

5

The Research Landscape

*Shade above shade, a woody theater
Of stateliest view*
—John Milton

Key Findings

- ◆ Institutions with an explicit research mission reported the greatest increases in the amount of both data-intensive research and sponsored research.
- ◆ Nearly half (47.5 percent) of all respondents indicated that sponsored research had increased at least 10 percent over the past three years. Only 3 percent indicated that the level of research had declined over that same period.
- ◆ Over the same period, respondents from one-fifth of all institutions—and 41 percent of Research Essential institutions—reported growth of more than 25 percent in sponsored research.
- ◆ Over half of respondents expected an increase in the use of data-intensive research among disciplines that have not been known for their use of computation (such as humanities and fine arts).
- ◆ Despite this expected increase in data-intensive research among traditionally noncomputational disciplines, these disciplines still lagged other disciplines when asked about current and projected demand for research IT services, suggesting that IT organizations can expect continuing high demand for services and support.
- ◆ Respondents have seen an increase in undergraduate research, interdisciplinary research, and multi-institutional research, and they expect these trends to accelerate.
- ◆ Institutions that favor teaching over research place a higher priority on undergraduate research than institutions with a more research-focused mission.

From the earliest days of computation through the emerging cyberinfrastructure, researchers and the IT organizations that support them have faced some fairly dramatic changes in opportunity and challenges. Very often, the contours of those changes are hidden at the time and become evident only in hindsight. This chapter explores how CIOs

perceive the current landscape for research, focusing on three questions:

- ◆ What trends have CIOs observed in research funding at their institutions?
- ◆ What academic disciplines are placing demands on the central IT organization?
- ◆ What research priorities are prompting new approaches to IT support of research?

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As discussed in Chapter 3, a primary analytical lens used in this study is institutional mission, not Carnegie classification. The survey asked respondents to describe the relative importance of teaching and research to their institution by selecting one of four statements about their mission. Table 5-1 presents the four categories and the percentage of total respondents ($N = 326$) who identified that statement as their institution's mission.

As one would expect, there was strong association between institutional mission and Carnegie classification, with doctoral institutions placing heavier emphasis on research than MA or AA institutions. But the correlation is not exact, and by refracting the data through the lens of institutional mission, we were better able to peel back the multidimensional labels associated with Carnegie classes and discover the institutions' real goals vis-à-vis research.

We asked respondents whether data-intensive research had decreased or increased at their institutions over the past three years. As shown in Figure 5-1, responses indicated a strong association with institutional mission.

Research Essential and Balanced institutions both saw a solid increase in the amount of data-intensive research over the past three

years. The Teaching Favored and Teaching Essential institutions were more likely to have seen data-intensive research increase at a lower level. The relationship with Carnegie classes was both weaker and in a narrower range.

Changes in Research Funding

Not all institutions place an equal emphasis on external research funding. As we showed in Chapter 3, there was a real difference among institutions in the priority they accord research. This priority manifests itself through funding, and there were significant differences among institutions when we asked them their level of agreement with the following two statements:

- ◆ My institution does a significant amount of federal- and state-sponsored research.
- ◆ My institution does a significant amount of corporate- and foundation-sponsored research.

When we compared the amount of sponsored research across categories of institutional mission, the statistical significance was extremely high—much higher than when compared across Carnegie classes. Figure 5-2 shows CIOs' responses by institutional mission.

Table 5-1. The Four Categories of Institutional Mission

Category	Mission	Percentage of Respondent Institutions
Research Essential	Research and teaching are the primary missions, but research is what really drives faculty and institutional success.	14.7%
Balanced	Research and teaching are both primary missions, and they are equally important for faculty and institutional success.	27.6%
Teaching Favored	Teaching is the primary mission, but faculty research is rewarded.	35.3%
Teaching Essential	Teaching is the primary mission, and faculty research does not factor heavily in faculty and institutional research.	22.4%

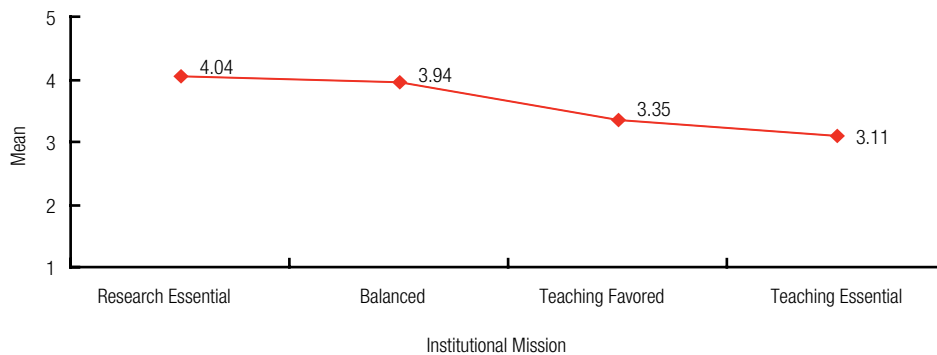


Figure 5-1.
Level of Change
in Data-Intensive
Research, by
Institutional
Mission (Mean
Value)

Q: In the past three years, computation-intensive research has: (1 = greatly decreased, 2 = decreased, 3 = stayed the same, 4 = increased, 5 = greatly increased)

