Research Computing
Strategic Planning Report

Cyberinfrastructure is empowering a new generation of researchers in their quest to unravel how the world around us works.

NSF Special Report on Infrastructure
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Research Computing

Advisory Group

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"Environments and organizations, enabled by cyberinfrastructure, are increasingly required to address national and global priorities, such as understanding global climate change, protecting our natural environment, applying genomics-proteomics to human health, maintaining national security, mastering the world of nanotechnology, and predicting and protecting against natural and human disasters, as well as to address some of our most fundamental intellectual questions such as the formation of the universe and the fundamental character of matter."

Revolutionizing Science and Engineering Through Cyberinfrastructure:
Report of the National Science Foundation
Blue-Ribbon Advisory Panel on Cyberinfrastructure, January 2003

Introduction

Research and scholarship at the University of Missouri – Columbia (MU) contribute to both the quality of life and the economic development of the state, nation and world. In contrast to the rate of change in the allocation of University resources, which frequently shifts slowly and incrementally, the world of research computing has made a quantum leap in the last decade. Rapid advances in powerful and pervasive information technologies (IT) have fundamentally changed the practice of research and education at universities. Simulation and modeling have joined theory and experimentation as critical means to discovery and innovation. High-performance computing, massive data storage devices, and high-capacity networks are increasingly necessary infrastructure for all academic disciplines from the humanities to the sciences. Further, computing technology is even spawning new disciplines as evidenced by MU's new PhD in Informatics. MU made a strategic choice to excel in Life Sciences and interdisciplinary activities which are particularly dependent upon research computing technologies. **To achieve our goals, MU must address research computing needs.**

This plan addresses three research computing needs deemed most critical to MU's research competitiveness:

(1) high-performance computing,
(2) high-capacity local and wide-area networks, and
(3) data storage capacity.

Multiple accelerating trends are converging in ways that show extraordinary promise for an even more profound and rapid transformation – indeed a further revolution – in how knowledge is created, disseminated, and preserved. It is important to recognize our opportunity and responsibility to integrate and extend the products of the digital revolution to serve the next generation of research and education. **To remain competitive in research, MU must develop and act on a plan for identifying and meeting the needs for cyberinfrastructure.**

The term "cyberinfrastructure" connotes more than just hardware and software, more than bigger computer boxes and faster networks connecting them. It encompasses new "research environments" in which disciplinary experts on interdisciplinary teams, supported by specialized computational support staff, have global and instantaneous access to enormous computing and networking resources. For contemporary scientific research, these IT resources are viewed as integral rather than ancillary to today's research agendas. Just as the Internet became a tool used by everyone, the research cyberinfrastructure being created today will likely evolve into the basic platform for all manner of future collaborative knowledge work affecting business and commerce, entertainment, education, health care, and virtually every human endeavor.

As noted in a recent *Chronicle of Higher Education* article, dealing with the "data deluge" of research experiments will be among the great challenges for science in the 21st century. At several leading universities, librarians are stepping forward to define, categorize and archive the voluminous detailed streams of data generated in experiments. Thanks to equipment recently acquired by the UM Bioinformatics Consortium through a grant from NASA, MU has made a critical next step forward in research computing capability. MU has the right combination of information technology and library science expertise to help MU researchers creatively address their research computing needs. A coordinated effort must be mounted to initiate an institutional repository to establish MU's reputation as a valuable data archive site— one that provides ready data access to MU researchers, and that serves as a dissemination point for those who can benefit from that information across the state and around the world.

Converging Forces

Several forces are combining to create the "perfect storm" in expanding the demand for cyberinfrastructure at MU:

1. Growth in research productivity

Research at MU has continued to grow at a phenomenal rate. External support for research nearly tripled in the decade between 1994 and 2004, and the growth rate in federal resources ranks MU near the top of all AAU public institutions. In the last five years, research expenditures have increased by 50%.

2. Increased use of advanced information technologies across all research disciplines

The need for cyberinfrastructure is not limited to the science and engineering disciplines. Scholars in the humanities and social sciences also require remote access to large data sets, instruments, and archives. A need for collaboration and development of other cyberinfrastructure is felt pervasively throughout higher education, not only in research but also in the fulfillment of the institutions' learning and service missions.

3. Globalization of research fueled by electronic interconnectivity

Many of today's researchers interact more frequently with colleagues in other parts of the world than faculty in different departments on campus. The evolving cyberinfrastructure, consisting of high-capacity dedicated networks, middleware and grid-based resources, is altering both the kind and quality of academic research in higher education. It is stimulating collaborative research endeavors that draw on diverse and dispersed partners across national and international communities.

