

Information Technology in Higher Education: Enabling Change at The University of Texas at Austin

Long-Range Planning for Information Technology Steering Committee

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INFORMATION TECHNOLOGY AND HIGHER EDUCATION
Enabling Change at The University of Texas at Austin
Chapter One:
LONG-RANGE PLANNING FOR INFORMATION TECHNOLOGY -
AN OVERVIEW

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Executive Summary

"Society is undergoing a fundamental transformation from the Industrial Age to the Information Age. Those who realign their practices most effectively to Information Age standards will reap substantial benefits."

Transforming Higher Education: A Vision for Learning in the 21st Century.
Dolence and Norris, 1995 [1].

The University of Texas at Austin is confronting a critical juncture in its history. Throughout the world, information technology (IT) including digital telecommunications are liberating the flow of information, expanding the possibilities for collaboration across distances, and accelerating the pace of change in virtually every field of human endeavor. This emerging digital society represents a new environment in which universities must compete and renders ineffective many of the organizational structures, strategies, and practices which have been successful until now. In this period of rapid change, the riskiest possible strategy is to continue operating as before. If The University of Texas at Austin is to retain its institutional stature and position of academic leadership, it must

- chart an innovative and daring new course and install an agile, responsive, and decisive organizational structure for information technology planning
- support and encourage new and improved modes of instruction, research, and administration
- re-direct resources to the electronic tools which maximize academic productivity and exploit the opportunities of the incipient digital age.

The Context of the Times

The combination of broad-based economic, social, and political conditions which comprise the environment in which UT Austin operates is changing rapidly. State funding is stagnant, if not in outright decline in real dollar terms. Nationally, the tuition and fee costs of a typical college education are increasing faster than the rate of inflation. In addition, students, parents, and political leaders are beginning to question the cost-effectiveness of the traditional university model and its relationship to quality of education in an era when most other types of institutions have reengineered themselves.

At the same time, the expectations and needs of incoming students for digital facilities and curricula are being shaped by a world of pervasive microprocessors and telecommunications which is foreign to the formative educational experience of most faculty and administrators. The job market is transforming rapidly to demand a trained work force which is technologically literate and able to engage in continuous, lifelong learning. As Governor George W. Bush indicated in his *Vision Texas* document, the State must "provide a cost-effective system of higher education which prepares individuals for workforce demands and furthers the development of knowledge through instruction and research." According to the *Back to Basics* planning document prepared by a coalition of higher education leaders in Texas (U.T. System, Texas A&M System, University of Houston System, and Texas Tech University), Texas must increase the

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recipients of bachelor's degrees by 22.5 percent to equal the U.S. average of baccalaureate degrees per population aged 18 to 34, or about 15,200 additional degrees per year. Instruction and basic research are increasingly dependent on access to and use of networked information resources. One EDUCOM report predicts that the demand for information technology-based teaching and learning programs will probably grow exponentially over the next decade.

Austin, along with Silicon Valley in California, is now recognized as a preeminent center of high technology. It is not the University of Texas, but companies such as Dell and Motorola, that are generally perceived as setting the high tech pace in Austin. In contrast, Stanford University and the University of California at Berkeley are often credited with being the driving forces behind Silicon Valley's success. UT's IT program can rapidly achieve world class status through strong institution-wide planning and commitment of resources. Indeed, the continuing vitality of Austin's high-tech industry and the Austin economy in general depends upon The University's success in providing cutting-edge IT facilities and training for all UT students and faculty. In return, making UT a high-profile leader in IT will attract increased investment from Austin's high tech companies.

In conclusion, UT Austin is faced with a set of external forces which simultaneously constrict the flow of additional funds while demanding substantially increased expenditures for information technology resources which have become central to the mission of the institution. We believe that this dilemma can best be resolved through the adoption of an innovative vision for the use of technology at UT Austin, and an aggressive plan to transform that vision into reality.

The Vision for UT Austin

Faculty, staff and students at The University of Texas at Austin must have ubiquitous and seamless access to a collaborative, knowledge-based learning environment that supports instruction, research, service, and administration at any time and place. In partnership with business, government, schools, and alumni, this environment extends beyond the campus boundaries and expands the virtual campus community to students at all stages in the lifelong learning process. Information technology can enhance The University experience by increasing the scope, breadth, richness, and variety of interactions among faculty, staff, and students, as well as affect the structuring, organization, and presentation of information and the production of knowledge. UT Austin will be a leader in higher education in the integration of IT in support of the institutional mission in order to remain a university of the first class and function at its maximum potential in the face of limited resources.

The Plan

To achieve the vision articulated here, The University administration should approve and adopt the following implementation plan by formally establishing the Information Technology Coordinating Council called for in Item 1 and immediately charging it with producing the detailed recommendation, plans, and budgets necessary to implement the remaining items.

Recommendation 1

Institute an agile, responsive, and unified organizational structure for information technology planning, management, and decision-making.

- formally establish an Information Technology Coordinating Council (ITCC) chaired by the Associate Vice President for Academic Computing and Instructional Technology Services;
- modify committee structures reporting to ITCC to eliminate duplication and streamline decision-making;
- charge the Information Technology Coordinating Council with submitting detailed implementation plans, programs, and budgets for the remaining items in this plan;
- develop a clearly defined process for information technology planning and budgeting;
- finalize university policies on access, responsible use, and privacy.

Recommendation 2

Adopt new funding models and resource generating strategies for information technology.

- implement life-cycle funding for major elements of the information technology infrastructure which represent recurring costs;
- develop budget mechanisms for funding capital expenditures of Academic Computing and Instructional Technology Services, Administrative Computing Services, UT Austin Libraries, Colleges, and Departments;
- aggressively seek out complementary strategic relationships with other universities and the private sector to maximize economies of scale and exploit new opportunities in the digital economy;
- make information technology funding a major focus of the Capital Campaign.

Recommendation 3

Plan and deploy an integrated, comprehensive, and robust networking and telecommunications infrastructure to support all types of digital communications.

- develop and implement a Network Master Plan for voice, data, video, facilities management, security systems and alarms;
- complete building wiring;
- integrate wired and wireless communications, external and internal to The University;
- coordinate telecommunications administration.

Recommendation 4

Deploy and operate a "next generation" information environment to support pervasive and aggressive use of information technology in all facets of University life.

- establish comprehensive career paths for information technology staff across the campus, including competitive salaries and opportunities for professional growth and advancement;
- develop an integrated, constituent-based, web-delivered information system;
- deliver one-stop shopping and integration of information technology service functions;

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- implement universal student, faculty, and staff computer and network access as an integral part of the information technology infrastructure;
- develop standards and purchasing programs for hardware and software that ensure a manageable and least cost maintenance program campus-wide;
- aggressively pursue resolution of the Year 2000 problems;
- provide extensive computer training opportunities for the university community;
- acquire an integrated library management system and increase digital library information holdings;
- develop goals and policy for the use of e-mail for official university business, academics and research.

Recommendation 5

Infuse information technology into appropriate areas of University teaching and learning.

- offer monetary and professional incentives for faculty to develop courses delivered by instructional technology and conduct strategic pilot experiments with technology-based courses to assess their effectiveness on learning outcomes;
- establish a first-class system of training and facilities to support faculty in the task of authoring digital instructional materials;
- implement widely accessible delivery systems, both in and out of the classroom, to permit digital instructional materials to be used effectively;
- provide instructional design support and appropriate tools and facilities for multimedia and distance education;
- institute an aggressive program to equip and support technology-enhanced classrooms campus-wide;
- develop goals and supporting policies for technology-enhanced learning and online course delivery;
- establish standards for delivery systems in technology classrooms.

Recommendation 6

Pursue advantageous external alliances with other universities and the private sector.

- develop strategic alliances with other universities (including those in the UT System) in the development of business and academic software and courseware, and in library services and systems;
- leverage outreach programs (alumni, K-12) with effective use of information technology;
- introduce smart card technology through business alliances.

Recommendation 7

Support leading advanced computing programs with appropriate funding.

- participate in national and regional consortia sponsored by state and federal agencies and industry;
- acquire specialized equipment to give faculty researchers access to advanced computing tools and capabilities.

Information Technology and Higher Education: Enabling Change at The University of Texas at Austin

The digital revolution driving societal change is as significant as the invention of the printing press or the Industrial Revolution. Since the introduction of the transistor and the integrated circuit, people have not just been doing things differently; they have been doing vastly different things. Nicholas Negroponte [2] of MIT's Media Lab describes it as the difference between atoms and bits. Atoms are about physical things and bits are about intangible information. As the emphasis shifts from one to the other, almost every aspect of society is altered.

Old Paradigm	New Paradigm
Take what you can get	Courses on demand
Academic calendar	Year-round operations
University as a city	University as idea
Terminal degree	Lifelong learning
University as ivory tower society	University as partner in society
Student=18 to 25-year-old	Cradle to grave
Books are primary medium	Information on demand
Single product	Information reuse
Student as a responsibility	Lifelong revenue resource
Competition is other universities	Competition is everyone
Student as a responsibility	Student as a customer
Delivery in a classroom	Delivery anywhere
Multi-cultural	Global
Bricks & Mortar	Bits & bytes
Single discipline	Multi-discipline
Institution-centric	Market-centric
Government funded	Market funded
Technology as an expense	Technology as differentiate
<i>Adapted from [4]</i>	

In manufacturing, business, and finance, such structural change has already transformed workplaces and marketplaces. In research, developments in areas such as molecular biology and computational finance (fields which owe their existence to information technology) are generating an explosion in which knowledge in some fields is doubling every five years. Now universities, always grounded in information, stand at a digital crossroads, confronted with a rapidly changing environment and a growing realization that ignoring change is no longer an option. The challenge facing higher education is to prepare for an uncertain future and to provide a technology-rich environment where students can obtain the continuously changing knowledge and skills needed to shape that future.

Over the next decade, many R1 research universities will assess broadening their current student clientele to include degrees, courses, certifications, and training made more easily available and customized through information technology. Competing for students, faculty, and especially financial resources in this environment will require a richer vision of education and a restructuring of the organizations, strategies and policies required to achieve it [3].

In order to successfully navigate through the institutional transformation, this vision requires a shared understanding of three key concerns:

1. The increasing impact of external pressures on higher education institutions that we cannot control.
2. The growing importance of information technology to the mission and practice of higher education.
3. The interdependence between organizational structure and effective information technology funding.

Without such a shared understanding, and a commitment to plan for a future that reflects these concerns, information technology efforts on this campus will fall short of what is required to maintain The University of Texas at Austin as a first-class institution.

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In that spirit, this report, based on the work of Long Range Planning Groups, begins by addressing the three concerns listed above as they pertain to higher education in general. Taking into consideration the environment in which The University will increasingly operate, the report moves to consider issues of particular significance to this campus that must be addressed as part of the process of integrating information technology into every aspect of the university experience. In the next section of the report, seven strategic recommendations define a set of priorities for moving The University of Texas at Austin forward in the planning, funding and implementation of information technology. Appendix A includes one-page summaries of the various subcommittee reports addressing specific information technology issues. The working papers for all of the subcommittees are available at:

<http://www.utexas.edu/computer/lrp/theplan.htm>.

External Pressures

During the next decade, higher education will be under considerable pressure to change. New patterns in the economy, demographics, and government spending will force a large number of colleges and universities to restructure fundamentally, as many U.S. business firms and local and national governments have been doing for the past decade or more. This change will take place amid ever-decreasing public support for higher education at local, state, and national levels. Public confidence continues to erode in the ability of colleges and universities to provide students with an education that leads to a good job upon graduation and a rewarding career. Various external constituencies, governments, businesses, parents, and students, increasingly will demand improved quality and reduced costs. As students pay a larger percentage of the cost of their college education, they look for accountability and guarantees. Students will also seek flexible learning opportunities designed to support a series of careers through their lifetimes. As Governor George W. Bush indicated in his *Vision Texas* document, the State must "provide a cost - effective system of higher education which prepares individuals for workforce demands and furthers the development of knowledge through instruction and research."

The transition to a service economy also will have an effect upon higher education. Academic institutions will need to offer instructional and support services oriented to the customer's convenience. Leading businesses and industries of the information age will seek out and support those universities capable of synergistic partnerships to develop advanced technologies and to educate the highly skilled workforce necessary to transfer those technologies to the market. If existing academic institutions are not organized and equipped to participate in such partnerships, new institutions will emerge to meet those needs. Competition for students, faculty, research grants, and contracts will intensify as new institutional reputations are built upon successful adaptation to a changing environment [5-8].

News Flashes

- Penn State University has announced the launching of its "World Campus" in the fall of 1997, including all forms of distance education delivery, along with the implementation of more technology-enhanced classroom teaching on campus.
- Rensselaer Polytechnic Institute is reengineering its large lecture classes by a computer-based combined lecture-laboratory for introductory courses in physics, mathematics, and chemistry. They report substantial reductions in teaching assistant and/or faculty costs, yielding a capital payout of less than two years, and improved learner satisfaction.
- Over the last three years, Northwestern University has become known as an innovator in educational uses of technology and has spent more than \$5 million on wiring for "smart" classrooms.
- The University of Michigan Mcard has the largest University Smart Card program in the U.S. and provides identification, library privileges, building access, and meal plan information. The card also contains a bank stripe and cash chip used for copy and vending machines. Revenue more than offsets the program cost.

- One year ago the University of California at Berkeley decided to outsource its Internet dialup program to a commercial provider. Nine months later, UC-Berkeley revised the outsourcing agreement due to unsatisfactory quality of service and assumed partial control of its network service
- University of Minnesota has requested \$147 million from the State for new information technology projects over the next four years.

Centrality of Information Technology

The days of considering technology simply as an enhancement for the instruction of students, a tool for computational academic scholarship, or the means to the efficient operation of the institution are past. Today, information technology is becoming a mission-critical, central foundation to the future of higher education. While The University's prestige will rest on teaching research, and scholarship, these activities cannot be carried out without an equally strong foundation in information technology. Nearly every significant change in the learning environment requires some application of information technology, from distributing instruction beyond the classroom, providing access to knowledge too recent to be available through traditional publishing, or creating simulations for student manipulation.

The ability to provide a "custom fit" to the needs of individual students within the context of a large, complex institution requires linked networks of information and resources that address both process and product. Over the next ten years, as personal computers, fiber optics, and digital networks expand into homes and businesses, prospective students and faculty will expect the ubiquitous availability of information technology in higher education. The technological advances of the past five years — widespread use of e-mail; the World Wide Web for delivery of content and services by business and academe; networking across home, school, and work environments; home computing for all members of the family; the increasing diffusion of networking and computing throughout the K-12 sector — have permanently altered the environment for institutions of higher education [6].