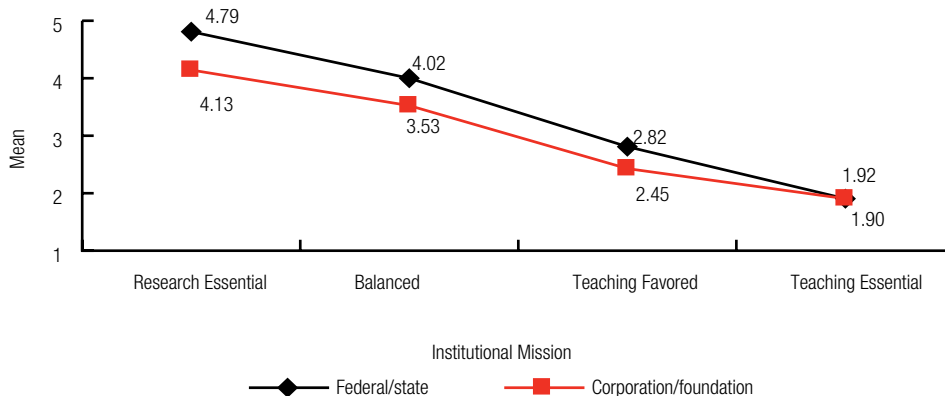


Figure 5-2.
Level of
Sponsored
Research, by
Institutional
Mission (Mean
Value)

(1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree)

The Research Essential institutions’ mean of 4.79 represents a resounding level of agreement—bordering on near-perfect “strong agreement”—that their institutions do a significant amount of federal- and state-sponsored research. With a mean of 4.13, the level of agreement about corporate- and foundation-sponsored research among Research Essential institutions is also impressive. As one moves across the categories, the level of agreement declines, reflecting not only the reality of funding levels but also the importance of external funding to the institutions’ mission and identity.

We asked respondents about the increase or decrease in the level of research contracts and grants at their institution over the past three years. As shown in Figure 5-3, three-quarters (74.5 percent) indicated that their level of research contracts and grants had increased over the past three years; one-fifth of all institutions had experienced growth of over 25 percent. Almost a quarter (22.4 percent) of institutions reported no change in funding over the three-year period, and only 3.1 percent indicated any kind of decrease.

Figure 5-3.
Reported Three-Year Change in Contracts and Grants

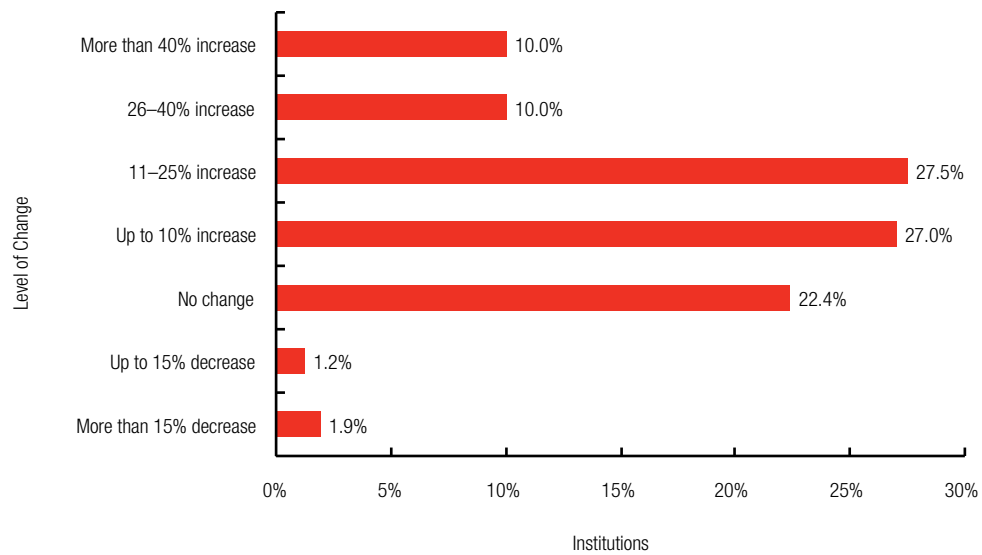
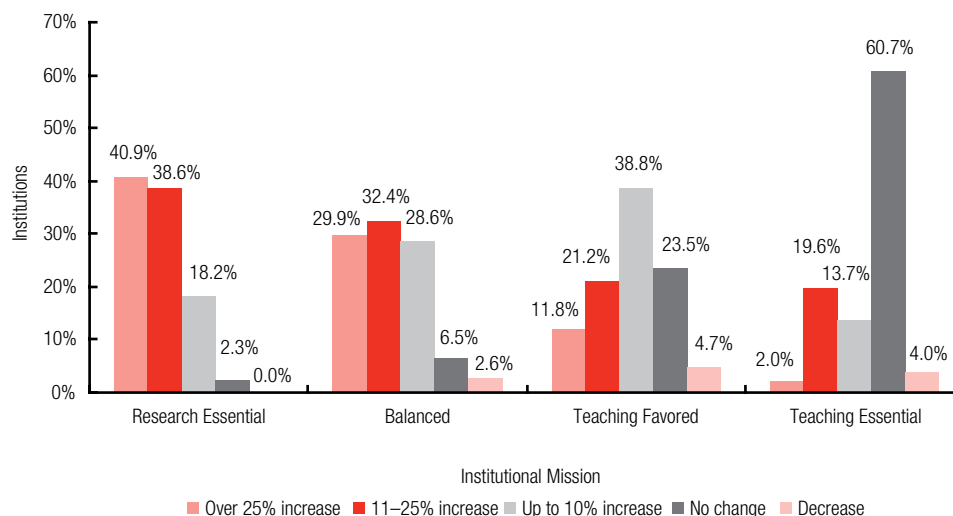


