

RESEARCH UNIVERSITIES AND THE CENTRAL IT ORGANIZATION: REBUILDING

The *raison d'être* of the American research university is to ask questions and solve problems. Together, the nation's research universities constitute an exceptional national resource, with unique capabilities:

- America's research universities are at the forefront of innovation; they perform about half of the nation's basic research.
- The expert knowledge that is generated in our research universities is renowned worldwide; this expertise is being applied to real-world problems every day.
- By combining cutting-edge research with graduate and undergraduate education, our research universities are also training new generations of leaders in all fields.¹



THE PARTNERSHIP

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Administrators at research universities devote much time to enhancing and sustaining these institutional capabilities. For administrators such as information technology (IT) directors and chief information officers (CIOs), however, the challenges are particularly daunting. In the last several decades, strategies used to achieve the administrative, instructional, service, and research missions of the nation's research universities have been forever changed by developments in IT. Miniaturization and networking have had especially dramatic effects, allowing the distribution of many activities that were once done only centrally. Most central IT organizations still play leadership roles in delivering services that meet the broadest institutional needs—services in areas such as administration, instructional support, and infrastructure—though these services are now usually provided in concert with distributed and department-level facilities and partners. A leadership role for central IT with regard to the research mission, however, is not as well defined today.

Frequently, central IT organizations in research universities find that their contributions to the research, scholarly, and creative missions have diminished greatly and may simply be incidental to, or a by-product of, their work in infrastructure provision. The fact that central IT is seriously distracted from giving attention to the needs of research and scholarship is evidenced by the EDUCAUSE annual list of ten high-priority educational IT issues, few of which relate directly to research support.²



NOW IS AN ESPECIALLY CRITICAL TIME FOR RESEARCH UNIVERSITIES TO CONSIDER THE FUTURE ROLE OF IT.

Moreover, a recent study by the National Research Council asserts that now is an especially critical time for research universities to consider the future role of IT. This report forecasts significant change in instructional delivery and organizational structure or methods and calls for several forms of IT-related planning and deliberation. Yet though the report firmly acknowledges the impact of IT on an institution's research and scholarly activities, it gives few specific recommendations for IT planning vis-à-vis the conduct of research.³

The partnership between research and central IT must be rebuilt and strengthened. Research universities should be reassessing their involvement with and planning for IT as a critical resource for research activity and success. Just as the research community is important to the nation's economic success, so IT activities play a vital role in the research community's success. A university's research enterprise may not remain viable without strong support from central IT, and central IT cannot properly plan for the future or contribute to the institution's advancement if it does not fully account for the research enterprise.

Historical Perspective

At research universities, IT found its way onto campus in two general ways. Unit record equipment (sorters, statistical

sorters, and simple accounting machines) found early acceptance in administrative units in the decades during and after World War II and led the way for the integration of full-scale data-processing systems. Very often, this led to the emergence of a distinct, central, administrative data-processing center under the direction of the institution's chief business and financial officer. On the academic side, research drove the introduction of IT on campus. The details varied depending on a university's strengths, but space physics, engineering, educational testing, chemistry, or another of the mathematical, physical, or social sciences often created the demand. Institutions responded to this IT demand by establishing central academic computing centers.

Researchers carried their data to the centers, created software there, and performed computations on the machines at these facilities. Research faculty were often intimately familiar with the operation of the machines and resources, and if they were not, centers were staffed with programmers, statistical consultants, numerical analysts, and other professionals who became very engaged in the detailed scientific questions. Partnerships developed. Teamwork was the norm. The IT organizational structures and service offerings reflected the emphasis on research. Infrastructure issues were quite limited and were focused on questions

such as when and how to purchase the next big machine or to expand the staff.

Steadily through the 1960s, 1970s, and 1980s, machines became smaller and more affordable and telecommunications capabilities became more prevalent and cost-effective. It became feasible to equip local research laboratories with their own equipment and computing capability. In some cases, activities at these laboratories augmented the work at central IT facilities: the small machines were used to control experiments, instruments, and data collection, while the centralized "big iron" still handled number-crunching or provided access to emerging commercial scientific applications, including numerical and statistical analysis packages, simulation systems, and similar products. In other cases, however, researchers began to discover that they could do essentially everything necessary at the local laboratory and did not need to travel to the central IT facility. As the small machines became more sophisticated and powerful, this movement away from centers accelerated.