The University of Texas at Austin is already participating in that altered environment. Networked computers now outnumber telephones on campus. Over 400,000 e-mail messages are delivered daily to and from the university community. Eighty percent of UT students have access to a personal computer in their own residence. The University was selected in 1997 as one of the top 25 "wired" universities in the U.S. by *Yahoo! Internet Life* magazine. Key attributes influencing a high ranking for UT Austin included wired dormitories (completed just several months ago), on-line course registration and advising, on-line transcript viewing, and student Web pages. With over 37,000 subscribers to Telesys, and many additional users on campus, UT Austin has become one of the largest Internet service providers in the state.

Information technology is central to achieving the mission of UT Austin. Long-term, on-going, strategic planning for technology is essential, and it must be integrated with all other forms of major planning in the institution: physical, academic, fiscal, and human.

Organizational Structure and Funding

Like many other institutions ranging from corporations to government agencies, higher education confronts a growing agenda of needs, issues, and questions about the use of digital technologies. Every aspect of The University, from faculty, students, staff, and alumni to libraries, classrooms, research laboratories, offices, and dormitories, is touched and transformed by the information age. Yet, because large public universities have traditionally operated in a decentralized fashion, information technology policies, resources, and funding are too often addressed in a fragmented and myopic way.

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A strategic institutional perspective on the information technology environment is essential for managing that environment. A strategic perspective is required because information technology is increasingly complex, connected, and systemic. Connectivity no longer means connecting a few desktop machines together; it requires linking the budget section of a grant proposal to the campus accounting office, to the management information system in the dean's office, and to a projected spreadsheet in the researcher's conference room. Multimedia content, involving real-time, nonlinear navigation through multiple sources of information, presents real opportunities for delivery of instruction and services to the campus community.

Production of that content and the requisite technological requirements will increasingly be beyond the capabilities of any one campus unit to address. No institution can afford to support large numbers of vastly different computer platforms, information systems, and communication networks. Standardization, where possible, provides opportunities for more services at lower cost.

The organizational structure for information technology services on the UT Austin campus has evolved over the past thirty years. Table 1 depicts the reporting relationships for the various information technology providers, all of which have separate budgets under the control of five different vice-presidents.

The President's Quandary

In 1994, Vartan Gregorian, President of Brown University, offered the following observation about the quandary of a university president in leading this transformation:

On some days the president will be beset by the prophets of the new technology. They will grab you by the arm and feverishly press upon you the revelation that "things are completely different now!" Then on other days you will be dogged by the self-styled protectors of ancient wisdom and old ways. "What is good is not new and what is new is not good," they will whisper darkly. You will think your faculty and advisors have all become Pre-Socratics: "Everything is changing!" announce the breathless Heracliteans; "Nothing changes!" warn the gloomy Parmenideans. To both you will give the same Aristotelian answer: some things change, and some remain the same -- our identity, values, principles, and goals are the same; the technological accidentals we use to exemplify these values in the late 20th century will vary. In fact these must vary, for we cannot remain the same in our essentials unless we change, in our accidentals, to meet the new circumstances.

Table 1. Organizational Structure of IT Entities (1997)

<u>Organization</u>	<u>Reports To</u>
1. Academic Computing and Instructional Technology Services (ACITS)	Executive VP/Provost
2. Administrative Computing Services (ACS)	VP-Business Affairs
3. The UT Austin Libraries	VP-Graduate Studies
4. Telecommunication Services Division (Utilities)	VP-Business Affairs
5. Texas Union Micro Center	VP-Student Affairs
6. Faculty-staff DISC Committees	VP-Research

In addition to the units listed in Table 1, many individual information technology units of varying size and functions are operated by individual colleges and departments (and they report to deans, assistant or associate deans for technology, or department chairs). Developing relationships with technology vendors, including equipment donations, is now managed by the vice president for development. Individual colleges are responsible for distance education programs, although recently, central coordination was established under the aegis of ACITS.

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Adjoined to the staff organizations listed in Table 1 is the DISC* Committee structure, chaired by the Vice President for Research, which provides policy advice to the President through a central campus-wide advisory committee (the DISC Committee). DISC serves as the umbrella for six other information technology-related committees:

- Digital Facilities Committee (DFI);
- Faculty Computer Committee (FCC);
- New Initiatives Committee (NIC);
- Multimedia Instruction Committee (MIC);
- Telecommunications and Networking Committee (TNC); and,
- Computer and Information Technology Use Policies (CITUP) committee

In addition, the Information Technology Advisory Committee (ITAC) coordinates with the DISC Committee and reports directly to the President on the use of student fees for information technology .

The first comprehensive attempt at UT Austin to track overall information technology expenditures, conducted as part of the SACS accreditation self-study, estimated the total within a range from \$70 to \$90 million, or about 10% of the total institutional budget (see Appendix B). These expenditures are divided up among a number of service providers (ACITS, ACS, the UT Austin Libraries, Telecommunication Services Division (Utilities) as well as the fifteen colleges and schools of The University.

A rational information organizational structure for technology must be coupled with revamped funding models to maximize the effective use of existing resources and the opportunity to acquire new resources. The cost of information technology, already perceived by many to be high, will continue to grow as a significant percentage of institutional budgets, perhaps approaching 20%. Allocations of these resources, especially as they occur during structural shifts in the funding base for higher education, demand strategic direction and management for accountability and effectiveness. Further, obtaining new sources of revenue and resources to support the institution's information technology needs, such as strategic partnerships with business and industry, demands a single point of contact capable of formulating plans that reflect a university-wide perspective.

Integrated Planning at UT

In preparing the 1997 Southern Association of Colleges and Schools (SACS) document for re-accreditation of UT Austin, the following assessment was provided by the DISC Committee:

The DISC Committee structure has a number of strengths: 1) it focuses on entrepreneurship in the individual colleges; 2) it fosters local innovation; 3) it is reasonably successful in engaging broad acceptance of a student fee financial base; and 4) it provides for wide faculty involvement for proposing new ideas for information technology and a means for promulgating these ideas, after evaluation, to the highest levels of university decision-making. It also has a number of weaknesses: 1) it provides an insufficient resource base across the colleges; 2) it provides insufficient coordination among Administrative Computing, Academic Computing and Telecommunications; 3) it provides insufficient coherent planning for a comprehensive vision for information technology and its connection to the budget; and 4) it relies on project-based capital investment, creating difficulties in being able to respond efficiently to major recurrent investments in constantly evolving infrastructure, like those encountered in information technology.

This led to the following recommendation by the DISC Committee:

* DISC stands for Digital Information, Science, and Communication

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Building on these strengths, while addressing the perceived weakness, we propose a modification of our current IT management arrangement. Because it spans both Academic and Administrative Computing, an integrated management structure is required. An effective information technology strategy will require a complete rethinking of The University's budget for information technology. We therefore recommend that one person be appointed, reporting through the Executive Vice President, with the following responsibilities: 1) would be responsible for information technology planning and budgeting; 2) would prepare a long range planning strategy for information technology, including information technology delivery through the General Libraries; 3) would provide an annual evaluation of University progress toward the long range goals; 4) would identify new information technology opportunities and their effect on The University's long term plan; and 5) would manage and provide oversight for only those financial resources provided centrally for Academic and Administrative Computing. Responsibility for the management of resources allocated to or generated by colleges, schools, and departments would remain with the respective Deans, Directors, or Chairs in conformity with campus-wide policy. This person would work closely with an Advisory information technology Budget Committee of faculty and staff charged to address the formulation of an information technology business model for The University.

The recent appointment of an Associate Vice President for Academic Computing and Instructional Technology Services, reporting to the Executive Vice President and Provost, satisfies many of the recommendations of the DISC committee. A rationalization of the information technology committee structure should be subsequently carried out, under the leadership of that office. Further, in line with the DISC recommendations and with issues raised earlier in this report, it is expected that UT organizational structures will need rethinking and modification in the future in order to develop and maintain an information technology environment that addresses all of the needs at The University. Examples of future areas that might require organizational changes are given below:

- Data and voice networks will soon find packet video traversing the same physical channels, and increasingly being integrated at higher levels. Internet telephony is on the horizon. The University should integrate the administration and operations of its Utilities and Energy Management Department's Telecommunication Services Division with ACITS' Telecommunications and Networking Services group. This integration should be done to improve the quality of service, increase operational efficiency, and promote the effective application of the telecommunication infrastructure in The University's mission of instruction, research and service. An integrated telecommunications organization would manage the complete lifecycle and functional spectrum of this increasingly critical infrastructure - from planning and design, through installation and operation, to cost recovery and investment. This type of integration also mirrors the service convergence that is inherent in modern digital communication technology: voice, video, and computer communications have converged upon common digital representations, transmission systems, and terminal equipment.
- The development of networked, high-speed laser printers has eliminated many of the technology differences between mainframe laser printing, printing services, and copy centers. A customer-focused approach would promote convenience and ease of use. Should each organization including departmental labs operate disconnected facilities, or could one organization perform all of these functions in a distributed fashion?

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- Various departments, museums, and libraries hold responsibility for the historical records of the institution. When these archives were populated by paper files and pictures, the distinction between the archivists' role and the computer center's role in maintaining archival computer files of administrative data was clear. But what is the role of the modern archivist and the computer center (digital library) when most of the historical information (and in the future photographs and video) is in computer files?
- Media service units are responsible for audio-visual support for instruction, currently provided by slides and movies. Now that audio-visual support is increasingly digital and delivered through workstations, is there a need for separate media groups operating under the old training paradigm? How does The University design, construct, and manage technology classrooms?

To keep information technology support and networking costs low across The University, ACITS and ACS should promulgate standard hardware and software configurations that must be used in order to receive fast, low-cost service. Non standard systems will not receive priority service because of the difficulty of keeping staff trained for a wide range of platforms. This policy is being adopted at other universities and in industry. Bulk purchasing of faculty and staff equipment (as was done in the Faculty Computer Initiative) should help ensure a *de facto* standard. ACITS should also advise new undergraduate and graduate students of recommended standard configurations for each college. The feasibility of establishing standards for research equipment should be investigated as well.

The Texas Union MicroCenter is another information technology service on the UT Austin campus, and, since 1985, has served as the computer sales outlet providing students, faculty and staff quick access to computer hardware and software at good prices. Because both University department financial accounts or personal funds may be used to make purchases there, the Center also establishes *de facto* standards. In addition, the Center's sales provide a source of revenue to the Texas Union itself to fund such projects as student activities. Several years ago, the revenue to the Texas Union amounted to as much as \$1 million. However, with increasing competition from the private sector (especially discount computer brokers), the annual return to the Union now averages around \$300,000 on \$12 million in sales. Since the Texas Union MicroCenter has been a separate (and private) auxiliary enterprise of The University, achieving alignment with campus needs and coordinating functions with other information technology service providers on campus is increasingly problematic. The Texas Union MicroCenter operates a help desk, equipment repair, training classes, and software sales, which are functions also provided on campus by ACITS and ACS. Further, ACITS is now involved in bulk purchasing of computers for department labs and faculty. The main obstacle to integration of the Texas Union MicroCenter with other campus information technology providers is the annual income it provides to the Union. If the Texas Union MicroCenter were combined with academic computing (ACITS), as it is at most major universities, the Union would need another source of income to replace the funds now generated from computer sales. The net gain to The University would include a cost-effective consolidation of information technology sales, support, repair and training.

Consolidations take on increasing importance as acquiring and retaining qualified staff for the increasingly complex digital operations of departments and colleges becomes more of a challenge. The growing demand for support and services at the confluence of communication and computing (networking), coupled with a nationwide shortage of qualified personnel, poses a significant risk for the successful integration of information technology on this campus. The University must strike a balance between centralized, expert support and department-level service. UT Austin must also find career paths for staff across campus and provide training and certification. The Technical support contacts program initiated by ACITS in 1997 is a good first step. Some departments have contracted with ACITS for technical support services. ACITS hires and trains the staff, who are located on-site in the department in order to give prompt service. ACS also hires and provides six-month training for its interns, who are then employed by departments and other offices on campus. With the distributed computing model adopted at UT Austin, ACS and ACITS increasingly rely on staff outside of their organizations to provide front-line service, creating a symbiotic alliance with such staff. However, there should be no misconception: the "virtual university" cannot be sustained by "virtual staff" compensated with "virtual "salaries.

Revamped Funding Models

The presence of so many independent fiscal agents with responsibility for information technology is both a strength and a weakness for The University. It is advantageous to have funding controlled and applied to meet local needs, to avoid the lack of responsiveness that often occurs in centralized organizations. On the other hand, this local focus is often accompanied by inefficiency, increased costs, uninformed decisions on technology selection, unrealistic expectations of support, and non standard solutions. The challenge is to devise a funding strategy that allows for meeting local needs responsively, and to retain a focus on the longer-term strategic goals of the institution. Table 2 summarizes the different funding models for the information technology providers at UT Austin: ACITS, ACS, the UT Austin Libraries, UT System Office of Telecommunication Services (OTS), Telecommunications Services Division (Utilities) and Texas Union MicroCenter.

Table 2
Current Funding Model for IT Providers

Organization	96-97 Total Budget	Income Sources	Income - Amounts	Comments
ACITS	\$10.0	UT Budget (AUF)	\$4.0	(1) Operates training, help desk, computer repair, software distribution, bulk purchasing of PCs.
		Telesys	\$1.3	(2) Telesys income will double in 97-98.
		Software Distribution	\$0.6	
		Printing	\$0.4	(3) NSF grant (97-98) to cover some costs of High Performance Computing Facility (PRC)
		ITAC (Operating)	\$0.7	
		ITAC (Equipment)	\$0.9	
		Facilities Management	\$0.6	
ACS	\$6.3	UT Budget	\$3.5	(1) Mainframe upgrade required in 1999 (\$1.5M).
		Contracts with UT Offices	\$1.3	(2) Operates training, help desk, computer repairs.
		Session charges to depts, offices (line usage)	\$1.5	(3) UT System components pay to use UT Austin administration software.
UT Austin Libraries (General Libraries, Law, HRC, CAH)	\$21.3	UT Budget	\$16.9	(1) UT Austin 1996/97 E&G budget for library materials is \$4.5M; all expenditures for Liberia materials expected to be over \$7.2M.
		Student library fee	\$1.2	(2) Student Library Fee of \$2 per SCH initiated 1/97. Revenue of \$2.4M anticipated for 1997/98.
		UT System	\$1.6	(3) UT System appropriations vary year to year.
		Other	\$1.5	(4) Other includes grants, gifts, revolving funds, and similar sources.
OTS	\$2.0	UT System	\$0.8	(1) Originally an arm of UT System but the actual enterprise has grown much larger due to THEnet. Some staff shared with ACITS.
		THEnet subscriptions	\$1.2	(2) UT System plans to increase funding of OTS in 97-98. (3) Operates help desk, parts storeroom.
Telecommunication Services Division of Utilities	\$7.0	Telephone Billing	\$5.2	(1) Full cost recovery operation.
		Long Distance	\$1.8	(2) Operates help desk, parts storeroom. (3) Subcontracts building wiring installation on campus.
Texas Union MicroCenter	\$12.0	Hardware, software sales	\$12.0	(1) computer sales to departments and individuals. (2) operates help desk, computer repair, training, software distribution. (3) full cost recovery operation including utilities, debt service, and building custodial, and maintenance.