Figure 5-4 shows a strong association between changes in the level of grant funding over the past three years and institutional mission. Ninety-seven and a half percent of the Research Essential institutions saw an increase in contracts and grants over three years, with almost 41 percent reporting an increase of more than 25 percent. Only 2.3 percent were unchanged, and none saw a decline in funding. The Balanced institutions also saw a phenomenal increase, with almost 91 percent seeing growth, although “only” 30 percent saw increases of 25 percent or

more. Most of the institutions showing no change or a decrease in funding were in the Teaching Favored or Teaching Essential mission categories, but even a large proportion of these institutions (71.8 percent of Teaching Favored and 35.3 percent of Teaching Essential schools) saw strong growth in grant and contract funding.

That so many colleges and universities reported growth in research funding is not surprising. According to the National Science Foundation (Jankowski, 2005), “Colleges and universities reported research and develop-

Figure 5-4.
Reported Change in Contracts and Grants, Past Three Years, by Institutional Mission



ment (R&D) expenditures of \$40.1 billion in FY 2003, 10.2 percent more than the previous year (\$36.4 billion) and double the \$20.0 billion expended in FY 1993.” With most of that funding (61.7 percent) coming from federal sources, FY 2003 saw the federal share of academic research and development support at its highest level since 1985. The past 10 years have been fat times for researchers.

Of course, as investment firms like to say, past results are no guarantee of future performance. NIH funding, which had grown by 15 percent annually between 1998 and 2003, has flattened out. For FY 2005, Congress raised overall spending on federal research and development by only 4.8 percent. However, according to the American Association for the Advancement of Science (Burd, 2005), 80 percent of that increase will go to defense research, and the majority of that work will be done by private contractors, not by universities. And a major federal source of university funding has not fared well: the R&D budget of the NIH will grow 0.05 percent, the smallest increase in 36 years. This means the number of NIH grants will decrease in 2006 for the second consecutive year (Bender, 2005).

This raises the obvious question of where the anticipated growth in funding will come from, and colleges and universities across the country are scrambling to identify new sources of research dollars. Some are seeking to boost their revenues from technology transfer and commercialization. Others are increasing their activities in Washington, hoping that an enhanced presence will help them capture a greater share of resources. As competition increases, there will be, of course, winners and losers. But as we show in the following sections, the forces and trends unleashed during the halcyon days of funding left a clear imprint on how research is done within institutions of higher education. The impending changes in these trends are also driving reconsideration of how research-related IT is deployed and supported.

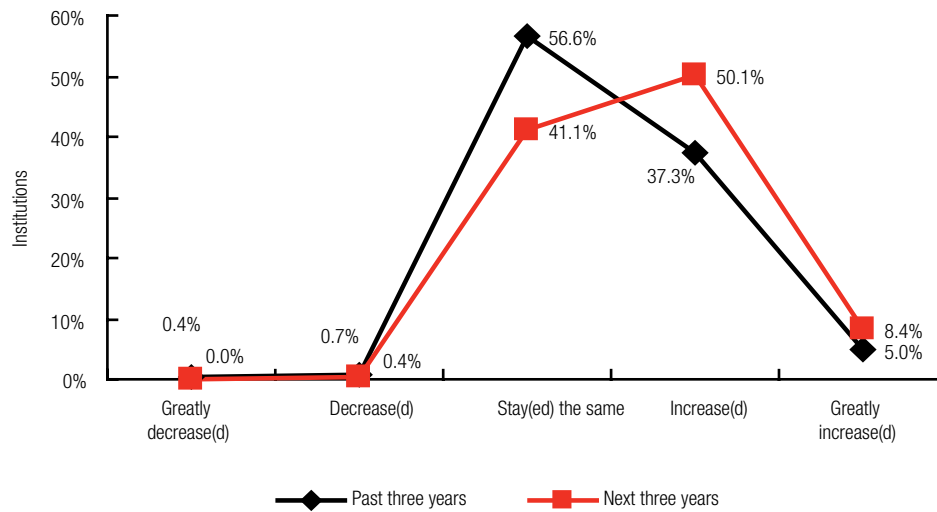
Computation and the Academic Frontier

One of the more eagerly anticipated trends in the cyberinfrastructure vision is the expansion of data-intensive research into the arts, humanities, social sciences, and other disciplines that traditionally have not relied heavily on IT as a research mechanism. As an example, the ECAR case study on the University of Virginia (UVa) (Blustain & Spicer, 2005) explores the rich ways in which sociologists, historians, and architects are pushing the boundaries of digital scholarship. The mainstream press has even noticed the trend, as witnessed by an article in the *New York Times* discussing how artists are working closely with “hard-core” scientists to influence the design of labs (Markoff, 2005).

The extension of research IT into new academic disciplines is an important trend for several reasons. First, intrinsic to the disciplines themselves, IT can bring a new set of research opportunities. Whether the field of inquiry is Tibetan texts, Civil War history, or William Blake (all of which are the focus of research at UVa), rich data sets and computational tools can bring new questions—and answers—to the table. But second, data-intensive research brings a new set of demands for more service, more equipment, and more support. Less obvious but also important are demands for IT organizations to expand their repertoire of applications and methodologies. As Felix the Cat might say, the “professor’s bag of tricks” is now bigger, and IT departments are expected to be responsive.

