role in their IT staffing, which also parallels the IT community’s current strategy to address this need. Implementing RC facilitators to enhance faculty research capacity also reflects trends that characterize IT as an agent of institutional transformation and innovation. This intersection of shared need among higher education stakeholders should be a catalyst for continued adoption, development, and evaluation of the RC facilitator role.

The domain of faculty research computing needs is complex, fraught with a host of externalities related to discipline, grant funding, academic rank, and institutional type. Our limited understanding of what it takes to support research faculty and our lack of funding models that can establish services for all might also explain our findings that suggest that faculty correctly perceive a lack of resources prioritized to support their research. With the typical institution dedicating only 2% of the central IT budget to research computing services, even the most modest increases in research computing spending could have a significant impact on faculty experiences and research productivity.
Recommendations

- **Increase funding for research computing services and technologies that support faculty research needs.** Faculty demand for research computing services, support, and infrastructure will only continue to grow, although the typical IT organization spends very little (about 2%) of their annual resources to support research computing services. Even a modest increase of budget expenditures for research computing has the potential to transform the experience of faculty engaging in research that requires IT support.

- **Build collaborative partnerships between academic departments, libraries, and IT to proactively meet faculty research needs.** Institutional CIOs should work on building collaborative partnerships that include academic and IT departments, libraries, and deans and department chairs as well. These partnerships can serve to implement training and workshops for faculty, inform faculty of currently available technology and IT services for research, help faculty identify IT solutions to meet their research needs, and create responsive systems for filling these needs. Building the capacity of IT departments to provide discipline-specific technological support hinges on establishing effective networks of communication, reaching a mutual understanding of priorities and capacities, and collaboratively identifying areas for improvement in research support.

- **Use RC facilitators to improve institutional capacities to proactively support and serve faculty engaged in all levels of research.** Faculty engaged in data-intensive research tend to have the computational resources they need but are dissatisfied with the ability of IT staff to anticipate and meet their specific research computing needs. RC facilitators can 1) offer support for a range of faculty research needs, including faculty that conduct data-intensive research and those that need less intensive research support, and 2) cultivate partnerships with faculty grounded in a shared responsibility for the success of research projects, and facilitate inter- and intra-institutional connections.

- **Increase access to analytic software.** Institutions should investigate how to increase faculty’s access to analytic software by the most cost-effective means possible while ensuring sustained access to these tools. This may include, for example, purchasing site licenses. It may also include the use of open-access software that offers robust and reliable analytic computing at minimal (or no) cost to users.

- **Work with libraries to increase access to peer-reviewed journals, open-access journals, and other open educational resources and databases.** This recommendation hinges on the ability of institutions to purchase.
and maintain access to databases. However, institutions can prioritize this access strategically by identifying databases or journals most relevant to disciplines via faculty surveys or by monitoring the use of particular databases across disciplines. Additionally, institutions can investigate participating in a state or regional consortium of colleges and university libraries to provide faculty and researchers with the information they need for teaching and research.
Acknowledgments

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We also extend a special thank you to Michael D. Erickson (Colorado School of Mines) for lending his expertise on the subject of research computing to the finalization of this report.

Lastly, we want to thank the 13,451 faculty respondents who completed the 2017 EDUCAUSE Technology Research in the Academic Community (ETRAC) Faculty Survey. Without the data they provided, this and other ECAR reports on faculty and information technology would not be possible.
Notes

1. In the 2017 faculty study, 13,451 respondents from 157 institutions in 7 countries (including the United States) and 37 US states participated in the research. The quantitative findings in the ECAR Study of Faculty and Information Technology, 2017 report were developed using the 11,141 survey responses from faculty at 131 US institutions. See Jeffrey Pomerantz and D. Christopher Brooks, ECAR Study of Faculty and Information Technology, 2017, research report (Louisville, CO: ECAR, October 2017) for more information.

2. The median of central IT research computing services FTEs is zero across all types of institutions, with 98% of institutions reporting 0–1 research computing services FTE per 1,000 institutional FTEs. One reason for these positive ratings may simply be that the few central IT research computing experts are very good at meeting the needs of the faculty who request their services. It is also possible that many of the research technology needs faculty have are such that IT staff not explicitly designated as research computing services are able to support their needs well.


4. According to 2016 CDS data, the median central IT spending on research computing services as a percentage of total central IT spending was only 2% for all US institutions.

5. XSDE Champions are examples of long-standing institutional staff who assist with computing-intensive and data-intensive research, education, scholarship and/or creative activity. See a description of XSDE Champions.

6. A total of 1,169 coded segments of data were derived from 1,100 open-ended faculty responses. Responses often had co-occurrence of codes and were not limited to single codes. The denominator to calculate percentages was based on total number of coded segments rather than total responses. We present the top 6 codes within these responses, which represent 61% of all faculty coded responses (or segments of coded data). For complete frequencies for this coded response, see the appendix.