Budget numbers are expressed in \$ millions (M)

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Historically, UT Austin has made computation and communication freely available to faculty, staff, and students. During the 1970s and 1980s, The University made significant annual investments in computing, especially in areas deemed to be at the cutting edge, i.e., research computing in science and engineering. However, with the advent of inexpensive personal computers in the 1980s, computing on campus moved to a dispersed model, and the needs for and usage of computing broadened considerably beyond the original science and engineering base. Because of the emerging computational needs of areas like liberal arts, and tightening capital budgets, such as that from the Available University Fund, the budget for computing not only declined but also was spread over a broader group of users.

This led to regents approval in 1993 of an information technology fee of \$6 per semester credit hour. This fee provides over \$7 million per year to fund campus computing infrastructure (such as the Student Microcomputer Facility) as well as departmental and college computing labs and services. Because most of these funds (about 75%) were generated from undergraduate students and were to be used for their benefit, the focus of the Faculty Computer Committee expenditures changed from supporting research computing to supporting instructional computing (although Information Technology Advisory Committee funds could be used for graduate-level individual instruction or research, since graduate students pay the same fee of \$6 per SCH). Since 1993, colleges have been required to develop vision plans describing their information technology expenditures. Plans are submitted to the FCC and then to ITAC for approval.

During the past five years, the ultimate oversight of campus-wide information technology fee expenditures has moved from the FCC to ITAC, and in fact, the composition of the FCC has changed from committee whose members were primarily interested in research to a more democratic representation by every college and school. As a result, the capital equipment needs of research computing have no established funding source. Instead, the acquisition and maintenance of high-performance computing equipment is accomplished through unpredictable, *ad hoc* sources such as individual faculty startup packages and grants from the National Science Foundation. Without a dependable source of operating funds, the usefulness of the equipment is severely compromised. The ITAC funds are also inadequate to meet the growing information technology needs of colleges and departments. Consequently, the colleges and departments have responded by instituting of a variety of separate information technology and learning resource center fees (total for 1997-98 estimated at \$5 million campus-wide). Before the fees are approved, student input is solicited and the proposed fees must be approved by the Provost's office to ensure that they are commensurate with cost requirements. Still, research computing remains an orphan: colleges and departments are scrambling to obtain needed resources, and private gifts of capital equipment may be rejected because of a lack of operating funds designated for meeting campus-wide needs.

The provision of funds for telecommunications equipment suffers from a similar difficulty, although beginning in 1997-98 a partial funding model will be established that matches revenues with expenses from a specific enterprise, namely the Telesys dial-up service. UT Austin has become the Internet service provider for approximately 60,000 faculty, staff, and students, with roughly two-thirds of the users with an off-campus connection. Access to the Internet from on-campus is free, but off-campus, users of Telesys are charged approximately \$3.50 per month (to be increased to \$7 per month in 1997-98, well under the commercial ISP rates). The income from Telesys services will be used to fund enhancements to UTnet for improved Internet access and for the staff to operate UTnet on a continuous basis: 24 hours per day, 7 days per week. However, the Telesys funding model for telecommunications infrastructure may be insufficient three years from now, due to changes in the commercial environment.

The University also benefits from other telecommunication services it provides. The Office of Telecommunication Services (OTS) manages voice, data, and video traffic for the UT System and is partially funded by the UT System. OTS also operates THENet, which provides Internet connectivity to over 350 educational and public sector institutions (school districts, universities, colleges, and libraries) throughout the state. By having this infrastructure operated by staff at UT Austin, we imbed UT Austin's costs into the larger group of users, achieving a significant economy of scale. Clearly OTS and THENet are of great strategic value to UT Austin, and it is in The University's interest to retain these operations and the corresponding staff expertise. Without expert networking staff, UT will be at the mercy of the commercial telecommunication companies.

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The telecommunications budget mentioned earlier does not cover wiring of campus buildings, which is estimated to be a \$7 million capital investment. Over the past two years, the pressing need for completing the wiring of the campus has been factored into various funding requests to the UT System and elsewhere, but no source of funds has yet been identified to accomplish this task. Discussions with private vendors, such as phone companies, might lead to some type of alliance where capital funds could be provided externally, but no solutions have yet emerged.

It is clear that the network is becoming mission-critical for faculty, staff, and students. With increased usage of multimedia in teaching and research, the capacity of the network will

need to expand, doubling every 12 to 18 months based on current trends. In addition, new technologies, such as cable modems and asymmetric digital subscriber line service(ADSL), will be available in some cities in 1997. ADSL offers ten times the bandwidth of ISDN in the "pull" mode at approximately the same cost, and users of UTnet will begin demanding it for specialized applications. Desktop video-conferencing will also rise in popularity during the next few years due to technology and bandwidth improvements, and this will place additional stress on the network. Of course, such premium services will need to be priced in accordance with the increased costs of operation and equipment, as done currently with ISDN service.

The UT Austin Libraries is another inadequately funded infrastructure provider, at least in comparison to peer schools. By providing several functions for the UT System, such as the UT System Knowledge Management Center, some of UT Austin's costs are covered by UT System funding. In addition, the UT Austin Libraries receive a special appropriation directly from the Board of Regents every year. Clearly there is some potential long-term risk in this arrangement if separate funding ends. Only recently did the UT Austin Libraries gain approval of a student fee for library usage, but this income is far below satisfying the needs for supporting the comprehensive digital library needed by a first class institution.

Administrative Computing Services (ACS) suffers from some of the same lack of connection between service revenues and investment. ACS permanent staff expenses are directly funded, two-thirds from the Business Affairs budget and the remaining salaries by other offices on campus (e.g., Student Affairs) on a project basis, usually for software development. One recent example of such a project is the advising program, IDA. As with OTS and the UT Austin Libraries, UT Austin provides administrative computing services to other UT System components at a price far below the cost of commercial software or individual operations at each component. ACS also provides a help desk and training for administrative computing personnel at other campuses, which is viewed by those components as a valuable benefit. Recently, ACS began modifying its operational model to include a Web-based, client-server approach using software authentication over UTnet, rather than operating a separate, secure network. There is also a stated need to develop a comprehensive, integrated student information system that has a customer-oriented front-end as well as a data warehouse concept that will deliver needed planning information directly to campus managers and administrators. However, there is no budget to provide for the development of such services.. It should be mentioned that other large universities have chosen to outsource this kind of software development, with startup costs of around \$20 million. Clearly such outsourcing is not feasible under the current fiscal climate at UT Austin.

Consideration of life cycle costs for computer equipment is another funding imperative implied in some of the previous discussion . A computer lasts about 36 to 42 months. Until recently, it has been the responsibility of departments, colleges and individual faculty to provide computer equipment for faculty and staff. The main departure from this policy is the Faculty Computer Initiative (FCI) from the Provost's office, which attempted a broad replacement of computer equipment and software across the campus at a cost

Online Library Access

Students in a first semester English composition class have been discussing a national magazine article about the ethical implications of genetic engineering. A student asks if there is any additional information on the subject. "Look it up!" the instructor suggests, and the student turns to her computer and connects to UT Library Online. The class continues discussing the article. By the end of the period, the student has found the complete electronic versions of several related periodical and newspaper articles, a discussion of genetic engineering from the online version of Encyclopedia Britannica, and a number of references in UTNetCat, the library's online catalog. She emails all of those things to her classmates via the class listserv.

of \$1.8 million. The FCI was perhaps the first recognition that the institution should provide essential productivity tools to the faculty, but it was a one-time investment. A similar program should be implemented to upgrade and purchase equipment for UT staff as well. Operating in a digital environment requires that everyone have access to the technology required to do their jobs. A hidden benefit in

instituting a regular program of hardware replacement is campus-wide standardization. This in turn reduces the range of expertise and lowers the cost of technical support. Lower costs for software and hardware are another benefit of bulk purchasing. ACITS recently implemented a bulk purchasing program offering large discounts to department for computer hardware. The life cycle costs for faculty and staff computers would be around \$1000 per year per person for the equipment, with support costs and software expected to be about the same or higher each year. (This is still lower than the Gartner Group estimate for true computer support costs of \$3000 per computer per year.) Even though some of these costs are already imbedded in MO&E and other University financial accounts, the total additional cost commitment would be substantial for UT Austin.

Using a Virtual Classroom

A nationally renowned scholar, a leading figure in the movement to broaden access to university education, is visiting the UT campus. She sits down at a computer in a windowless room in Parlin Hall and logs into a "virtual classroom," where she joins a discussion already in progress between students enrolled in a lower-division writing course at UT and a group of high school honors seniors in a parallel-enrollment class at Roma High School in the Rio Grande Valley. This is the first time the students from Roma High School have had the opportunity to converse with a living author and to make the connection between something they have read and a living person.

Teaching and Learning in the Virtual University

The 1997 report by the Kellogg Commission (carried out under the auspices of the National Association of State Universities and Land Grant Colleges which UT Austin is a member) on the future of state universities, recommended that "our learning communities should be student-centered, committed to excellence in teaching and to meeting the legitimate needs of learners, wherever they are, whatever they need, whenever they need it." This anytime/anywhere environment is desirable goal for UT-Austin and its current customer base and it can be utilized as a springboard to serve other learning constituencies in the State of Texas and beyond in the future.

Integrating information technology at UT Austin will require careful planning and experimentation over the next decade to effect a major change in teaching, learning, research, and public service. This will not be an easy process. Universities exhibit many of the same impediments to change seen in businesses before they are reengineered: lack of speed, inflexibility, lack of corporate will, archaic business models, focus on internal processes, entrenched habits and skills, and a desire for perfection. Many faculty members and administrators will believe that gradual evolutionary change over a period of thirty years or so is the best path to transformation. However, responding to evolutionary technological change may be an inefficient way to manage a comprehensive research university. Simply adding technology in an incremental way to curriculum and instruction will not reduce costs, although it may slightly enhance the classroom experience. Automating student educational services without a commitment to improving the quality of the student-institution interaction will not produce long-term positive outcomes.

Robert Heterick, President of EDUCOM, asserts that "when a revolution is brewing, a focus on the past as a way to extrapolate the future can be misleading". Instead he suggests that university leadership should create a scenario for the future and then set the course. Ten years from now, the vast majority of students in the U.S. will not be pursuing a degree program; instead they will seek to update their skills and knowledge base in response to changes in the economy. While this process is often referred to as "lifelong learning", Dolence and Norris [1] have labeled it with the imperative phrase "perpetual learning". The nontraditional student population in Texas will increase significantly in the future, and UT Austin must decide whether and how it will serve this group in addition to, or in place of, the requisite number of 18 to 23 year olds.

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Over half of the colleges at UT Austin have educational programs underway or in planning that are focusing to a certain extent on the non-residential professional education market.

Indeed, The University of Texas at Austin has already begun moving toward creation of a “virtual university”, a parallel structure arising alongside the existing physical one. The traditional modes of teaching and research of R1 universities such as UT Austin will still dominate ten years from now, but changes at the perimeter can and should occur [5,8]. The paradigm shift offered by the Virtual University can be illuminated by comparing two models of student learning:

Video Conferencing and Virtual Instruments

Three professors and their graduate students are huddled over the workstations in their respective offices. Dr. Williams at Lehigh University is working with his colleagues at UT Austin and Oak Ridge National Labs; on their screens are the working draft of their paper and the presentation slides for the upcoming national colloquium. The final copies are due in this week and they are using on-line video conferencing and shared documents to work out the final details. Also on screen are live images from a high resolution transmission electron microscope at Oak Ridge National Labs, clearly showing the atoms in their super thin metal experiment, with each participant able to position the view and magnification. The lively debate as to how best to present their findings continues over the Internet late into the night

- Traditional (linear) model: a sequence of topics are covered in a series of lectures, held in classrooms at weekly intervals, with homework practice in between. All teaching is done synchronously. Everyone proceeds at the same pace, regardless of their interests, prior experience, talents, or demands on their time. At the end, grades indicate the level of achievement attainable in the fixed time period for the course.
- Hyperlearning (nonlinear) model: there are a series of check points (learning stations) with a starting point and ending point for each, which is guarded by a certifier to assess student competence against well-defined standards. The student can visit any station to learn certain topics in an order consistent with his or her current knowledge. Trial certifications and self-assessment tests are elected by the student periodically to check progress. Everyone who completes the course and passes the certification test gets the same grade ("competency"). This approach is called nonlinear because of the ability to jump to different topics and take different paths enroute to the final objective. Learning can take place asynchronously where the instructors and student may be separated by time and place. The analogy to hypertext, now the standard in multimedia and Web-based education, is obvious. In this model the richness of the latest instructional technology tools will need to be exploited in order to ensure learning outcomes and student satisfaction comparable to the traditional approach.

Not every course or cohort of students will benefit from the latter approach. However, the hyperlearning model may figure prominently in addressing new issues that education customers are now raising, e.g., requests for post-baccalaureate professional education, access to asynchronous Internet-based learning, distance education, wider ranges of student preparation, certification of practical specialized competencies, collaboration in education and research, and competition with private organizations entering the education market. In addition, UT Austin should:

- reconsider faculty rewards and incentives (e.g., promotion and tenure, salary) especially given the extra time and effort required to develop courses delivered by technology,
- find resources to provide technical support (infrastructure), classroom facilities and training/release time to faculty who want to adopt new methods,
- find the appropriate balance between productivity increases, faculty overloads, and quality of education, including the incorporation of off-campus students into residential classes.

Given the decentralized nature of education at UT Austin, colleges and departments should formulate plans to deal with these topics as part of their compacts and performance-based instructional systems with the Provost's office. Colleges should also assess the need for distance-education courses and work with the

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Provost's office in developing the appropriate campus infrastructure, which is currently inadequate compared to other major universities.