Our survey confirmed CIOs’ perception of the trend of IT’s extension into these new areas. We asked respondents whether data-intensive research in traditionally non-computing-intensive disciplines had decreased or increased over the previous three years, and we also asked what they expect to see over the next three years (Figure 5-5). Only 1.1 percent of respondents indicated a decrease of any kind over

Figure 5-5.
Increase in Use
of IT Among
Non-Computing-
Intensive
Disciplines, Past
and Next Three
Years



Q: *In the past three years, computational research in traditionally non-computing-intensive disciplines (e.g., humanities) at your institution has: (1 = greatly decreased, 2 = decreased, 3 = stayed the same, 4 = increased, 5 = greatly increased)*

Q: *In the next three years, computational research in traditionally non-computing-intensive disciplines (e.g., humanities) at your institution is expected to: (1 = greatly decrease, 2 = decrease, 3 = stay the same, 4 = increase, 5 = greatly increase)*

the past three years, and an even smaller 0.4 percent predicted a decrease over the next three, with none of these anticipating a great decrease. The most interesting finding here is the growing expectation that technology use would increase in these disciplines. This “shift to the right,” as shown in Figure 5-5, indicates that 58.5 percent of respondents expect an increase or a great increase in IT use in nontraditional disciplines, compared with 42.3 percent of respondents who observed an increase or great increase over the previous three years.

When we compared the means across categories of institutional mission (Figure 5-6), the results were as we expected. The Research Essential and Balanced institutions, both retrospectively and prospectively, were more likely to see a greater increase in IT use in traditionally non-data-intensive disciplines. Further, the next three years should see the trend accelerate, although the comparison with the previous three years is not startling.

To gain greater clarity on the demands from the various disciplines, we asked three follow-up questions.¹

- ◆ In the past three years, which three disciplines have displayed the fastest growth in demand for central IT infrastructure and support services for research? (Select up to three.)
- ◆ Which three disciplines currently generate the greatest demands for centrally maintained IT infrastructure and support for research? (Select up to three.)
- ◆ From which disciplines do you regularly receive input and guidance on their needs related to IT research infrastructure and support services? (Select all that apply.)

For all three questions, respondent were given an identical set of options. Table 5-2 presents the responses to the three questions, with the traditionally non-data-intensive disciplines in italics.

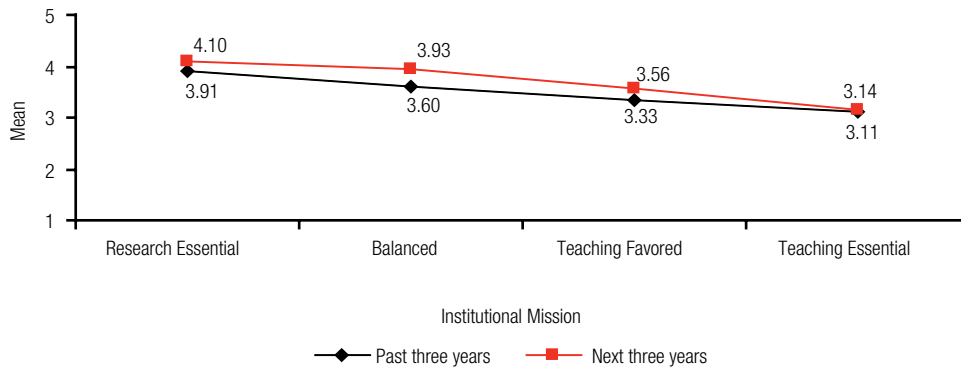


Figure 5-6.
Changes in Noncomputing Disciplines, Past and Next Three Years, by Institutional Mission (Compare Means)

Q: In the past three years, computational research in traditionally non-computing-intensive disciplines (e.g., humanities) at your institution has: (1 = greatly decreased, 2 = decreased, 3 = stayed the same, 4 = increased, 5 = greatly increased)

Q: In the next three years, computational research in traditionally non-computing-intensive disciplines (e.g., humanities) at your institution is expected to: (1 = greatly decrease, 2 = decrease, 3 = stay the same, 4 = increase, 5 = greatly increase)

Table 5-2. Disciplines and Their Relationship with Central IT

Fastest Growth in Demand Over Three Years (Three Responses Allowed)		Greatest Current Demands on Central IT (Three Responses Allowed)		Most Regular Input to Central IT (Select All That Apply)	
Biological/life sciences	54.9%	Biological/life sciences	55.2%	Computer science/math	43.6%
Physical sciences	40.5%	Physical sciences	44.8%	Biological/life sciences	39.3%
Computer science/math	39.3%	Computer science/math	39.9%	Physical sciences	38.7%
Engineering	29.3%	Engineering	29.9%	Engineering	24.1%
<i>Social sciences</i>	16.2%	<i>Business</i>	15.5%	<i>Social sciences</i>	22.9%
<i>Business</i>	15.9%	<i>Social sciences</i>	15.2%	<i>Business</i>	20.4%
<i>Education</i>	15.5%	<i>Education</i>	14.3%	<i>Education</i>	18.0%
Medicine	12.5%	Medicine	12.2%	<i>Humanities</i>	17.4%
<i>Humanities</i>	8.8%	<i>Fine arts</i>	7.6%	<i>Fine arts</i>	16.2%
<i>Fine arts</i>	8.2%	<i>Humanities</i>	6.7%	Medicine	12.8%

On all three lists, the traditionally non-IT-intensive disciplines fall to the bottom. The humanities and its kindred disciplines have experienced the slowest growth in demand, make the fewest demands on central IT, and provide the least regular input into central IT. Even with the possibility of multiple responses, humanities and fine arts on the first two dimensions were not able to get out of the single digits. We accept the premise that new disciplines are coming around to an appreciation of IT. What the data mean to us is that even though these “new” disciplines are fast turning to computation, the more traditional IT-heavy disciplines are demanding IT resources at an even greater rate. And that should give CIOs something to think about in the middle of the night.