IT centers compensated by becoming more specialized and by adding support for new uses and new users. The need for research and scholarship support in many more disciplines was growing, particularly as sophisticated text-editing and document-processing services grew, along with access to commercial databases and tools for general data analysis.

Interest in the use of computing in instruction was accelerating. Time-sharing became popular as a way to serve all of these needs, and central IT organizations began to face new demands in the provision of telecommunications infrastructure, including, in some cases, links to equipment in research laboratories. The number of total users grew at an enormous rate, until virtually everyone on campus had reason to be engaged by the technology. Whereas the original centers supported a small set of administrative users and a small set of researchers, by the 1990s every student, faculty member, and staff member was a user or would soon become a user.

Meanwhile, institutions began to see extraordinary growth in IT costs, largely because of continuing strong demand from more segments of the campus for inclusion and support. Yet the resources to meet this demand remained fairly static, leading administrators to begin to consider the ideas of consolidating facilities and of offering only those services that met the broadest, most general needs. Was it necessary to continue to have distinct administrative and academic centers? How were telecommunications services going to be planned and managed? Did it make sense to have distinct voice, video, and data services? The Internet, lurking in the background, raised its head more often. How many rooms for terminals and points of access were going to be needed? How would classrooms be integrated? Who would pay for the equipment? Complicated policy issues were arising. How should IT be financed? Who should have access and with what priorities? What kinds of uses were appropriate, and how would the emerging issues of data privacy, security, and sensitivity play out?

University presidents began to understand that CIOs were needed. The CIOs and “their” centers were being looked to for solutions to a number of problems. Meanwhile, researchers were building their own computing facilities, solving their own problems, and hiring their own support staff members. Their access to external grants and contracts allowed for this independence. As a result, the central IT organizations began to pay less attention to the research community at

many—perhaps most—research universities. This is not to say that research was ignored, but given all of the very serious demands placed on the central IT organizations for more instructional support, more infrastructure, and more administrative services, researchers’ ability to proceed on their own relieved some pressure.

The Situation Today

Undoubtedly, research and scholarship have been significantly enabled by advances in IT. However, to assume that the presence across campus of numerous pockets of research excellence means that all is well misses some important issues that require attention:

- The costs to the institution
- The regulatory and policy environment
- The continued advancement of the research and scholarly enterprise

Attending to these issues will require increased support from central IT for the research community and will necessitate a renewed partnership between central IT and the research community. In many cases, the current “distance” between central IT and the research community will make this task quite challenging.

The Costs to the Institution

Costs associated with the research technology itself are significant, but there are numerous other costs that arise indirectly.

Personnel costs. When research IT is supported independently of central IT, one of two scenarios will play out. Either a percentage of the involved faculty member’s time will be lost to system installation, maintenance, and administration, or an effort will be made to build up a support staff. In the latter case, research budgets or research assistantships are typically used to pay for student employees, perhaps at the expense of time that these students might better spend on the research questions themselves. Staff turnover and independence lead to a lack of consistency in system administration quality and perhaps also to the use of incompatible approaches to security, backup, and maintenance, with consequences not only for the research units but for the institution at large.

HOW

CAN IT FACILITIES BE COOPERATIVELY DESIGNED AND SUPPORTED IN ORDER TO MAXIMIZE UTILITY?