Asynchronous modes of learning suggested in the nonlinear instructional model already play a role in research. Doctoral research work involves thoughtful contemplation and writing in an independent setting and supervision of dissertation or thesis research is sometimes carried out over a distance. In other cases email and videoconferencing can augment face-to-face meetings between a research student and members of the supervising committee. On the other hand, research utilizing laboratory experimentation requires a structured environment (e.g., well-equipped laboratories). It would be difficult to perform experimental research at a distance, although sharing of expensive, specialized equipment through virtual connections will become more common in the future. The existing one-year residency requirement for the Ph.D. at UT Austin establishes a minimum amount of synchronous faculty/student and student/student interaction. The Distance Education Task Force in their report to President Berdahl (1997) reaffirmed support for this requirement and also no residency requirement for the Master's degree. Both of these rules afford considerable latitude for the use of distance education in the graduate student program of work.

Technology classrooms equipped with Internet access as well as computer projection capabilities (including portable units) are another critical need. There is no credible estimate of the percentage of wired classrooms, since no such records are kept by Official Publications or Institutional Studies. ITAC funds are being used (\$0.5 million in 1997) to renovate existing classrooms into technology classrooms in various colleges, but the cumulative percentage is probably less than 5% of the total number of classrooms at UT Austin. Some major universities are already at the 50% level in terms of classroom wiring, so it is clear that UT Austin is behind in this area. The University spends other funds each year on classroom remodeling, but this does not cover adding technology to each room. It is reasonable for The University to commit long-term funding for this purpose roughly equivalent to the cost of other major renovation projects (\$25 million). This would wire and equip around 200 to 400 classrooms, using a standard design framework so that Physical Plant A&E Services does not have to deal with a large number of different room specifications. A question still to be addressed is how to provide campus-wide support for classroom operations, a role currently played by audio-visual groups who are more accustomed to operating 35 mm slide projectors.

Research

The digital science and information revolution is rapidly transforming the ways we conduct research, collaborate, solve problems, and disseminate knowledge. The integration of computers, telecommunications, audio, video, multimedia, and other digital technologies creates a worldwide information environment that can be accessed easily from the laboratory, office, field, and home. Information technologies can be used to augment and magnify the capabilities of the human mind across all disciplines and serve as agents of scientific and intellectual innovation for the academic community. The near-term impact of IT on research in science, engineering and business are relatively transparent but there are clearly impacts in the arts and humanities and specialized fields represented by library science, social work, and others.

Digital sciences, which include broad areas of the computational sciences, computational applied mathematics, digital libraries, telecommunications and multimedia, and related areas, have been identified by The University as a principal research thrust to be expanded over the next decade. Significant progress has been made toward realizing this goal, including the creation of an interdisciplinary graduate degree program (involving thirteen academic departments in Science, Business and Engineering) in Computational and Applied Mathematics (CAM). The University has established six endowed chairs and fifteen supporting tenure track positions in support of the CAM program. Research centers formed under the umbrella of TICAM include Center for Subsurface Modeling, Center for Computer Visualization, Institute for Computational Finance, Center for Numerical Analysis, Computational Fluid Dynamics Laboratory, and others.

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In 1997 The University became a major site in the National Science Foundation's program for National Partnerships in Advanced Computing Infrastructure (NPACI); see Appendix A.7. The University of Texas at Austin is part of the five year NPACI grant led by the University of California at San Diego, and will develop high-performance computing theory and practice under the direction of CAM faculty. The University of Texas at Austin is also a member of Internet 2 and has been awarded a vBNS grant from NSF, to provide high bandwidth capabilities for UT Austin faculty research. This may include, for example, digital libraries with audio and video content, collaboration and immersion environments, interaction in music instruction, remote monitoring of experiments, and data-intensive applications.

An eclectic review of current science and engineering literature reveals a potpourri of changes in how research will be carried out in the future in different fields because of the impact of information technology:

- astronomy: compilation of digital sky surveys in many wavelengths and use the resulting terabyte data bases for analysis.
- biology: coupling of different organ models to gain a holistic view of how organs function in health and disease.
- neuroscience: development of a complete structural and functional map of the brain, including the inner working of individual nerve cells.
- chemistry: simulating the effects of molecular structural properties such as stereochemistry in order to develop improved drugs, without having to resort to numerous chemical and analytical tests of the drug.
- physics: prediction of the strength and toughness of a material (how well it resists cracking) and the number of defects when two dissimilar materials are combined in a composite, based on quantum mechanics.
- materials science: design of passivation films for preventing corrosion damage.
- computational finance: development of numerical techniques that can enable real-time decisions in financial markets.
- business: data mining where intelligent agents draw simple conclusions from large databases (e.g., how should retail warehouses be stocked according to the season).
- manufacturing: simulation to design and operate efficient factories that manufacture high quality, just in time products as well as to understand and predict three-dimensional, time-dependent phenomena in process equipment.

It is clear from the above examples that experimental scientists in the future will rely more heavily on computational and visualization tools, possibly with less intensive capital investment in equipment and laboratory facilities. Experimentation is relatively more expensive to perform with today's stringent safety requirements.

The increased use of data bases in research is leading to more interest in the field of informatics (information organization, storage, retrieval, processing, and visualization) as one that cuts across a multitude of disciplines. This could be an area where groups in library science, computer science, and molecular biology, for example, could collaborate on real-time analysis using large data bases. Informatics could be used to access genomic databases in order to compare genes in healthy and diseased tissue, to identify new therapeutic targets, and to understand the impact of new drugs.

Multimedia aided by hardware and software advances is expanding the realm of applications of high performance computing into the arts and entertainment. Distributed multimedia technology is increasingly

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critical in highly content-driven creation and delivery applications, such as real-time news and entertainment, computer animation, navigation of image-intensive databases, and 3D virtual environments. New computing technology offers the opportunity to migrate creation and delivery applications to off-the-shelf systems, which offers significant enhancement in research productivity not available today.

Information technology is transforming knowledge itself by radically altering the tasks and goals of scholarship. One type of scholarship is to compile and document everything connected with a certain artist or person of interest. With computers such lists can be produced in a few minutes with a computer. Therefore, the kinds of questions scholars have traditionally tackled may become obsolete, or rather they will become so easily solved that scholars can concentrate on other things. For example, a classicist often spent a lifetime reading through the major texts of classical literature in order to understand the evolution of concepts such as nature or love. Today, most Greek and Latin literature exists electronically and is available on-line. Tracing the etymology and all the uses of a word takes only a matter of minutes even if the question of their interpretation still requires some time. A Shakespearean scholar, instead of simply studying a single text, may choose to study the history of different editions and translations. Historians have usually limited themselves to studying what the evidence showed happened, as it actually was. Now they can use virtual reality to create various scenarios and test hypotheses about urban organization, social structure, and economic factors. Visualizations are becoming so realistic that these tools can no longer be dismissed as conjectural.

So often in the past a scholar spent a lifetime working on some difficult or esoteric problem, unaware that someone else was interested in the same thing. Independent scholars can use the emerging tools in seeing new patterns and trends, not just the facts but the contexts in which they arise, and share the results on-line without the normal journal publication delay. Collaborative tools will allow people inclined to cooperate to compare results more regularly. Dolence and Norris have described the global networking faculty groups a "collaboratory". No longer is it a requirement that a department maintain multiple experts in a single field so they can have colleagues for face-to-face interaction. In some cases, a faculty member's ties to the collaboratory may be stronger than the connections to his or her own department or university.

No truly significant computer-based scholarly practice can emerge until the huge body of literary texts and ancillary materials that form the basis of literary research has been converted to digital (library) form. Therefore, we can expect to see considerable energy going into the production of electronic scholarly editions and into the problems of encoding these materials for scholarly use. The Text Encoding Initiative Guidelines published in 1994 by an interdisciplinary working-group of humanities scholars represent one effort in this direction.

There has been relatively little work so far on computer-based analytical tools for studying large bodies of text; available tools are comparatively crude, and are not designed to handle graphics or to work in a distributed environment. Tools will emerge in the future that can cope with compound texts and large corpora whose constituents may be globally distributed, as well as text-analysis tools that employ scientific visualization techniques to represent patterns of very small elements that become visible only in very large aggregations of text. Such tools will become increasingly important in dealing with documents which, like hypertext or virtual environments (whether text-based or graphical), are composed on-line and which must be read or viewed or enacted in on-line environments because they cannot be meaningfully instantiated in print. Existing tools can be possibly modified to support the analysis of these materials, e.g., the use of

Changing Research Methodology

Due to the influence of IT, my research in strategic management now involves working with larger sets of data over longer periods of time, and employing more sophisticated computational techniques. I am working with more collaborators who are geographically distant because it is easy to stay in touch and share documents. Illustrative data for article manuscripts are obtained from the Internet because journal referees like the idea that the data will be accessible to the reader. Unfortunately, I now have to keep up with the field of IT in addition to my own subject area, reading the equivalent of eight or nine extra journals a month. In addition, more of my research is carried out in conjunction with private industry because they can afford the data and computer power needed to do cutting-edge work.

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Web-statistics utilities to help scholars understand the rhetorical effectiveness of specific sites, etc. Scholarly interest in digital originals may outpace interest in computationally-based study of print-based materials, both because of generational changes in the composition of the field and because the task of converting print materials to digital form will proceed much more slowly than the production of new electronic "texts".

Changes in computer science and engineering will likely modify how research and scholarship are carried out, perhaps as early as the year 2000. This includes such items as:

- groupware for collaboration
- query of image content (vs. query of text)

Lifelong Learning: A Competitive Advantage

It is April 1, 2005. Ted Ellis, a Plano High School senior, has been accepted into Plan II at UT Austin but also received an acceptance into the College of Engineering at the University of Michigan. Texas appears to have a slightly better football team for next year but Michigan offers a comprehensive lifetime learning program for its alumni that is delivered directly to home computers of those alumni who subscribe. Since both Ted's mother and father have worked in industry, they recognized the need for retraining, especially that offered by a leading university, Ted accepts the offer of admission from Michigan even though its tuition costs are significantly higher. Texas finishes fifth in Big 12 football the following fall, and Coach John Mackovic's job is in jeopardy again.

- use of intelligent agents for searching the web
- speech synthesis and text to speech conversion

The University's information technology infrastructure could provide the campus research community with a wealth of research and development opportunities. Today, these opportunities include the areas of high performance networking, distributed system management, system security, personal identification, records management, and multimedia delivery. Performing research in these areas, with the campus IT infrastructure as the focus of the research or as a experimental instrument, would yield symbiotic benefits. The University's research mission would be advanced while simultaneously extending selected elements of its IT infrastructure to tomorrow's capabilities and performance.

Clearly information technology will impact the kinds of faculty hired by departments and colleges at UT-Austin, and most faculty will need to stay up to date in some aspects of IT in order to carry out cutting-edge research. This suggests a greater need for training of faculty by faculty, not only in instructional tools, but also in research tools that are IT-based. One other impact of IT is the need to form interdisciplinary groups on campus in order to attack important, multi-faceted problems in advanced computing that have high potential for external funding. University leaders can proactively serve as brokers to put together interdisciplinary teams. A research (high performance) computing committee broadly representing the campus research community could help implement such a strategy.

Outreach

The Institute for Technology and Learning (ITAL) was established as an organized research unit in 1996 and charged with identifying, designing, creating, and disseminating high-quality, computer-based instructional materials to the Texas K-12 community and to serve as a research and development organization for the Texas Education Network (TENET). Startup funding was provided by the Texas Education Agency/TENET, but future TEA funding is in doubt. ITAL is developing innovative programs involving schools across the state, and tools created to support these projects will be available for use in UT courses and other outreach projects. Outreach promises a significant return on investment in terms of the applicant pool, community relations, and the quality of the Texas educational system.

Successful deployment of new instructional materials requiring the use of new, highly complex technologies depends upon successful, continuing, and systematic professional development for the 230,000 teachers in Texas. TENET's statewide network of master trainers could form the nucleus of a first-rate faculty development corps, capable of training teachers and administrators to integrate technology effectively into the curriculum--and of complementing the regional service centers and other commercial ventures. These trainers' activities could be further enhanced by volunteer mentors and trainers from interested UT Austin graduates, local businesses, and community organizations. The University should also support college- and department-level initiatives to recruit and train excellent students to serve as K-12 teachers and peer counselors. The approach is being used successfully at the University of Michigan.

The Kellogg Commission report also supports strengthening the partnerships between universities and elementary and secondary schools in order to create a seamless educational continuum and make better use of scarce educational resources. In fact, this concept can be extended to "K through Gray", to indicate that the continuum should include lifelong learning. ITAL, TENET, the Telecommunication Infrastructure Fund, and Greater Austin Area Telecommunications Network (GAATN) provide opportunities for UT Austin to interact with secondary schools, both locally and statewide.

Business Plan

The preliminary cost estimates to implement each of the groups of recommendations are shown in Table 3. The responsible offices or groups for implementation for each recommendation are shown in Table 4. Budget items 3a, 3b, 4a, 4c, and 4d require a non-recurring project effort, while the remaining projects involve recurring capital expenditures and/or operating/staff costs of a constant amount each year once the recommendation is fully implemented. For each recommendation we show a starting date and a phase-in period over a two to seven year horizon; a starting date of 1997 indicates the urgency of initiating a particular activity while later starting dates imply a somewhat lower priority. The variable length of ramp-up period to full life cycle funding is due to a combination of two factors: the gross amount of funding needed and the time required to obtain such funding through legislative action, establishment of new fees, generation of new external income streams, or re-allocation of existing expenditures within The University. We show ranges for items (2a, 4b) that have a great deal of uncertainty regarding implementation details.

The magnitude of funding needed each year is a significant ongoing increment to the 1995-96 IT funding level of \$70 to \$80 million per year, but it should be noted that the total IT spending projected for 2004 (\$100 million per year) is less than the \$120 million per year the University of Michigan (serving 35,000 students) spends on information technology. The assumptions used in developing Table 3 are briefly explained in the explanatory notes for the table.

With such large capital and recurring cost requirements, it is clear that new funds cannot be derived by charging departments and colleges higher service fees; that approach is a zero-sum game. Increased funding could be realized through increased legislative appropriations, increases in student fees, or gaining permission to set a tuition rate different from other universities in the State. Viewed purely as a per capita charge, we need to obtain new revenue in the range of \$600 per student per year in order to implement all IT recommendations. In comparison, during 1995-97, the General Fee was increased from \$12 to \$32 per credit hour, which provides incremental income of roughly \$500 per student (for the two Long Sessions) over the two year time period.