Research Priorities

In the previous chapter, we highlighted fundamental changes in research triggered by the development of computer science and information technologies, such as the increase in data-intensive, interdisciplinary, and multi-institutional research. Have CIOs seen these changes at their institutions?

We asked respondents a series of questions about the importance of research at their institutions. The statements began, “My institution places high priority on ...” and continued with

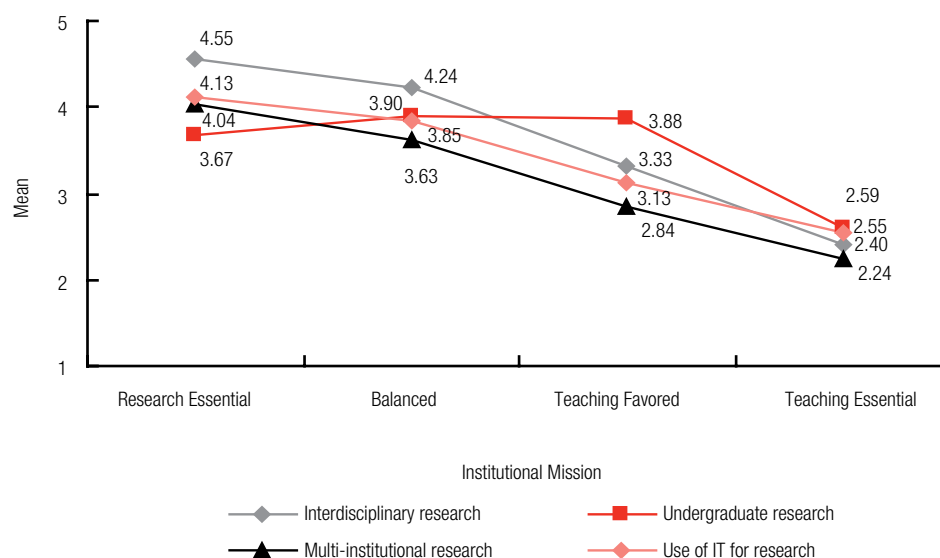
- ◆ ... research
- ◆ ... recruiting faculty who will do research
- ◆ ... the use of IT for research
- ◆ ... interdisciplinary research
- ◆ ... multi-institutional research
- ◆ ... undergraduate research

Respondents were asked to indicate their level of agreement or disagreement with the statement. In Chapter 3, we presented data on the first two questions and showed there was a strong association with institutional mission. Here, our focus is on the latter four, which are to a great extent representative of the new trends in research.

Figure 5-7 compares the means across institutional missions for the latter four types of “nouvelle research.”

Once again, there is generally a healthy relationship between priorities and institutional mission. The more central research is to the mission of an institution, the more likely it is to place a priority on interdisciplinary research, multi-institutional research, and the use of IT for research.

Figure 5-7.
Research Priorities,
by Institutional
Mission (Mean
Value)



Q: My institution places high priority on ... (1 = strongly disagree, 2 = disagree, 3 = neutral, 4 = agree, 5 = strongly agree)

We take a look at three of these priorities—undergraduate research, interdisciplinary research, and multi-institutional research—as each demonstrates its own dynamics and challenges for IT organizations. We begin with undergraduate research because that is the line in Figure 5-7 that invites the greatest explanation.

Undergraduate Research

The emphasis on undergraduate research can be seen in Figure 5-7, where there is a notable bulge in the undergraduate research line, especially among the Teaching Favored institutions. This rising prevalence of research among undergraduates reflects a number of trends: faculty interest in involving students in their research as a form of pedagogy, student appreciation of the learning opportunities accruing from closer contact with faculty, and institutions' awareness of the competitive advantages of having a credible undergraduate research program. Two organizations now exist to promote undergraduate research. The National Conferences on Undergraduate Research (NCUR; <<http://www.ncur.org>>) sponsors several activities, including an annual three-day conference at which several thousand undergraduate scholars have the opportunity to present their research. The similarly named Council on Undergraduate Research (CUR; <<http://www.cur.org>>) helps administrators and faculty members improve the research environment at their institutions through publications, lobbying, and outreach.

Joanne Kossuth, chair of the Northeast Regional Computing Program (NERCOMP), has seen many of her member institutions place an increasing emphasis on undergraduate research. As she explains,

There is a growing trend at BA institutions of students working over the summer or on projects. We're talking 50, 100 students. If it takes off, then

there is talk of fellowships. This is especially true of schools with a science or engineering curriculum. Everyone agrees that we need to support students doing research, whether it be for independent study or class projects. There is a push from students demanding things around their passions, like music or art. (personal communication, January 25, 2006)

But she cautions that as beneficial as it is, undergraduate research generates its own demands for IT:

How do you encourage academic experiment and freedom without breaking resources? For undergraduate research we need more storage, faster clusters, videoconferencing. To protect the infrastructure, you have to put money into firewalls, filtering, and policies. We all take security seriously and money has to go for that. There is a push for space and bandwidth, and these are seen as being institutionally provided infrastructure. How will we handle the visualization of data sets? There is a push for digitization. There is lots of potential in the humanities for blogs and wikis. Internet2 is being used for music. It is not mainstream yet, but it will be.