Researchers are beginning to understand these costs and may be open to discussions about controlling them. *What opportunities exist to reduce such expenses through appropriate partnerships between central IT and the research groups?*

Technology-specific expenses. Licensing expenses for common software applications have grown dramatically. In addition, critical research databases have become quite important. One risk is that these types of resources, if handled on a lab-by-lab basis, might not be licensed in ways that benefit the greatest number of researchers. Another area of concern involves operating system updates and maintenance. Centralized reference implementations may be of benefit to distributed research units, may help to enforce consistency, and may reduce workloads for common tasks. *Are there useful approaches to handling common licensing, distribution, and maintenance tasks and costs?*

Facilities costs and sustainability. Frequently, important IT research facilities are established with seed funding from federal agency grants or contracts. Later, sustaining these facilities can become a problem if up-front planning for usage fees or institutional subsidy has not occurred. In addition, facilities may require special space considerations or preparation costs. New building designs must account for infrastructure distribution and

IT laboratories. *How can IT facilities be cooperatively designed and supported in order to maximize utility and reduce cost to the institution for the long term?*

Faculty recruitment and retention. Competition for the very best faculty members often requires consideration of expensive startup packages, including technology, space, personnel, and other laboratory support. *Can the institution and those engaged in recruiting respond to startup requests in a way that maximizes the potential for the faculty member being recruited while at the same time considering long-term sustainability and overall institutional cost? Are there, for example, viable approaches to shared use of expensive instruments via networking infrastructure?*

Research administration expenses. More of the interaction with funding agencies is becoming electronic. Electronic proposal submission is relatively commonplace, and the federal government has plans to advance this capability. On a pre-award basis, the inclusion of IT expenses requires greater attention. Post-award grant accounting must support a researcher's need to manage the financial aspects of an award and must support/protect an institution for audits and indirect cost recovery. *What are the best and most cost-effective models for research administration support systems?*

Security vulnerabilities. Even before 9/11, concern for the integrity of campus systems was growing. Now, universities are

working with heightened awareness of the need to protect research and IT systems from intrusion, to guard sensitive research data from internal and external terrorists, and to assure outside interests that a campus will not, perhaps inadvertently, become the base for a cybersecurity attack on others. Information is often lacking on design criteria to secure physical research and IT assets, such as data centers, wire closets, and cable plants. These responsibilities create new demands for the tracking and monitoring of employees, select biochemical and biological agents, radiation resources, and other materials. *Is the overall research and IT environment properly designed and protected to manage these areas of facilities cost and policy-enforcement expense?*

The Regulatory and Policy Environment

Senior campus administrators are increasingly concerned about regulation and oversight of research activities; the events of 9/11 have made those concerns more acute. Recently, for example, research involving human and animal subjects has been heavily scrutinized by the federal government. IT is receiving extra scrutiny as well, and some regulation of IT is beginning to appear.⁴ In addition, federal and state attention to return on investment in research and scholarship is often closely tied to economic development expectations. In some cases,

researchers are acutely aware of these issues, but on the whole, researchers may be unfamiliar with such regulations or may assume that “someone else” will deal with the responsibility.

Regulation and compliance. In the case of existing regulatory domains (e.g., human subjects protection, animal care and use, clinical trials, responsible conduct of research, conflict of interest/conflict of commitment), IT continues to be a critical tool for management, record retention, access controls, and monitoring purposes. Additional responsibilities will derive from the USA PATRIOT Act, SEVIS, the recently announced NIH data-sharing policy, HIPAA, federal PKI initiatives, the President’s Commission on Critical Infrastructure Protection, and the new Department of Homeland Security. Grants and contracts may arrive with new requirements—for example, NASA’s IT security clauses in some space research contracts⁵ and NIST’s guidelines for IT security.⁶ NSF has been lobbied for IT security language in its grant conditions.⁷ In November 2002, Congress passed a bill authorizing NSF and NIST to provide leadership in developing academic IT security programs and processes that could become standard across all federal agencies.⁸ *How can higher education work proactively with EDUCAUSE and others to assist in tracking policy initiatives and developing best-practice, campus-wide solutions to requirements in these areas? How can the interests of higher education be focused in order to appropriately influence policy development?*