There is the possibility of reduced costs and/or increased income for The University through a number of IT initiatives, namely:

- external alliances with technology companies, to provide equipment for instruction, research, and technology development
- increased amount of grants from outside agencies in the areas of instructional technology, high performance computing, and digital libraries
- lifelong learning programs (distance education) marketed to a variety of constituencies
- smart card implementation and revenue sharing with commercial entities
- paperless administrative functions and mailings
- IT as a major focus of the Capital Campaign

We have not attempted to estimate the revenue or cost implications of these initiatives, since all of them require an induction period of several years. We should note, however that several business alliances will have short term impact, such as with Intel, Dell, IBM, and GTE. These are being pursued by a partnership of various College deans, the Development Office, and the Associate Vice President for Academic Computing and Instructional Technology Services.

High Priority Recommendations

The working papers of the Long Range Planning Committee contain over 100 specific recommendations made by the eleven groups. See

<http://www.utexas.edu/computer/lrp/theplan.htm>

The twenty eight member steering committee prioritized these recommendations and aggregated them into seven components for the long range plan. Each general recommendation is given below, along with an elaboration of the tasks involved. The committee has structured the plan so that implementation of Recommendation 1 is a necessary condition for the other six recommendations. In other words, the management structure, which includes the Information Technology Coordinating Council chaired by the associate vice president must be in place to carry out integration, planning, budgeting, and coordination. Then the Information Technology Coordinating Council can proceed to develop more details, cost estimates, and time schedules to begin implementing the remaining recommendation of the long range plan.

Recommendation 1

Institute an agile, responsive, and unified organizational structure for information technology planning, management, and decision-making.

- *formally establish an Information Technology Coordinating Council (ITCC) chaired by the Associate Vice President for Academic Computing and Instructional Technology Services;*
- *modify committee structures reporting to ITCC to eliminate duplication and streamline decision-making;*
- *charge the Information Technology Coordinating Council with submitting detailed implementation plans, programs, and budgets for the remaining items in this plan;*
- *develop a clearly defined process for information technology planning and budgeting;*
- *finalize university policies on access, responsible use, and privacy.*

The Information Technology Coordinating Council (ITCC) will have the responsibility of formulating and updating the integrated long-range plan (LRP) for information technology and keeping the Executive Officers apprised of budget ramifications of the LRP. Within the context of biennium budget planning, the ITCC will develop detailed implementation (tactical) plans, programs, and budgets, and identify who is responsible for implementation. These plans will be developed in cooperation with college deans, who have budget responsibilities for their units. ITCC will predict and monitor the impact of new technological developments on The University's mission, including best practices of peer institutions. ITCC will also identify opportunities for collaboration with other universities (including the UT System) as well as government and private sector partners. Finally by its composition, ITCC will seek to achieve better integration of information technology services and functions across the various information technology organizations of UT Austin.

The planning process will be led by the Associate Vice President for Academic Computing and Instructional Technology Services, who will convene and chair the ITCC. The 15 to 20 members of the coordinating council should represent leadership of academic units as well as the major information technology constituencies on campus plus have student representation. The existing IT committees should be reviewed and restructured in light of the Council's scope. ITCC would make budget and other recommendations to the executive officers since these recommendations would likely cut across the responsibilities of a number of Vice Presidents. If most of the IT functions and organizations are integrated

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together in the future, a new Vice-President position (Chief Information Officer, or CIO) could be created to be responsible for all IT functions and budgets.

The University now spends over \$70 million annually on information technology resources of all types. These expenditures are made by a variety of different departments and offices, with no formal procedures for coordination. Unified tracking of all major information technology budgets and expenditures would result in substantial progress toward both the integration of information resources and their efficient use. Integral to this process will be utilizing the College reports to students on how their technology fees are spent. In order to remain competitive, The University must use this coordinated approach to develop a wholly new and innovative model for funding, budgeting, and managing information technology resources, a model that recognizes their unique and rapidly changing role in the institution.

The Computer and Information Technology Use Policy committee (CITUP) has dealt with information technology policy matters in the past but is completing its work. Task forces similar to CITUP should be established to deal with policy issues as they arise, such as new legislation, court decisions, Regents Rules, and technology changes as they relate to institutional information technology policy; advise the administration on new policies or on the interpretation of policy interpretation; and to promote awareness of information technology policy within The University community.

Recommendation 2

Adopt new funding models and resource generating strategies for information technology.

- *implement life-cycle funding for major elements of the information technology infrastructure which represent recurring costs;*
- *develop budget mechanisms for funding capital expenditures of Academic Computing and Instructional Technology Services, Administrative Computing Services, UT Austin Libraries, Colleges, and Departments;*
- *aggressively seek out complementary strategic relationships with other universities and the private sector to maximize economies of scale and exploit new opportunities in the digital economy;*
- *make information technology funding a major focus of the Capital Campaign.*

In dealing with future costs of information technology and operations of The University, special attention should be paid to life-cycle costs for the growing equipment base for computing and communications, formally recognizing and budgeting for the periodic technological obsolescence and replacement of computer hardware and software. In many instances, life-cycle funding is also necessary for ongoing support costs such as training, maintenance, trouble-shooting, and repair. Life cycle budgeting is intended to fund essential technology resources as perpetuities rather than viewing them as apparent one-time, *ad hoc* funding decisions.

Such funding is especially relevant for capital computing equipment needs for staff and faculty as well as ACITS, ACS, and the UT Austin Libraries. Currently there is an insufficient and unpredictable ongoing capital funding base. Asset management practices are needed to identify, quantify, and implement cost-saving opportunities in consolidated procurement, deployment, technical support, maintenance, software volume licensing, usage metering, electronic distribution, and retirement of information technology resources.

As indicated earlier in this report, a multitude of funding models are used in the operation of information technology services and infrastructure at UT Austin. Not only is there a need for new funding models and more efficient use of available funds, but also, through a variety of strategic relationships with the private

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sector, The University should try to increase its funding base. There is considerable interest among technology companies who would like to partner with UT Austin to test new technologies and to provide commodity services (e.g., wireless telephone and smart card). There is also an urgent need to incorporate information technology needs in the capital campaign, since few of the informational technology constituencies has been asked to participate. We believe some of the needs and opportunities presented by integration of information technology into all aspects of The University's mission are very attractive for potential donors. However, this will not provide any short-term solutions to IT needs.

Recommendation 3

Plan and deploy an integrated, comprehensive, and robust networking and telecommunications infrastructure to support all types of digital communications.

- *develop and implement a Network Master Plan for voice, data, video, facilities management, security systems, and alarms;*
- *complete building wiring;*
- *integrate wired and wireless communications, external and internal to The University;*
- *coordinate telecommunications administration.*

Telecommunication and network systems provide the information technology infrastructure for The University. The integration of voice, video, and data distribution is inevitable and must be addressed from both administrative and technological perspectives. Emerging needs in such areas as technology classrooms, campus security, and environmental control should be considered in any discussion of The University's data communications infrastructure. The ongoing transition of UTnet from a relatively passive data conduit to a mission-critical resource for the entire UT community — campus-based and beyond — fundamentally changes how The University plans, manages, and funds its telecommunications and networking system.

A Network Master Plan prepared by outside consultants is required for several reasons. It is imperative to determine whether the interbuilding data transmission needs and costs of all interested parties on campus can be simultaneously optimized by a single plan. A Network Master Plan is also important for the master plan for the campus. The wiring standards promulgated in 1995 by the erstwhile Physical Network Standards Committee remain the blueprint for intra-building wiring at The University for the next five years. The aim of those standards was to support the inevitable migration to higher bandwidths for data communication as well as to accommodate the potential integration of voice/data/video over a single wiring infrastructure. Cost estimates for achieving ubiquitous Category 5 intra-building wiring on campus range from \$6 to \$7 million exclusive of hubs, routers, switches, etc. Completing the installation across campus of Category 5 wiring awaits a source of funding. The advent of wireless technology may offer new economic options for communication, both on and off campus. This mode may become dominant for students in some colleges that are pursuing portable computer initiatives.

From a functional perspective, Utilities (Telecommunications Services Division) is primarily responsible for providing voice telephone services and telecommunications media placement and is operated as a full-cost-recovery service bureau. ACITS is responsible for UTnet operations, video services, and GAATN. Both groups have cooperated closely, if informally, in the design, development, and operation of The University's telecommunication infrastructure. However, the convergence of voice, video, and data raises an important concern about the campus inter-building fiber optic infrastructure. To date, it has been installed incrementally and on an *ad hoc*, tactical basis: an inefficient and ultimately very costly practice. This problem arises partly as a consequence of the administrative separation that often exists between the units responsible for media installation and those managing information across that media. This separation must be addressed in the integration of information technology operations discussed in Recommendation 1.

Recommendation 4

Deploy and operate a "next generation" information environment to support pervasive and aggressive use of information technology in all facets of University life.

- *establish comprehensive career paths for information technology staff across the campus, including competitive salaries and opportunities for professional growth and advancement;*
- *develop an integrated, constituent-based, web-delivered information system;*
- *deliver one-stop shopping and integration of information technology service functions;*
- *implement universal student, faculty, and staff computer and network access as an integral part of the information technology infrastructure;*
- *develop standards and purchasing programs for hardware and software that ensure a manageable and least cost maintenance program campus-wide;*
- *aggressively pursue resolution of Year 2000 problems;*
- *provide extensive computer training opportunities for the university community;*
- *acquire an integrated library management system and increase digital library information holdings;*
- *develop goals and policy for the use of e-mail for official university business, academics and research.*

The University faces a near-crisis situation in recruiting and retaining staff with adequate skills and training in the technical areas necessary to support the development and maintenance of our information technology infrastructure. The specific staff positions in shortest supply are programmers, systems analysts, networking technicians, and local area network (LAN) and microcomputer support personnel. There is a discrepancy between the pay scales for these positions at The University compared to those offered in the private sector in Austin and around the nation (typically 30%), compounded by an increasing number of job opportunities in these fields in the private sector.

Directors, department heads, and managers at all levels need easy access to management information about all aspects of their operations in order to provide the most effective and efficient leadership for their areas of responsibility, including trend analysis, budget projections, and historical patterns. Data warehousing represents an expense that goes beyond the basic information technology infrastructure historically funded out of the core administrative computing budget. New funding sources must be found to develop and support this additional service and to apply it to the reengineering of existing transaction-based systems.

The topic of "one-stop shopping" for information technology cuts across all areas of the Long-Range planning effort. The University presently offers a wide range of services, but no single source offers all of the services required on a regular basis by students, faculty, and staff. One-stop shopping might be viewed as a goal for the interface to all campus information technology services, both physically and electronically.

Within the next three years, The University should formally adopt the policy that electronic, networked communication will be the "primary and preferred" means of interacting with students, faculty, and staff for administrative and business transactions. Such a policy requires computer access. A transition to electronic communications for routine administrative functions can save or offset substantial operating costs by reducing printing and postage costs and reducing the staff time necessary to process administrative procedures. Movement to electronic communications would simultaneously improve the quality of administrative services by making them convenient and available 24 hours a day, and encouraging self-service both physically and electronically.

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A regular program of hardware replacement (under the umbrella of asset management) can result in approaching *de facto* standardization on several platforms and software packages around the campus. This is already being done through the bulk purchasing programs of ACITS for new faculty (Faculty Computing Initiative), for departmental laboratories and the Student Microcomputer Facility (SMF). With fewer platform types, it will be easier for information technology service organizations and departmental staff to provide technical support. This standardization will also help the campus deal with the Year 2000 problem that has received much attention in the press. Since recommended hardware and software standards at UT Austin will be Year 2000 compliant, The University can avoid many of the problems presented by potential software failures on January 1, 2000.

A comprehensive digital library is a linchpin for creating an environment that allows students, faculty and staff to carry out their work anytime, anywhere. Increased numbers of students working off-campus will need expanded digital library resources. The scope, size and functionality of the digital resources of UT Austin General Libraries is currently limited by funding levels. Significant increases in budgets are needed to acquire an integrated library management system (ILMS) and expanded holdings of digital information resources. The latter area will also need augmentation in the area of images, video, film and advanced media.

Four of the information technology organizations listed in Table 2 train faculty, staff and students. The University should examine how increased cooperation can make more efficient and effective use of training personnel in the four groups. The University should also investigate adding new courses that are Web-based or on-line. It is desirable to increase the number of highly skilled faculty, but this will not be achieved by purely voluntary means. Teaming of faculty and students seems to be an attractive option, much like the Undergraduate Research Opportunity Program at MIT (funded by their administration). We should provide all UT Austin graduates with a basic level of computer literacy and internship opportunities (on campus and also in Austin's high technology industry), which will make them more attractive for possible employment.

Recommendation 5

Infuse information technology into appropriate areas of University teaching and learning.

- *offer monetary and professional incentives for faculty to develop courses delivered by instructional technology and conduct strategic pilot experiments with technology-based courses to assess their effectiveness on learning outcomes;*
- *establish a first-class system of training and facilities to support faculty in the task of authoring digital instructional materials;*
- *implement widely accessible delivery systems, both in and out of the classroom, to permit digital instructional materials to be used effectively;*
- *provide instructional design support and appropriate tools and facilities for multimedia and distance education;*
- *institute an aggressive program to equip and support technology-enhanced classrooms campus-wide;*
- *develop goals and supporting policies for technology-enhanced learning and online course delivery;*
- *establish standards for delivery systems in technology classrooms.*

Programmatic actions to promote technology-based instruction fall into four topical categories:

- curriculum development;
- faculty, staff and student development;
- integrated networked learning environments;

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- access to digital resources.

In order to encourage an environment which promotes improved teaching and learning at all levels through the use of appropriate new technologies, we must promote curriculum planning and programmatic action in all academic units to respond new media technology. The Provost's office should encourage all academic units to prepare technology integration plans incorporating new technology, as appropriate, into curriculum and degree plans. Technology integration plans should include such information as infrastructure needs and resources for administrative and support personnel associated with basic curriculum change over short and long-term timelines, as well as defining how new technology will enhance and improve traditional learning modes.