One institution working through these issues is Union College in Schenectady, New York. Undergraduate research is one of the five "pillars" underlying the college's approach to education, a commitment it has had since the 1930s. It was a founding member of NCUR, hosted the conference twice, and currently serves as the organization's home base. Since 1986 the college has funded summer research projects. In 2005, there were 110 summer research students on campus, and in 2006 the college will encourage greater participation by offering opportunities for half-summer fellowships. The college has

also offered the Steinmetz Symposium since 1991, an annual two-day event that showcases student research projects. In 2005, 350 students, or 17 percent of the student body, presented their research, performed, or displayed artwork.

Provision of the IT needed to support all this research is coordinated between Diane Keller, director of academic computing; Mary Carroll, director of undergraduate research and professor of chemistry; and J. Douglass Klein, director of converging technologies and professor of economics. Some of the IT needs for undergraduate research are met through external grants, with students working on projects for which faculty have obtained funding that covers those needs. This is especially true in engineering, but much less so in the other disciplines. According to Mary Carroll, "Students in the humanities and the social sciences are less frequently working on funded faculty research grants, and therefore their IT needs (hardware, software, data) must be funded internally" (personal communication, February 2, 2006).

Several practices are in place to help the Union College IT organization meet these needs. In 2005, as part of a planning exercise for the renovation of space, each academic department prepared a long-range vision, from which IT was able to infer infrastructure needs. Union's Internal Education Fund awards undergraduate researchers up to \$1,000 for databases, travel, or other small-dollar expenditures that can make or break a student's project. When faculty apply for external funding, the college has them fill out a form that gives advance notice of any needs, such as in the library. There are plans to amend the form to incorporate IT needs as well.

Ultimately, however, the college has had to get creative on a case-by-case basis. As Diane Keller expressed it,

When it comes to undergraduate research, much of the funding comes from internal grants, an active external

grants office, and departmental capital budgets. We hope and expect that most of the undergraduate research IT needs will be accommodated by our existing public computer labs, and by specialized department and faculty grant-supported research labs. Beyond that, we in ITS do our best to support what we can. We have no specific budget and are not systematic in how we make priorities. When students do come to ITS with individualized research needs, we try to deal with them one-on-one. There is no grand plan, and let's just say that we are not building to the Atkins plan. (personal communication, February 2, 2006)

Interdisciplinary Research

Are there any researchers who still believe that inquiry is best confined within disciplinary boundaries? If there are, it is a good bet that they have not received any significant external funding recently. The advances that have been made in virtually all fields have repeatedly confirmed that research is most productive when it combines the methods, theories, and knowledge of multiple disciplines. We have already seen how the Atkins vision of cyberinfrastructure relies heavily on models of interdisciplinary research.

Many academic institutions remain oriented toward the needs of traditional disciplines. A study by Stephanie L. Pfirman and her colleagues (Pfirman, Collins, Lowes, & Michaels, 2005) surveyed environmental studies programs and asked, in part, "Do you have the process for interdisciplinary hires and promotion codified?" Twelve of 19 institutions did not, and four said that the process was "under way." Failure to resolve basic faculty and researcher career concerns poses a barrier to the kind of research that everyone acknowledges is critical to the advancement

of knowledge. It is no wonder, then, that in 2004 the National Academy of Sciences issued a report from the Committee on Facilitating Interdisciplinary Research urging academic institutions to address the multitude of policies—hiring, promotion, tenure, and resource allocation, among others—that inhibit collaboration across disciplines (National Academies of Sciences, 2004).

Spanning all departments and schools, the central IT organization is in an excellent position to facilitate the integration of academic disciplines. Unbiased by any specific intellectual tradition, IT professionals can objectively seek to bring together the disparate traditions and tools of various disciplines.

To what extent are CIOs seeing interdisciplinary research as an important trend at their institutions? We asked respondents whether interdisciplinary research had increased or decreased over the past

three years and whether they expected an increase or decrease over the next three years. Very few institutions, as shown in Figure 5-8, saw any kind of decrease over the past three years, and an equally small percentage (0.3 percent) expect a decrease over the next three. In contrast, 61.2 percent of institutions saw an increase or great increase in interdisciplinary research over the past three years, and, looking ahead, 68.9 percent are expecting growth in the next three years.

When analyzed by institutional mission (Figure 5-9), growth rates do vary, but the differences are not significant. Respondents from the Research Essential and Balanced institutions are continuing to anticipate a solid increase, and respondents in all categories of institutions anticipate that interdisciplinary research will remain a feature of the research landscape.