Reporting and information sharing. Congress continues to scrutinize return on investment for grants and contracts. For evidence of this, consider the Government Performance and Results Act (GPRA) of 1993 and, as a specific example, the recently announced NIH GPRA plan for FY2004.⁹ All granting agencies, whether public or private, typically expect research and scholarly results to be shared and require reports demonstrating value returned for dollars invested. On a biennial basis, the National Science Board transmits to the White House a detailed report on science and engineering indicators.¹⁰ The Office of Management and Budget (OMB) guidelines for data quality have been issued, along with responses from each federal agency.¹¹ The

NIH has announced a data-sharing policy, which may place new requirements on researchers while at the same time raising serious infrastructure and support questions.¹² *What role can central IT organizations and campus CIOs play in helping institutions respond appropriately to and mitigate the impacts of demands in these areas? What infrastructure implications may derive from new policies in these areas?*

Federal support for the arts and humanities. The 104th Congress dealt significant blows to federal support for NEA and

NEH, and except for an FY2004 White House budget proposal for an NEH emphasis on American history, there has been little recovery since that time. With recent economic conditions, private support for the arts and humanities has also waned. On most campuses, scholarship in these disciplines has increasingly come to rely on technology for everything from basic resource access to collaboration and communication and to integration for purposes of performance, presentation, and instruction. Indeed, new artistic and

NEW

ARTISTIC AND SCHOLARLY FORMS ARE EMERGING BASED ON THE CAPABILITIES PRESENTED BY NETWORKS AND COMPUTING.



scholarly forms are emerging based on the capabilities presented by networks and computing. *With declining federal support, what is the state of interaction between central IT and the arts and humanities disciplines in terms of supporting and advancing scholarly and creative activities?*

Expectations of federal and state governments and businesses. Businesses and federal and state governments rightly look to institutions of higher education to provide outreach services and fuel for economic development. Often with federal money providing startup funding, many states have invested in statewide networking infrastructure and have expectations for the ways in which higher education will contribute to workforce and economic developments by using that infrastructure. Since the Bayh-Dole Act of 1980, federal investment in research has produced dramatic change in the output of patentable ideas. For example, prior to Bayh-Dole, fewer than 250 U.S. patents were issued to universities each year. Since 1993, U.S. universities have averaged more than 1,600 U.S. patents annually. In recent years, patents issued to U.S. universities have exceeded 2,000.¹³ Managing these expectations and possible partnerships between campuses and the economic and governmental sectors can be complex for a variety of reasons, including time conflicts, failure to

properly confront the cost of involvement, and intellectual property issues. Also, not all faculty members feel an obligation or have an opportunity to contribute to outreach and economic development. *How can central IT organizations and campus CIOs participate in the development of government and business partnerships, the evolution of shared infrastructures, and the planning for outreach, educational, and technology transfer opportunities?*

Intellectual property strategy and management. Digital assets are creating new problems related to intellectual property and its management. Policy issues are arising from the Digital Millennium Copyright Act and from scholarly communication based on digital systems. Also, methods for handling software and databases as intellectual property and for facilitating the “technology transfer” of that property are very complex. We suspect that few universities have dealt with data ownership policies. Copyright law does not provide sufficient protection for ideas in most cases. Meanwhile, patent law, as applied to software, has an uncertain future. Interest in general public licensing (i.e., “open software” strategy) is growing but may conflict with the institutional desire to control assets. *What is being done to influence and develop policy, advise and assist researchers and scholars, and build infrastructure or methods for handling digital assets?*

The Advancement of the Research and Scholarly Enterprise

Perhaps of most interest to the research and scholarly community itself is the question of how best to advance the community through the provisioning of resources and services that will directly affect productivity and opportunity.

Vision. First and foremost, the university president's vision for research must be clearly understood and supported so that central IT administration and research administration can work in harmony to advance this vision.

Infrastructure. The days of centralized computing infrastructure are gone, but the need for networking technology, network-based storage systems, grid-based computing infrastructure, enabling middleware, and collaboration facilities has never been higher. In some cases, a specific research, scholarly, or creative goal may be best pursued through partnerships between experts in a central IT organization and the research groups involved. The research community and central IT need to engage in dialogue aimed at determining infrastructure investment and strategy. *What models exist for campuses to use in establishing appropriate infrastructure? How are partnerships established? Under what conditions can central IT organizations serve as staff or partners in research projects and activities? That is, when should central IT participate in the*

research rather than only support it?