Changing modes of higher education will demand a major reorientation of the human resources that make up The University: faculty, staff and students. Much attention is being given in administrative circles to the hardware delivery systems associated with new instructional technology: computers, networks, and classrooms. It is imperative that equal attention be paid to The University's human capital- the developers, maintainers and users of the hardware. This will entail the establishment and continuous upgrading of training programs, providing adequate incentives (e.g., release time or summer support) for Colleges to undertake courseware development, and providing the technical support and facilities needed for development of a variety of courseware types as well as possible commercialization of courseware. The University needs to engage in planned experiments to evaluate the cost effectiveness of instructional technology as well as assess learning outcomes from technology-based courses. Strategic courses should be targeted where introduction of technology is likely to be cost-effective and offer enhanced learning outcomes. Availability of university staff consultants in instructional design will be necessary to re-design courses.

Explosive growth of the Internet as a medium of information distribution and personal communication has profound implications for higher education. An important goal of The University must be to promote and develop the potential of computer networks, and the Internet in particular, as a complement to conventional instructional environments. The current anarchic structure of the World Wide Web, while appropriate as a first-generation paradigm, will not adequately serve the more rigorous requirements of a formal education system. Some degree of coordination, collaboration, and integration of instructional media will be needed to ensure uniformly high quality and availability to the diverse constituencies we serve.

As educational resources in digital form become more widely accepted, limitations on access to these resources by faculty and students will become a critical impediment to their adoption unless measures are taken early to assure that they are fully available to all who need to use them. This includes the tools that faculty and staff need to develop instructional media, the facilities and infrastructure (e.g., technology classrooms) to deliver them, and the tools that students need to use them. This implies a future expansion in staff and facilities of the Center for Instructional Technologies.

Recommendation 6

Pursue advantageous external alliances with other universities and the private sector.

- *develop strategic alliances with other universities (including those in the UT System) in the development of business and academic software and courseware, and in library services and systems;*
- *leverage outreach programs (alumni, K-12) with effective use of information technology;*
- *introduce smart card technology through business alliances.*

A major impetus for changes in information technology at UT Austin will be initiatives by the UT-System. Andersen Consulting Company recently completed a comprehensive study for the UT System, based on extensive interviews and discussions with focus groups at every UT component institution. The Andersen consulting report covers the following topics:

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- Distance Education
- Knowledge Management (Digital Library)
- Telecommunications
- Telehealth
- Multimedia Instruction
- Workgroup Collaboration Tools
- Clinical Research
- Administrative Support Systems
- Student Information systems
- Common Data Warehouse
- System Smart Card

Under the leadership of Dr. Mario Gonzalez, UT System Vice-Chancellor and Chief Information Officer and using UT System funding, many elements in the above topics (especially the first four) will be implemented during the next biennium. UT Austin staff are heavily involved in developing the implementation plans. Potential cost savings can be realized by sharing of instructional and administrative software (e.g., the last four areas).

In the area of outreach to K-12 schools, both TENET and ITAL offer capabilities to leverage content developed by UT Austin faculty as part of their normal research and instruction activities. Expanded outreach is a strategic initiative that could have short and long-term benefits: student recruitment, direct service to the states' primary and secondary schools, and creating a positive impression among the States' elected leaders.

The University has recently joined with the Ex-Students Association in a venture to offer an e-mail forwarding service to UT alumni. As more graduating classes are added to the roster of active alumni e-mail subscribers, UT Austin will have a powerful tool to stay in contact with former students. This electronic access to UT Austin will give our graduates future options for access to lifelong learning and delivery of educational materials.

An increasing number of U.S. universities are now either using smart-cards or making plans to do so in the next three years. This trend is being driven by several factors: a) the economics of smart-card technology is improving as the cost of both the cards and card readers has fallen sharply in the last two years; b) the expanding use of the Internet for personal communications and electronic commerce has increased the need for a universal authentication mechanism; and c) smart-cards can be used to improve the quality and convenience of services for students while providing the institution with a new revenue stream. Through an alliance with private sector companies, The University should conduct a thorough evaluation of the suitability of smart-card technology to provide debit card services, document storage, and authentication for Internet services. A major pilot project should be conducted in which smart-cards are distributed to faculty, staff, and students on a controlled but large-scale basis.

Recommendation 7

Support leading advanced computing programs with appropriate funding.

- *participate in national and regional consortia sponsored by state and federal agencies and industry;*
- *acquire specialized equipment to give faculty researchers access to advanced computing tools and capabilities.*

In September 1997, UT Austin will begin a relationship with The University of California at San Diego and the San Diego Supercomputer Center (SDSC) through a successful proposal to the NSF's Partnership for Advanced Computational Infrastructure (PACI) program. This partnership will provide additional funds for the operation and capital expense of providing high performance computing resources in exchange for a significant fraction of UT Austin computing resources for the nation's research community. This long-term commitment to the continued support of high performance computing demands a new vision for the role of

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high performance computing at The University of Texas at Austin and its overall economic impact in the State of Texas.

Compared to peer institutions around the nation, the total budget for high performance and research computing at UT Austin is insufficient to support a competitive computation-based research program of national recognition, even with the additional financial support provided by NSF PACI funds. There is presently no funding plan for high performance computing and related research infrastructure at U.T. Austin. The current budget commitment of \$900,000 per year for the next five years is inadequate to support a nationally competitive research program in computational science. We believe that \$1.5 million per year is the minimum funding necessary and is comparable to funding levels for similar programs at peer institutions.

The State of Texas and neighboring states support an unusually high level of activity in high performance computing and related technologies. This level of support is derived from both private and government sources and is important to the economic vitality of the State of Texas. Forming cooperative consortia could provide additional resources for UT Austin.

The University of Texas at Austin is positioned to play a leadership role in high performance computing through its participation in the NSF PACI program. This initiative will bring high visibility to the quality of the research programs at UT Austin and will provide tremendous educational experiences for our students, both graduate and undergraduate, in the coming years. A short-sighted policy would view this opportunity as merely a substitute for University funding, rather than the strong leverage it provides for strengthening and broadening UT's research program in advanced computing. High performance computing brings considerable resources to The University - both through the five-year duration of the PACI program, and also through additional research funds that are leveraged through sponsored research in the colleges and organized research units. The University of Texas at Austin must be successful with the PACI initiative if it is to secure a leadership role in advanced computing technologies for the State of Texas in the 21st century.

Table 3
Preliminary Cost Estimates for LRP Recommendations
(Project Expense/Recurring Expenses)

#	Item	Recurring Expense (\$/yr.)	Project Expense (non-recurring)	Phase-In Period
	Recommendation 1 - Unified Planning Structure			
1a	I.T. Coordinating Council budget	\$ 200,000	0	1997-2000
	Recommendation 2 - New Funding Models			
	Life-cycle Funding for:			
2a	Desktop Computers for Faculty/Staff	\$1,000,000 to \$8,000,000	0	1998-2004
2b	Desktop Client Support Services	\$2,000,000	0	1998-2004
2c	UTnet Backbone Hardware/Software	\$2,000,000	0	1997-1999
2d	Central Servers Hardware/Software	\$1,500,000	0	1998-2002
	Recommendations 2 Totals	\$6,000,000 to \$13,500,000	0	
	Recommendation 3 - Integrated Telecommunications Infrastructure			
3a	Complete Building Wiring 2	0	\$8,000,000	1997-2001
3b	Develop Network Master Plan 4	0	\$ 200,000	1997-1998
3c	Increase Staffing for Network Operations	\$200,000	0	1997-1998
	Recommendations 3 Totals	\$200,000	\$8,200,000	
	Recommendation 4 - Deploy Next Generation IT Infrastructure			
4a	Integrated Administrative Services, Data Warehouse	0	\$10,000,000	1997-2001
4b	Competitive Salaries for Technical Staff	\$1,000,000 to \$7,000,000	0	1997-2002
4c	Address Year 2000 Problems	0	\$1,500,000	1998-2000
4d	Integrated Library Management and Digital Resources	\$2,000,000	\$3,000,000	1998-2001

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	Recommendations 4 Totals	\$3,000,000 to \$9,000,000	\$14,500,000	
	Recommendation 5 - Infuse Instructional Technology			
5a	Incentives to Faculty	\$300,000	0	1998-2000
5b	Training and Support Facilities/Staff	\$700,000	0	1997-2002
5c	Technology Enhanced Classrooms	\$2,400,000	0	1997-2000
	Recommendations 5 Totals	\$3,400,000	0	
	Recommendation 6 - Pursue External Alliances			
6a	Support Outreach Programs	\$500,000	0	1997-1999
6b	Introduce Smart Card Technology	\$300,000	0	1998-2002
	Recommendations 6 Totals	\$800,000	0	
	Recommendation 7 - Enhance High Performance Computing			
7a	Ongoing Support for HPC and Visualization (staff/equipment)	\$900,000	0	1998-2000
	Grand Totals	\$15,000,000 to \$28,000,000	\$22,700,000	

Explanatory Notes for Table 3

Recommendation 1 - Unified Planning Structure

1a. I.T. Coordinating Council Budget - The ITCC will require administrative staff and operating funds in order to carry out its mission of providing overall management and coordination for the University's IT infrastructure. This amount includes two full time staff positions and sufficient funds for on-going data collection and analysis, external consultants as needed, and production of reports and recommendations.

Recommendation 2 - New Funding Models

2a. Lifecycle Funding for Desktop Computers - The upper limit for this item are based on the assumption of a forty-two month life for a desktop computer multiplied by the total number of faculty and professional staff.

2b. Lifecycle Funding for Client Support Services -These figures are based on an increase of 50 technical support staff (in addition to approximately 700 current staff).

2c. Lifecycle Funding for UTnet Backbone Hardware/Software- This cost represents on-going investments in hubs, routers, switches, renewal and maintenance of existing equipment, increased bandwidth capabilities and the implementation of new telecommunication technologies as they are available and needed.

2d. Lifecycle Funding for Central Servers Hardware/Software - This estimate includes servers needed for administrative as well as academic computing needs, and the acquisition of software licenses and maintenance contracts.

Recommendation 3 - Integrated Telecommunications Infrastructure

3a. Complete Building Wiring -This item calls for full funding of the wiring recommendations initially made by the Building Wiring Committee in their 1996 report to the DISC Committee and effectively extends the basic wiring required for access to UTnet services to all UT buildings (one-time project expense).

3b. Develop Network Master Plan - This is an estimated one-time cost to hire an external consulting firm to develop a comprehensive master plan for an integrated, comprehensive, next generation telecommunications services for the UT Austin campus.

3c. Increase Staffing for Network Operations- This items funds the addition of three new technical network operations staff positions for UTnet development and support.

Recommendation 4- Deploy Next Generation IT Infrastructure

4a. Integrated Administrative Services - This item combines funding for the Administrative Computing projects to provide comprehensive, constituent-based services over the Web and decision support services for managers using data warehousing technologies.

4b. Competitive Salaries for Technical Staff - The upper bound of this cost funds an across-the-board 30% increase in salaries for all University staff, regardless of department, with technical IT titles such as programmer, analyst, network specialist, etc. These figures are based on an in-depth study conducted by the Management of Administrative Computing Services with the assistance of the Office of Human Resources, ACITS, and other administrative offices.

4c. Address Year 2000 Problems - This item is intended only to provide supplemental funding to assist the numerous Year 2000 efforts already underway across campus. The one-time funds will be targeted for high risk/high priority Year 2000 projects.

4d. Integrated Library Management and Information Resources - The project cost estimate, provided by General Libraries, is for acquisition of a current generation Integrated Library Management System. The operational expense estimate is for the acquisition of digital content and resources to be made available through electronic access.

Recommendation 5 - Infuse Instructional Technology

5a. Incentives to Faculty - This estimated cost is to provide initial seed money to establish a fund for the development of courses to be delivered through instructional technology. Grants and awards from this fund will be made to faculty members on a project basis.

5b. Training and Support Facilities - This supplemental funding for the Center for Instructional Technologies, TeamWeb, and other existing faculty support organizations is based on an estimate of unmet faculty needs for training and assistance in developing interactive instructional materials.

5c. Technology-enhanced Classrooms - The figures for technology-enhanced classrooms are based on the assumption of equipping 30 classrooms per year at an average cost of \$80,000 per room. The total number of UT-Austin classrooms is about 700.

Recommendation 6 - Pursue External Alliances

6a. Support Outreach Programs- This cost is based on an estimate of necessary ramp-up funds for projects designed to use IT to strengthen connections between the University and its numerous external constituencies, such as K-12, alumni, donors, and private industry.

6b. Smart Card Technology- This cost represents an estimate of the start-up and ongoing expenses required to develop and deploy this technology as an IT product that provides required campus functionality and also ultimately provides a source of revenue.

Recommendation 7 - Pursue High Performance Computing

7a. Ongoing Support for High Performance Computing and Visualization - This cost is based on an assessment of the requirements for technical staff, general operations and matching funds necessary for a research computing faculty at an R1 institution.

Evidence and support for the assumptions driving cost estimates in this table can be found in the full report available at:

<http://www.utexas.edu/computer/lrp/theplan.htm>

Table 4
Implementation of LRP Recommendations
Involving Budget Actions

#	Item	Authorize	Responsible/ Accountable	Execution (includes budgeting)
Recommendation 1 - Unified Planning Structure				
1a	I.T. Coordinating Council budget	PRES, EO	ITCC	ITCC, ACITS, ACS, GL, Deans
Recommendation 2 - New Funding Models Life-cycle Funding for:				
2a	Desktop Computers for Faculty/Staff	PRES, EO	ITCC	ITCC, ACITS, ACS, Deans, PROV, VP-BUS
2b	Desktop Client Support Services	PRES, EO	ITCC	ITCC, ACITS, ACS, OHR, Deans, PROV, VP-BUS
2c	UTnet Backbone Hardware/Software	PROV	ITCC, ACITS	ACITS
2d	Central Servers Hardware/Software	PROV, VP-BUS	ACITS, ACS	ACITS, ACS, PROV, VP-BUS
Recommendation 3 - Integrated Telecommunications Infrastructure				
3a	Complete Building Wiring 2	PRES, EO, PROV, VP-BUS	ITCC	ACITS, TSD, Deans
3b	Develop Network Master Plan 4	PRES, PROV, VP-BUS	ITCC	outside consultants
3c	Increase Staffing for Network Operations	PROV, VP-BUS	ACITS	PROV, VP-BUS, ACITS
Recommendation 4 - Deploy Next Generation IT Infrastructure				
4a	Integrated Administrative Services, Data Warehouse	PRES, VP BUS, PROV, Deans	ITCC	ACS, Deans
4b	Competitive Salaries for Technical Staff	PRES, VP-BUS, PROV, Deans	ITCC	PROV, VP-BUS, OHR, ACITS, ACS, GL
4c	Address Year 2000 Problems	VP-BUS, PROV	ITCC	ACS, ACITS
4d	Integrated Library Management and Digital Resources	PRES, EO	GL	GL, Deans, Faculty
Recommendation 5 - Infuse Instructional Technology				
5a	Incentives to Faculty	PRES, PROV	ACITS, PROV	CIT, PROV, Deans
5b	Training and Support Facilities/Staff	PRES, PROV	ACITS	CIT, PROV, Deans
5c	Technology Enhanced Classrooms	PRES, PROV, VP-BUS	ITCC	VP-BUS (Phys.Plant), CIT, ACITS, PROV, Deans
Recommendation 6 - Pursue External Alliances				
6a	Support Outreach Programs	PRES, PROV	ITCC	PROV, ACITS, Deans
6b	Introduce Smart Card Technology	PRES, EO	ITCC	VP-BUS, ACS, ACITS, PROV
Recommendation 7 - Enhance High Performance Computing				
7a	Ongoing Support for HPC and Visualization (staff/equipment)	PROV, VP-RES, Deans	ACITS	ACITS, Deans, PROV

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Appendix A

Working Group Summaries

1. Academic Computing

The current burgeoning growth of information technologies places increasing demands on the human and financial resources of The University, and those resources are increasingly decentralized about campus. It is apparent that centralized planning and coordination are needed for the efficient management of those resources. Access to information technologies is more than a question of hardware, software, network connections, and operating systems; just as important are institutional planning, financial management, intercollege and interdepartment coordination, and the provision of support to all faculty.