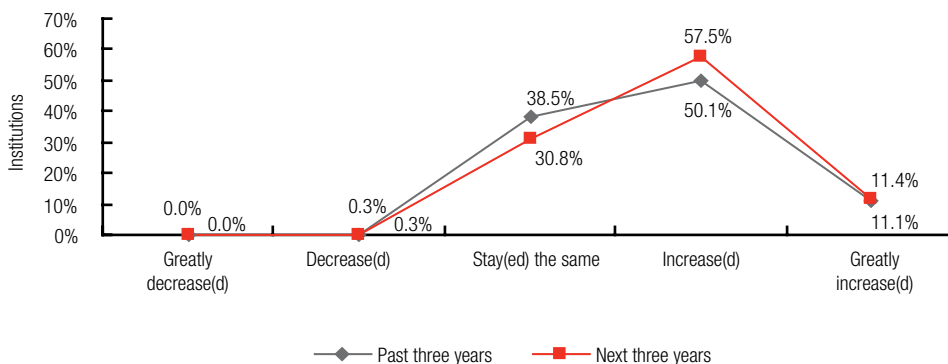
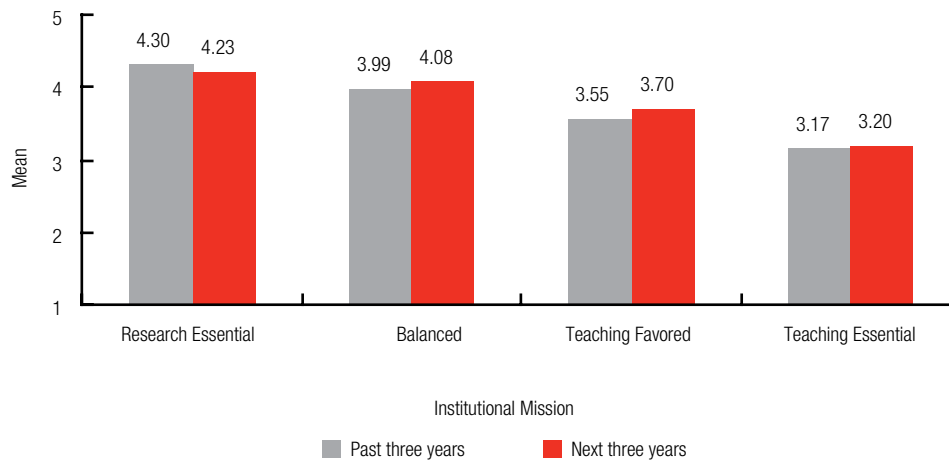


Figure 5-8.
Changes in Interdisciplinary Research, Past and Next Three Years

Q: In the past three years, interdisciplinary research at your institution has: (1 = greatly decreased, 2 = decreased, 3 = stayed the same, 4 = increased, 5 = greatly increased)

Q: In the next three years, interdisciplinary research at your institution is expected to: (1 = greatly decrease, 2 = decrease, 3 = stay the same, 4 = increase, 5 = greatly increase)

Figure 5-9.
Changes in
Interdisciplinary
Research, Past and
Next Three Years,
by Institutional
Mission (Mean
Value)



Q: In the past three years, interdisciplinary research at your institution has: (1 = greatly decreased, 2 = decreased, 3 = stayed the same, 4 = increased, 5 = greatly increased)

Q: In the next three years, interdisciplinary research at your institution is expected to: (1 = greatly decrease, 2 = decrease, 3 = stay the same, 4 = increase, 5 = greatly increase)

Multi-Institutional Research

Just as boundaries between disciplines are breaking down, so too are the barriers between institutions. Back in the 1950s, sociologists like Erving Goffman wrote about “total institutions” that were inward-looking, self-contained, and self-referential. Among the classic “total institutions” in the literature were prisons, insane asylums, and universities. No more. As networks create conduits for the flow of information, there is no reason for researchers from different institutions not to cooperate. Even some of the policy barriers are coming down. In 2004, Congress approved the Cooperative Research and Technology Enhancement Act of 2004 (also known as the CREATE Act), which amended federal law to allow the government to approve patent applications on inventions that had been made collaboratively among multiple institutions (Gidjunis, 2004).

Doug Van Houweling, president and CEO of Internet2, sees this as a growing trend:

I think there is more multi-institutional activity in the higher ed environment at this time than at any time I can think of since I have been involved. There’s open source, fiber acquisitions, national interfaces—all kinds of things going on to support hard science researchers. It is not in any sense highly coordinated, but there is a lot happening. (personal communication, January 24, 2006)

Randall Thursby, vice chancellor and CIO of the University System of Georgia, agrees:

What I’m seeing now—and making sure we can support our researchers on—is an increasing number of grants that involve activities among multiple institutions. Some of the granting agencies involved are almost requiring this for their grant proposals. (personal communication, January 25, 2006)

Indeed, within a two-week period in January 2006, the *Chronicle of Higher Education* featured two articles that demonstrated the power of collaboration. The first (Kiernan, 2006) was an announcement of a \$24.5-million, five-year grant by the Gordon and Betty Moore Foundation to create the Community Cyberinfrastructure for Advanced Marine Microbial Ecology Research Analysis (CAMERA). CAMERA will be a joint effort of the J. Craig Venter Institute in Rockville, Maryland, and the Scripps Institution of Oceanography at the University of California, San Diego. With links 100 times faster than on the conventional Internet, CAMERA will allow genetic researchers in Maryland to analyze huge databases on marine life held in California.

The second article (Wills, 2006) described how institutions within the Five Colleges Consortium in western Massachusetts—the University of Massachusetts at Amherst and Smith, Hampshire, Mt. Holyoke, and

Amherst Colleges—are building their own 53-mile fiber-optic network to connect the institutions (scheduled to be completed in 2006). Although the project is motivated by a desire to avoid paying high local loop rates to the local telecommunications provider, and although the network will have instructional and administrative uses, it “promises to make its most significant impact on faculty research” by allowing freer access to clusters of computers across the colleges.