Staffing and engagement in research. As noted, the early central IT organizations were often deeply engaged in research activities. This often meant that IT directors (pre-CIOs) and staff held legitimate research credentials in their own right. Today, IT organizations are often staffed by individuals with very different backgrounds; it is not uncommon for CIOs to have MBAs or other backgrounds instead of coming up through academic ranks. The reporting structure of central IT within the institution is also of interest. Many CIOs report to the provost, some report to the vice-president for finance or the vice-president for research, whereas still others report directly to the president or chancellor. *How are IT organizations structured to contribute to the research enterprise? What is the training and background of IT leaders vis-à-vis research and scholarly activity? How does prioritization for support of research and scholarship—as opposed to support for administrative, instructional, and other areas—occur? What is needed for chief technologists to be recognized as viable contributors or*

partners in all grant processes? To whom does the central IT organization report, and therefore, where is the voice of research IT heard? Can faculty participation in campus technology initiatives become an acceptable activity for promotion and tenure?

Motivation in the research labs. Researchers and scholars are, for the most part, motivated by things very different from those of importance to central IT organizations. Not the least of these motivations are promotion/tenure and positioning for the “next” grant. These concerns often draw researchers’ attention away from many of the issues discussed above, including cost management, infrastructure planning, IT staff management and growth, intellectual property management, and IT security. *What role can promotion and tenure policies play in recognizing and supporting the contributions of the IT community? Are there useful models for relieving promotion/tenure concerns while still ensuring scholars’ productivity, independence, and opportunity?*

Teaching. Research institutions argue that the value of an undergraduate education at a research institution is enhanced

by proximity to, exposure to, and even involvement in the institution’s research and scholarly work. Of course, graduate education at such institutions is deeply enmeshed in research and scholarship. *What role can the central IT organization play in helping to ensure that the institution’s research and scholarly work makes a difference in classrooms?*

Recommendations

More than ever before, central IT organizations need to rededicate themselves to becoming involved with the research mission and enterprises at their institutions. In the past, this involvement would have focused on the research problems themselves. Today, though such involvement still makes a great deal of sense, researchers are now concerned with a vast range of additional issues with which central IT organizations can and should provide help. The following recommendations represent merely a few ways in which activity might begin:

- Increase campus dialogue regarding the respective roles for the researchers,



THE RESEARCH COMMUNITY AND CENTRAL IT NEED TO ENGAGE IN DIALOGUE AIMED AT DETERMINING INFRASTRUCTURE INVESTMENT AND STRATEGY.

local research IT support staff, and the central IT organization. Engage senior research administrators in matters related to policy development, cost, and strategies for enhancing the research enterprise.

- Identify best practices for support of the research enterprise and for dissemination of those support models training researchers in various kinds of disciplines, supporting equipment and software needs, providing systems administration support, and offering software licensing approaches, fee-for-service models, and advisory groups.
- Identify and disseminate models for mutually beneficial research collaborations, not only for collaborations involving a research group and the central IT organization but also for related inter-institutional collaborations.
- Identify and disseminate models regarding mutually beneficial development by researchers and IT providers of IT policies in such areas as research IT financing, security/privacy/protection, and resource sharing.
- Identify and disseminate information about electronic grant proposal processing and grant accounting, including the related issues of interfacing with federal agency systems and emerging PKI and other infrastructures.

- Create forums for education about and discussion of the implications of emerging federal and state policies for research and scholarly enterprises. Help organizations like EDUCAUSE with analysis and with such forums.
- Identify and disseminate information about cost-effective licensing strategies. Consider consortium approaches or means to influence or work with such vendors for more affordable access.

University research is an important engine driving the creation of new knowledge and fueling the nation's economic success. With the country, states, and local communities increasingly looking to research institutions for answers to difficult questions, campus leaders are struggling to find ways to respond. Critical to this response is the partnership with central IT. *e*

Notes

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