Our key recommendation is to establish a clearly defined planning body for information technology within The University, authorized by and making recommendations directly to the President. In addition, it is essential that The University develop a campus-wide business plan for information technology expenditures, provide adequate and ongoing training to personnel supporting computing resources in departments and colleges, and provide adequate computer power to faculty with teaching responsibilities.

The planning process should be led by the new Associate Vice President for Academic Computing and Information Technology Services; who should be charged with 1) identifying, prioritizing, and resolving information technology issues within the context of a comprehensive campus-wide information technology masterplan; 2) convening campus-wide teams (*ad hoc* subcommittees and task forces) to research and define information technology standards and policies; 3) publishing and promoting these standards and policies; and 4) maintain awareness of external information technology standards and best practices among peer institutions and in industry. The Associate Vice President should convene and chair an Information Technology Coordinating Committee to oversee the planning process.

The SACS Accreditation Study Committee has recently documented the fact that The University now spends over \$67 million annually on information technology resources. These expenditures are made by a variety of different departments and offices, with no formal procedures to maximize coordination and minimize redundancy and duplication. In its 1994 report "Improving Information Technology Integration at The University of Texas at Austin," the FCC found that "while informal collaboration among the major providers of information technology access has created progress towards integration of its information resources, The University lacks institutional mechanisms and infrastructure for attaining effective integration." A unified review of all major information technology budgets and expenditures would result in substantial progress toward both the integration of information resources and their efficient use. While there are legitimate organizational needs for separate information technology expenditures to originate from different offices, the Committee contends that central planning can 1) help to identify and eliminate redundant and otherwise unnecessary expenditures, 2) provide a formal mechanism for encouraging integration of services where applicable, 3) promote more innovative and efficient use of available resources, and 4) facilitate integrated reporting to external state agencies, such as was done the biennial operating plan.

Any new financial model for information technology resources must include three elements: a) life-cycle budgeting for information technology resources, b) institution-wide asset management practices that recognize the unique characteristics of Information Technology; and c) rigorous "business case" analysis of major purchasing decisions. Life-cycle funding is defined here as the practice of formally recognizing and budgeting for the periodic technological obsolescence and replacement of computer hardware and software. In many instances, life-cycle funding is also necessary for ongoing support costs such as training, maintenance, trouble-shooting, and repair. Life-cycle budgeting is intended to fund essential technology resources as perpetuities rather than viewing them as one-time, *ad hoc* funding decisions.

2. Administrative Computing

The vision of Administrative Computing is for an environment in which students, faculty, and staff can conduct all routine business with the institution twenty-four hours a day, seven days a week, via one-stop-shopping over the Internet. In this environment, deans, directors, and department heads will have immediate access to accurate, timely, and appropriate decision-support information, to achieve new levels of efficiency through reengineered work flow and electronic commerce.

Over the last eighteen months, Administrative Computing Services has made substantial progress toward this vision by focusing on true network-delivered services, using technologies such as the World Wide Web for interactive applications and data warehousing for decision support. The use of these technologies has produced important benefits as well as new costs and challenges, and progress is well underway toward delivering all administrative services directly over the Internet. The first generation of data warehouses now provide trend analysis, projections, and other services to decision makers.

To gain full advantage and efficiency from the new generation of networked services, The University should formally adopt the policy that electronic, networked communication will be the primary and preferred means of interacting with students, faculty, and staff for: a) distributing official administrative information services; b) collecting and receiving forms-type information; and, c) conducting transaction-oriented business such as paying fees or updating records. An aggressive transition to electronic communications for routine administrative functions can save substantial operating costs by reducing printing and postage costs and staff time necessary to process administrative procedures.

All students, faculty, and staff wishing to use administrative services must have access to a current-generation personal computer. The University should therefore adopt a life-cycle funding program to replace institutionally owned desktop computers every forty two months.

Another essential cost is professional technical staff. The University faces a near-crisis situation recruiting and retaining staff with adequate skills and technical training necessary to develop and maintain the institution's information technology infrastructure. This crisis is due primarily to a) the discrepancy between The University pay scales for these positions and those offered in the private sector, and b) the increasing number of job opportunities in technical fields. The University administration should immediately raise salary rates substantially, campus-wide, for programmers, systems analysts, networking technicians, and local area network and microcomputer support personnel.

Finally, three broad requirements must be addressed to achieve the Administrative Computing vision:

1. Establish a comprehensive, collaborative, and decisive campus-wide planning process to address the full range of information technology issues;
2. provide a secure, robust, and comprehensive campus-wide information technology infrastructure, including Utnet, necessary to support electronic administrative services; and,
3. secure adequate funding to keep pace with the demands for rapidly expanding and changing technologies.

3. Telecommunications and Networking

The campus telecommunications network, UTnet, conveys the lifeblood of information technology at The University. UTnet also supports the communications needs of telephone services, campus security, and building environmental controls. Once the exclusive province of leading-edge researchers, the telecommunication infrastructure on campus has become an essential utility for the entire community.

By every measure, UTnet witnessed exponential annual growth over the past few years, as faculty, staff, and students grasped the importance and understood the capability of this new means of communication. The growth in the number of users will slow dramatically over the next year or two as access becomes ubiquitous. Nonetheless, for the indefinite future, demands on the raw capacity of the network as well as network-based services will continue to grow at rates requiring continuous upgrades of all facets of the basic

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infrastructure. This growth is driven by the continuing convergence of digital video, voice, and computer-generated information and the increased sophistication of multimedia application technology that enables the effective combination of these three types of information.

The campus has reached an important threshold with the recent announcement of an award from the National Science Foundation to fund a high capacity research network connection known as the Very High Speed Backbone Network Service, or vBNS, which likely will be the genesis of the next generation of the global Internet. (At present this network is limited to fewer than 20 major US universities.) This high-capacity connection has implications in terms of both the practical — how will high capacity networking be integrated with the existing network — and the theoretical — how do we plan for new network-based services and applications that will emerge from the national vBNS initiative.

The recommendations for telecommunications and networking start with the need to fund a Network Master Plan, a strategic plan for the physical and logical layout of interbuilding data communications on campus. The *ad hoc* design and construction of the current infrastructure cannot continue without risking tremendous economic and technical inefficiencies. The critical role played by the campus network, which now must take into account data needs that extend beyond UTnet, the “computer” network, to include such things as security and environmental control systems and the integration of voice, data, and video, must be acknowledged and treated with the same respect and planning as is given the distribution of water and electricity on campus. The Network Master Plan must also contain appropriate recommendations for the phased introduction of next-generation switching technology throughout UTnet.

The inevitable integration of voice, data, and video distribution suggests a need for the re-evaluation of the organization of information technology services on campus, specifically ACITS and the Telecommunications Services Division (Utilities). A single entity needs to be established and charged with responsibility for the design, development, and operation of all telecommunication facilities and associated services.

4. Digital Libraries

In pursuit of its primary mission to support and enhance The University’s learning, research, and public service programs by providing access to information resources and library services, the UT Austin Libraries continue to follow a strategic plan of using computing and information technologies to enhance and extend this access.

More must be done to meet the escalating information needs of students and faculty. Funds available for information resources, encompassing not only traditional library materials located on campus, but also the increasingly rich and diverse world of electronic information, have steadily fallen behind those of peer institutions. UT Austin information-resource expenditures, per faculty member, are significantly lower than at Berkeley, Minnesota, UCLA, and Michigan. A base budget increase of \$4M is needed to address the immediate situation, as is the development of an ongoing budgetary mechanism to address continuing inflationary pressures and scholarly demands for information resources.

The University libraries have long followed a development plan to provide state-of-the-art services, not only for the Austin campus but also for The University of Texas System and beyond, through collaboration and resource-sharing partnerships. By combining funding from the UT System Board of Regents, external grant funding, and collaboration with UT System component libraries, with consortia relationships among libraries of other publicly supported institutions of higher education within Texas, UT Austin libraries have created an array of information-technology based resources and services. The digital library concept encapsulates the vision.

Continued development and enrichment of UT Library Online, UT Austin's digital library initiative, is needed to provide the carefully selected information resources to complement The University’s programs, the interactive reference and consulting services, the digitized representations of The University’s unique holdings, and similar hallmarks of today's digital library. Digital libraries are central to the teaching, learning, and research of The University community and to the lifelong learning needs of citizens throughout the state.

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While a digital library is designed to deliver information content directly to the user, an integrated library management system (ILMS) is the software used to manage the operations of the library. The current UT Austin library management systems (online catalog, circulation, acquisition, and serials control) lack many functions contained in vendor systems. The UT Austin libraries must secure a standards-based ILMS, built upon an open systems architecture, that will fit comfortably into the distributed computing environment on the UT Austin campus and that will meet the needs of the General Libraries, Tarlton Law Library, the Ransom Center, and the Center for American History.

5. Instructional Technology

In the coming decade, digital information technology will offer expanded opportunities for educational systems, unbounded by physical, institutional, geographical or temporal limits. This technology will unquestionably change the nature of instruction in The University in fundamental ways.

Many of the topics concerning the educational uses of information technology focus on the nuts and bolts: computers, systems, and networks. Equally important is the "soft side" of the equation, the formulation and support of strategies to create an environment at UT in which innovations in educational methods can co-evolve with new information technology. This section recommends actions on how these innovations can be integrated into the mainstream of academic life at UT.

An extensive listing of programmatic recommendations to promote technology-based instruction is contained in the detailed report of the working group. These recommendations fall into four general categories: curriculum development; faculty, staff and student development; support of networked learning environments; and access to digital resources.

Two principal needs stand out in this list of recommendations:

1. The need for incentives and a first-class system of training and facilities to encourage faculty to undertake the daunting task of digital courseware development and to support that development process; and
2. The need for widely accessible delivery systems, both in and out of the classroom, to permit these materials to be used effectively in University instruction.

Implementation of the first of these recommendations will require a combination of financial resources and an institutional commitment, not only for programs and facilities, but for institutional change that will permit faculty to receive appropriate credit for their creative contributions. The second recommendation will require a continuing program of renovation, acquisition, maintenance, and renewal of capital equipment to support the instructional process on a scale larger than that ever experienced in The University's history.

Neither of these critical recommendations should take priority over the other: advanced courseware is useless without the facilities to deliver it. Above all, The University administration must make a clearly articulated commitment to information technology as the central nervous system of our institution, if we are to remain a University of the first-class.

6. Distance Education

With the increasing ability of computing and communications networks to reach people wherever they are—at home, at work, in their cars, in the middle of the Sonoran Desert—interest in distance education is on a rapid rise. It also is no accident that the interest is growing at a time when information is increasing exponentially, and knowledge is exponentially more difficult to distill from the information tidal wave. The question, most agree, is not whether we should get involved. We must. If universities are unwilling to change, private industry will be happy to supply the learning environments that students need to achieve their educational goals. Thus, unless universities act soon, "degrees" or "certifications of knowledge" from Microsoft or IBM may one day be as prestigious as the college or university degrees now offered.

The University of Texas at Austin should be setting benchmarks for quality distance education programs rather than simply following the pack. Administrative and technical support will be key to the success of

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any distance education courses and programs delivered from the UT Austin campus. Most of our programs today are the result of “grass roots” initiatives, with little assistance from the upper administration. Past experience in distance education at other major universities has shown that long-term gain cannot be expected without upper-level administrative support. Today, distance education requires much more than a faculty member on one end linked by a bundle of telephone lines to a group of students on the other.

So, the question of distance education is now a more practical one: how will we do it? How will we find the people to craft the new systems? How will we reward them? How will we create the labs and the materials and the access to communications media that we need? Above all, how will we overcome the natural inertia of educational systems that have gone largely unchanged for a thousand years?

These questions are partially answered through recommendations made by a Committee on Distance Education appointed by President Berdahl (chaired by Terry Sullivan and Mark Yudof) and a subsequently formed working group called the UT Distance Education Committee (DEC). Recommendations from these two groups cover a broad range of distance education topics, including faculty issues (i.e., teaching loads, compensation, promotion, and tenure); student services and the student market; technology (current and future possibilities); partnerships with K-12, government and healthcare agencies; and other distance education initiatives (UT System Virtual University Project, Western Governors University, the Lone Star College, the Virtual College of Texas).

UT Austin now has an Office for Distance Education (ODE) in the Center for Instructional Technologies that can address many of the recommendations made by both committees. However, there are only two staff members who coordinate all distance education activities for the campus. It is impossible to meet the growing demand for services without expansion of the staff. We need (at a minimum) three distance education specialists, with at least one specializing in student support services, and a variety of instructional designers and faculty development professionals. While the colleges need to lead new programmatic initiatives in distance education, especially in the areas of master’s degrees, these initiatives will be hindered unless the UT Austin infrastructure is improved.

Although the ODE can address faculty and student development needs, and can establish partnerships with outside organizations, there are policy questions that must be addressed as well. They must be discussed by appropriate persons at the executive level in order to set standards for distance education on the campus. Therefore, a permanent advisory council should be established that includes members of the DEC (faculty and staff) as well as representatives from the Provost’s Office, to work to set distance education policies and procedures for the UT campus.