As with interdisciplinary research, CIOs are seeing their institutions become more engaged in multi-institutional research (Figure 5-10). Again, very few institutions saw any kind of decrease in the level of multi-institutional research over the past three years, and a paltry number (0.4 percent) expect a decrease over the next three. Over the next three years, 56.9 percent of institutions expect some increase in multi-institutional research, a small but re-

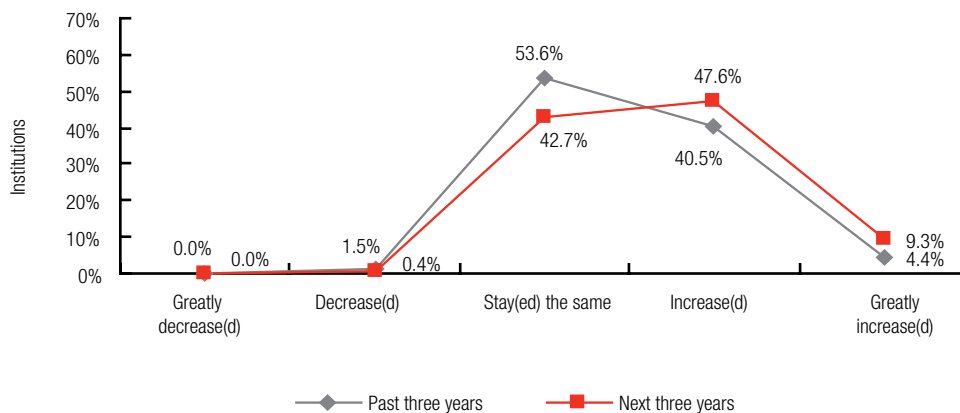


Figure 5-10.
Changes in Multi-Institutional Research, Past and Next Three Years

Q: In the past three years, multi-institutional research at your institution has: (1 = greatly decreased, 2 = decreased, 3 = stayed the same, 4 = increased, 5 = greatly increased)

Q: In the next three years, multi-institutional research at your institution is expected to: (1 = greatly decrease, 2 = decrease, 3 = stay the same, 4 = increase, 5 = greatly increase)

spectable increase over the 44.9 percent of institutions that had seen an increase or great increase over the previous three years.

As with interdisciplinary research, there is little distinction among the categories of institutional mission in terms of their past experience and their future expectations for an increase in multi-institutional research (Figure 5-11). One of our hypotheses was that there would be a clear distinction in this regard between public and private institutions, with the expectation that public institutions, because many are members of a system, would have stronger expectations for multi-institutional research. The association, however, was not significant.

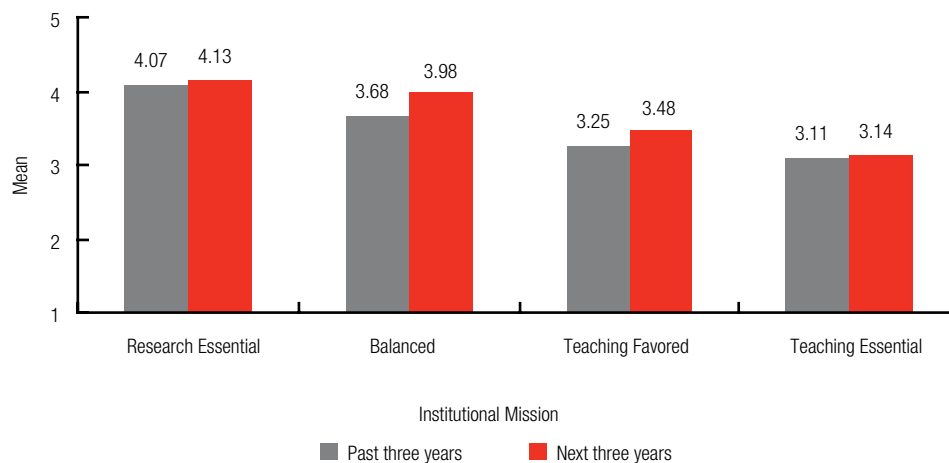
There is a clear belief among CIOs that demands in all three of these areas—undergraduate research, interdisciplinary research, and multi-institutional research—will continue to grow. And from the survey data, it would seem that the marked growth in the practice of data-intensive research in the humanities and social sciences, as dramatic as it is, is be-

ing eclipsed by growth in the disciplines that have traditionally been demanding users of IT. Any significant growth, of course, will place additional demands on the infrastructure, and in the next chapter we explore trends related to three major elements of the infrastructure: high-performance networking, high-performance computation, and data storage.

Endnote

1. The data come with two caveats. First, it is important to reemphasize that the questions addressed central infrastructure and support services. The survey did not capture the perspective of the local IT units which, as we show in Chapter 8, are close to the research and researchers. Second, we were surprised by the consistently low ranking of “medicine” as a source of demand for central IT. We can think of several reasons for this: “Medicine” as a response was preempted by the “biological and life sciences” with which it shares many of the same research agendas; it was selected as a choice only by that subset of institutions (27.1 percent of respondents) with a medical school; or CIOs of medical schools, many of which have their own IT organizations, did not participate in the survey.

Figure 5-11.
Growth in Multi-
Institutional
Research, Past and
Next Three Years,
by Institutional
Mission (Mean
Value)



Q: In the past three years, multi-institutional research at your institution has: (1 = greatly decreased, 2 = decreased, 3 = stayed the same, 4 = increased, 5 = greatly increased)

Q: In the next three years, multi-institutional research at your institution is expected to: (1 = greatly decrease, 2 = decrease, 3 = stay the same, 4 = increase, 5 = greatly increase)