4. The changing nature of research

Historically, scholarly research in higher education has been characterized by an individualistic and discipline-centric focus involving minimal collaboration. Academic research today emphasizes collaborative teams working across discipline and institutional boundaries. Academic research is also becoming more dependant on computing and networking infrastructures and related enabling technologies.—fostering scientific study that is independent of space and time. Fundamental new approaches to research are exceedingly rare. Information technology has ushered in such a fundamental change. Technology-enabled research has now joined with theory and observation as one of the three primary accepted methodologies in the scientific pursuit of new knowledge.

Converging Forces

5. Changes in the processes supporting scholarly communications, and the emergence of institutional digital repositories

Institutional repositories are digital collections that capture and preserve the intellectual output of university communities. They address two strategic issues facing universities: 1) providing an affordable solution to skyrocketing publication costs of journals in the face of tightening library budgets, and, 2) serving as indicators of an institution's quality, thus increasing its visibility, prestige, and public value. Dozens of universities are developing institutional repositories, e.g. MIT's DSpace.

6. Increasing expectation of federal funding agencies that the university will retain and continue to provide access to research data

As called for in the National Science Board publication: "Long-Lived Digital Data Collections Enabling Research and Education in the 21st Century", National Science Foundation funding proposals are required to include a data management plan. Research universities ultimately will be held responsible for the ongoing responsibilities for storing and maintaining data generated by sponsored research.

7. Increasing emphasis on economic development and its effect on research computing

The University of Missouri recently adopted economic development as its fourth mission. Strategic to this endeavor are the following two major new initiatives designed to promote innovation and academic synergy through public-private partnerships. Both developments will require access to and places new demands on MU's research computing infrastructure.

- MU Business Incubator— $8.4 million 33,000 gsf building to be located east of the Research Reactor.
- Discovery Ridge - a 114-acre Research Park located on the South Farm. ABC Laboratories will be the first tenant.

Conclusion: Planning for Research Computing is Critical

Contemporary research agendas in higher education are dictating an institutional response to provide emerging network capabilities and a growing portfolio of enabling technologies such as middleware, various computing resources connected via grids, visualization and analysis tools, etc. As networks become more robust, in capacity and capability, IT planners and university administrators must find ways to efficiently facilitate access to what is rapidly becoming a ubiquitous component of the national cyber infrastructure. Access to all types of grid-enabled resources is fundamentally tied to networking infrastructures that allow scientists and researchers to collaboratively pursue multidisciplinary and inter-institutional research projects. These are the hallmarks of 21st century academic research which form the benchmarks for IT planners in higher education today.

Recommendations

1. Enhance Communications

1.A Improve web-based and interpersonal communications to assure MU researchers are aware of local research computing capabilities. Provide enhanced access to campus-based cyberinfrastructure so that the majority of researchers who are currently turning to outside sources for their research computing will be able to meet their needs locally.

1.B Proactively identify emerging demands for research computing resources through (a) an enhanced PeopleSoft grant routing sheet prepared for each grant proposal and (b) the administrative systems used for new faculty hires.

1.C Continue strategic planning involving interdisciplinary researchers and monitor and report on progress.

1.D Implement a process for collecting and addressing researcher requests for special-purpose software.

1.E Acknowledge cyberinfrastructure as a strategic asset within MU's strategic planning and resource allocation process.

2. Provide Requisite Support and Training

2.A Leverage the recently approved PhD program in Informatics to assist in meeting the needs of MU researchers and to generate revenue for the University.

2.B Hire additional staff with adequate discipline-specific knowledge to fill the 'informatics gap' between researchers and the computational and data storage facilities they require for optimizing their research.

2.C Provide learning opportunities for current faculty and staff to retool their skills in this important new area.

2.D Hire more technical support staff.

2.E Provide support for the development and maintenance of research project web sites.

3. Implement a Sustainable Funding Model

3.A Develop a sustainable model to finance the replacement and enhancement of existing equipment, and to address the growing need for additional research computing infrastructure. Creatively tap external as well as local resources.

3.B Identify, allocate and coordinate the resources necessary to provide researchers the necessary computing and analytical support

3.C Seek corporate and foundation funding; partner with vendors to secure discounts, including development of arrangements for training and support and/or joint projects.

3.D Work with MU researchers to assign relevant compute expenses (computational access, data storage) as direct costs charged to sponsored projects.

3.E When possible, purchase equipment with non-federal funding so equipment-use and depreciation can be charged as a direct expense of research projects.

3.F Implement recommendations of the faculty group that studied F&A Recovery and Research Investment in 2005 see: **http://www.missouri.edu/~umcresearch/Research/Forms/F_A_Recovery_Final.doc**.

4. Initiate an Institutional Digital Content Repository

4.A Study institutional repositories developed at other universities. Evaluate the benefits and costs of such a system, and if appropriate work with faculty to develop a vision and requirements for a digital repository that fulfills the needs of the University of Missouri.

4.B Charge IAT Services to work with relevant UM-wide entities (e.g. libraries, Library Systems Office, etc.) to begin the development of an institutional repository.

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