8. Advanced CyberInfrastructure–Research and Education Facilitators (ACI-REF) is a consortium of six institutions (Clemson University, Harvard University, the University of Wisconsin at Madison, the University of Southern California, the University of Utah, and the University of Hawaii) that embrace a condominium computing model and “are dedicated to forging a nationwide alliance of educators to empower local campus researchers to be more effective users of advanced cyberinfrastructure.” These efforts support building best practices and a network of facilitators to support research computing on six campuses.

9. CaRC is a group of approximately 35 campuses whose goal is to identify how to sustain and maintain the incredible increases in demand for campus research computing by sharing, collaborating, and developing best practices.


11. For more information on the utilization of networks computing for data analysis, see Mark Berman et al., Networking to Support Data-Intensive Research: A View from the Campus, working group paper (Louisville, CO: EDUCAUSE, May 2018).


14. A majority (51%) of institutions reported institution-wide deployment of institutional support for public-cloud storage (28%) or plans to move to broad or institution-wide deployment (23%) in 2018. Institution-wide data management and integrations is a strategic trend that is incorporated at 11% of institutions and is a major influence at another 49% of institutions. See the “Research and Scholarship” tab at Grama and Brooks, *2018 Trends and Technologies: Domain Reports*.


17. For more information on “big data” in the higher education context, see the collection of ECAR Working Group papers “Big Data in the Campus Landscape.”

18. We asked respondents, “Do you conduct what you consider to be data-intensive research?” and left what constitutes “data-intensive research” up to the individual faculty members responding.

19. One good example of this is the statistical computing and graphics program R.
Appendix: Frequencies of Coded Faculty Responses

Below we present the frequencies of codes for faculty’s open-ended responses to the following question: “What is ONE thing that your institution can do with technology to better facilitate or support your faculty research role?” Percentages do not add up to 100%, due to independent rounding.

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Available software</td>
<td>Faculty reported that they need access to analytic software (e.g., SAS or NVivo).</td>
<td>289</td>
<td>25</td>
</tr>
<tr>
<td>Don’t know/NA/no response</td>
<td>Faculty reported they do not know, question not applicable, or no response.</td>
<td>163</td>
<td>14</td>
</tr>
<tr>
<td>Live support</td>
<td>Faculty reported that they need live support.</td>
<td>115</td>
<td>10</td>
</tr>
<tr>
<td>Access databases – journals</td>
<td>Faculty reported they need access to journal databases or other academic/research databases.</td>
<td>87</td>
<td>7</td>
</tr>
<tr>
<td>Training workshops</td>
<td>Faculty reported they need training or workshops.</td>
<td>83</td>
<td>7</td>
</tr>
<tr>
<td>Cloud storage</td>
<td>Faculty reported that they need storage or repositories for data or their completed research.</td>
<td>78</td>
<td>7</td>
</tr>
<tr>
<td>Access hardware</td>
<td>Faculty reported they need access to hardware, e.g., laptops.</td>
<td>64</td>
<td>5</td>
</tr>
<tr>
<td>Aware available resources</td>
<td>Faculty reported that they need to be made aware of the available resources for research.</td>
<td>57</td>
<td>5</td>
</tr>
<tr>
<td>Institution specific</td>
<td>Faculty reported institution-specific issues, such as having institution support for their research when they are adjuncts.</td>
<td>52</td>
<td>4</td>
</tr>
<tr>
<td>Support</td>
<td>Faculty reported needing support for engaging in research.</td>
<td>41</td>
<td>4</td>
</tr>
<tr>
<td>Reliable</td>
<td>Faculty reported they need reliable technology.</td>
<td>40</td>
<td>3</td>
</tr>
<tr>
<td>Control software/hardware</td>
<td>Faculty reported they need to have admin rights over their software and hardware.</td>
<td>32</td>
<td>3</td>
</tr>
<tr>
<td>Funding general</td>
<td>Faculty reported that funding is necessary to support their research.</td>
<td>26</td>
<td>2</td>
</tr>
<tr>
<td>Increased computing capacity</td>
<td>Faculty reported they need increased computing capacity at their institution.</td>
<td>18</td>
<td>2</td>
</tr>
<tr>
<td>Remote access</td>
<td>Faculty reported they need remote access to their institution.</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>Teaching load</td>
<td>Faculty reported they need to have decreased teaching load in order to conduct research.</td>
<td>8</td>
<td>1</td>
</tr>
<tr>
<td>Totals</td>
<td></td>
<td>1,169</td>
<td></td>
</tr>
</tbody>
</table>