7. High Performance Computing

For the past forty years, The University of Texas at Austin has been one of the nation’s leading institutions in support of high performance computing (HPC). This long-term investment has led to the creation of many nationally recognized research programs that provide unique opportunities for students and faculty to participate in cutting-edge computational research. There is overwhelming evidence, both here at UT Austin and throughout the country, that support for high performance computing is directly tied to high-impact, high-visibility research and is one of the metrics by which excellence in research is measured. With the growth of new information-based technologies, coupled with high-speed networking, there is little doubt that this trend will continue into the 21st century.

The transition of the UT System’s Center for High Performance Computing to UT Austin in 1994 has led to a policy vacuum for the future of high performance computing. There is currently no institutional plan or set of policy guidelines for continued support of high performance and research-oriented computing. This problem is highlighted by the recent announcement of UT Austin’s participation in the National Science Foundation’s Partnership for Advanced Computational Infrastructure (PACI) Program. This highly visible program thrusts UT Austin into the national spotlight in high performance computing and will provide five years of funding for HPC and related technology development at UT Austin.

The role and mission of high performance computing is evolving at the national scene with increasing emphasis placed on the development and deployment of “enabling technologies.” These are technologies derived from the integration of high performance computing systems, high speed networking, and new

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software paradigms to create new capabilities in computation and information-based science. Relevant examples include digital libraries, parallel distributed computing, Web-based interoperable software, and real-time visualization systems. These technologies are to be developed under the direction of the PACI program to build the nation's computational infrastructure into the next century.

To sustain The University's mission to become an institution of the first class, resources must be identified that will maintain a competitive program in high performance computing and allow The University to finance significant upgrades in its high performance computing facilities and upgrades over the next five years. The University's participation in NPACI will provide an important step in meeting these goals. The NPACI resources will provide leveraging of funds through ACITS that should help The University move to a second-tier level in high performance computing within three to four years. With additional support from the State of Texas and federal agencies, the possibility of moving towards a first-tier institution in collaboration with other state institutions is a possibility within five years. The HPC Subcommittee strongly recommends that approximately \$1.550 million be appropriated for FY98 for continued support of High Performance Computing and Visualization and that appropriate action be taken to pursue a Legislative Appropriation Request (LAR) to provide State of Texas matching funds for PACI and related HPC programs.

8. Universal Student Computer Access

One year ago, a task force concluded that universal student access to information technology services was "essential to ensure that our institution keeps pace with the Information Age Revolution and sustains its position as an institution of the first class, not only regionally, but nationally." Data from the first campus-wide survey of computing use, (1500 students) conducted in May 1997, indicate that eighty-percent of the registered students at The University of Texas at Austin provide most of their own technology required to write papers, communicate with others, perform numerical calculations, analyze data, retrieve information from databases, and prepare presentations. This technology typically includes a computer available to them at their residence, a printer, and a modem for telecommunications. Further, these students balance their investment in technology by looking to The University as a highly distributed information technology system that includes an institutionally supported network, multipurpose servers and services, client machines in convenient locations, output devices, special-purpose labs, support, and digital content.

The recommendations of the Universal Student Computer Access group begin with the recognition that, as students assume the responsibility for providing the client part of a distributed universal computing system, it is incumbent upon The University to ensure that an adequate and convenient infrastructure of networks, servers, printers, technical support, and services be available for their use any time and from any place. A second recommendation urges the University to allocate more funds to make information technology services such as printing and file storage readily and conveniently available, rather than funding more general purpose facilities such as the Student Microcomputer Center.

The vision of universal access assumes that students accomplish academic work through their digital connections to The University. Thus, The University should increase the availability of content, services, and resources delivered over the campus network. Such content ranges from instructional materials for specific classes to grade reports and electronic journals.

Finally, The University should move quickly and decisively to implement a comprehensive information technology management structure. This structure, with clear policies and responsibilities, and ongoing planning towards specific goals, is mandated when resources and services are delivered to multiple constituencies, in this case, students, colleges and departments, and The University administration.

9. Outreach to Schools and Alumni

Contemporary information technology has changed the nature of The University, transforming its role in the larger polity. The campus is not The University. The University is a living system of constantly changing information and accumulating knowledge, situated within a complex and dynamic learning community that extends from pre-kindergarten through college and beyond, into increasingly demanding public and private sectors. For example, home schooling is gaining widespread acceptance as a legitimate alternative to school-based education (Texas is the leader in the U.S.), while lifelong learning is increasingly recognized as crucial to success in the Information Age.

Just as the explosive growth of campus networking affects the internal structures of teaching, research, and administration in ways described elsewhere in this report, so The University's participation in regional, state, and global computer networks (e.g., GAATN, THENet, the Internet) and its growing presence on the World Wide Web make it clear that we are inextricably embedded within an educational system that extends far beyond the geographical boundaries of the UT Austin campus. Our fate is intertwined with that of the system as a whole.

In this context, outreach becomes a strategic investment, a means of maintaining our leadership in an ever more complex, densely integrated, and highly competitive environment—and information technology becomes the primary vehicle for maximizing the impact of our outreach efforts. This is already the case at peer institutions like Michigan and Illinois. Using The University's resources—including our expertise in instructional uses of technology—to raise the quality of the system as a whole, we also put ourselves in position to improve our own condition by attracting and retaining world-class faculty, increasing the pool of excellent students gaining admission to The University, and sustaining relationships with those students throughout their lives.

There is now little coordination of outreach activity on campus. We recommend establishing an Outreach Coordinating Office (OCO) within the office of the Associate Vice President for Academic Computing and Instruction Technology Services. The OCO will function as an information clearinghouse and enabling structure. It will encourage individual, entrepreneurial outreach projects, identify related efforts that would benefit from coordination and projects well-suited to scaling up with the aid of technology, promote new projects to meet emerging needs, and coordinate the work of multiple units within The University. The OCO will also assist in aggressive identification of external funding opportunities and preparation of proposals for the Telecommunications Infrastructure Fund Board and other federal, state, and local programs and private initiatives into creating a statewide telecommunications infrastructure for public education and lifelong learning. The University should also invite prospective donors to consider supporting outreach efforts as a kind of legacy, a way of making a mark not just upon the physical space of the UT campus, but also upon the minds of hundreds of thousands of Texas children.

We also recommend increased support for the Institute for Technology and Learning, (ITAL) established as an organized research unit in 1996 with startup funding from TENET and 1996-97 funding from both TENET and The University. ITAL is charged with identifying, designing, creating, and disseminating high-quality, computer-based instructional materials to the Texas K-12 community. ITAL is developing innovative programs involving schools across the state, and tools created to support these projects will be available for use in UT courses and other outreach projects. The long-term success of such programs depends on effective teacher training. The University should support college- and departmental initiatives to recruit and train outstanding teachers, and build TENET into a world-class faculty development corps.

10. Alliances and Partnerships with the Private Sector

In areas of the economy in which the underlying technology is moving rapidly, organizations in the information technology industries have found that one very good way to be on top of information technology developments is to form strategic alliances with other organizations in the information technology industry. Strategic alliances represent more than just hand-shake agreements between or among organizations. Because they typically involve mission-critical aspects of an organization's activities, they are negotiated and maintained by the chief executives of the organizations involved. Frequently they involve sharing previously developed intellectual property and joint development of new intellectual property; usually they involve the exchange of personnel—sometimes in the form of joint ventures established by the partners.

Historically, The University has not participated as an enterprise in alliance activities, and such activities at the level of colleges or departments have been limited by organizational incentives and operating policies. In the information technology area, limited alliance activity has occurred between colleges and private-sector information technology firms. More often, such relationships have been characterized by the private-sector firm acting as donor and The University unit acting as recipient—or the relationship has been one of contractor-contractee or grantor-grantee.

If The University is to survive and prosper in the digital era it is incumbent upon it to devise ways to be a partner with private sector information technology organizations as a means of acquiring and developing mission-critical information technology knowledge and competence. The senior executives of The University should articulate a vision for The University that: (a) promotes information technology alliances with leading private sector companies, government agencies, not-for-profit organizations, and other educational institutions; and (b) develops and articulates a vision for the funding of information technology resources within the context of the broader fund-raising efforts. These articulations should be framed to legitimize and motivate enterprise-wide relationships directed at enhancing The University's understanding and use of information technology in carrying out its mission. Educating administrators and faculty in the development and nurturing of alliances should be made a priority. Current obstacles to alliance formation and operation must be removed or limited through internal policy changes, through changes in state law (or interpretations of state law), and through the establishment of new organizational forms.

11. Policy Issues in Information Technology

Technology develops faster than our ability to understand its impact on society. For an institution as large and complex as UT Austin, this means that we absorb and use technology without policy issues being clearly understood, let alone developed and articulated. There are key policy issues: access to appropriate technology resources for The University community, responsible use of University resources, including consistency with state and federal law as well as University policy and Regents Rules, records, retention and management decisions, privacy of student information in an era of decentralized decision making, and the creation and use of intellectual property. Of course, policy must be developed on a strong ethical foundation.

A University committee on Computer and Information Technology Use Policy (CITUP) now exists. The CITUP committee's assignment is to produce a report or policy document that will likely include responsible-use assurance, authentication and security, copyrighted material and trademarks, e-mail, political activities, academic advising and student records, access for alumni, file retention and backup, and Web concerns, including publishing guidelines, personal Web pages, disclaimers, and advertising.

A committee similar to CITUP should be established to deal with ongoing policy issues, once the CITUP committee completes its work. The membership of this new committee must include faculty, students, and staff. It should have three roles: a) To consider new legislation, court decisions, Regents Rules, and technology changes as they relate to institutional information technology policy; b) To act as an advisory board to those charged with implementing policy when incidents occur that are not clearly covered by policy

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or when policy needs interpretation; and, c) To promote awareness of information technology policy within The University community.

Without adequate policy and information about policy, students, faculty, and staff make inconsistent decisions about the use of technology resources. In such an environment, The University runs a substantial risk of alienating the public, if not incurring substantial liability for actions of members of The University community.

Appendix B

INFORMATION TECHNOLOGY EXPENSES (1995-96) The University of Texas at Austin

Computer Equipment Purchase	21,987,495
Computer Lease/Purchase	63,438
Computer Maintenance	2,081,942
Computer Parts	4,181,986
Computer Rental Equipment	1,623,212
Software Maintenance	1,787,088
Software Purchase	4,056,995
Software Usage Fees	8,152
Telecommunication Equipment	1,855,273
Telecommunication Equipment Lease	497
Services	
Computer Consultant - UT Employee	3,461,723
Computer Consultant - Non-UT	85,966
Computer Programming - Non-UT	1,419,675
Other Operating Expenses	
ITAC	2,074,366
Administrative Computing	142,183
Salaries	
ITAC	1,195,111
Administrative Computing	4,021,704
Academic Computing	6,286,677
Other Departments - Classified Salaries Only	10,123,224
TOTAL	67,499,366

Note: Excludes expenses such as wiring, distance learning, and other Administrative and Professional Salaries that may be involved with Information Technology

Chapter Two

Long-Range Planning Issues in Academic Computing

1. Introduction

The Faculty Computer Committee (FCC) was asked to consider a number of issues relating to the changing conditions of academic computing on campus. These issues included: 1) long-term lifecycle financial planning and the information needed for strategic planning; 2) the support of department and college projects; 3) management practices for distributed systems; and 4) faculty access to information technologies. In addition, the FCC attempted to assess whether major issues had been overlooked in the long-range planning effort.

The current trajectory of information technologies is placing large and increasing demands on University human and financial resources. The challenge addressed by the FCC is how to get the most out of this investment through better planning and management. By stressing organizational and policy issues, the FCC wishes to make the point that access to information technologies is not merely a question of hardware, software, network connections, and operating systems. Just as important are issues of planning, finance, management, and coordination of all campus information technology resources.

2. Methodology

The issues addressed by the FCC have been under discussion at the University of Texas for several years. As a consequence, the FCC began its work by reviewing a number of key reports prepared on campus during this period (Faculty Computer Committee 1994, 1995, 1996, 1997; Watkins 1996; Wheat and others 1996). Information technology strategic plans from other universities were also considered.

Working groups were then formed to address each of the FCC's assigned issues. These groups prepared short position papers on their assigned topics that were, in turn, discussed by the full membership of the FCC. After revision, these position papers were consolidated into this full report.

A key assumption of this report is that the Associate Vice President for Academic Computing and Information Technology Services expected to be hired this spring will serve a key role in implementing the recommendations enumerated in this report. Indeed, this entire report underscores the important role that this new associate vice president will play as the University's chief information officer.

3. Findings and Recommendations

Based upon its discussions, the FCC developed findings and recommendations in four major areas: planning, finance, support of distributed computing, and faculty access. In addition, the FCC has prepared a short list of "orphan" issues that may yet need to be addressed by the long-range planning effort. The recommendations are summarized below and detailed in the appendixes found at the end of this report.

Chapter 2 - Academic Computing

Planning (Appendix 1)

1. Establish a clearly defined planning process for information technology within the University, authorized by and making recommendations directly to the President.
2. Establish clear responsibility for gathering and maintaining factual information about information technology on a campus-wide basis.

Finance (Appendix 2)

1. Establish a Unified Budget Process and Business Plan for Information Technology Expenditures.
2. Establish a Comprehensive New Financial Management Model for Strategic IT Resources
3. Establish a Life Cycle Funding Program for Desktop Computers.

Support for Distributed Computing (Appendix 3)

1. Provide adequate and ongoing training to personnel supporting computing resources in departments and colleges.
2. Establish a collaborative process for determining campus IT standards and best practices.
3. Ensure that common hardware and software products required by departments will be simple to acquire and with pricing that reflects the volume.
4. Move to centrally coordinated management of distributed computing resources.
5. Establish an Information Systems Security Initiative (ISSI) -- an interdisciplinary initiative for the learning and teaching of information systems security and systems management.

Faculty Access (Appendix 4)

1. Provide adequate computer power to faculty with teaching responsibilities .
2. Provide staff and resources to assist faculty with the development of instructional, research, and service applications of information technology.
3. Cultivate and reward faculty achievement in the development of instructional media.
4. Develop a streamlined mechanism to promote faculty access to new software, especially the latest versions of commonly used packages.

Orphan Issues (Appendix 5)

1. Year 2000 Problems Affecting IT Systems

2. Emerging Technologies
3. Strategic Alliances and Partnerships with Peer Institutions
4. Promoting Interdisciplinary Programs
5. The Role of the University of Texas Press and Union MicroCenter
6. One-Stop Shopping for Information Technology and Support

4. Priorities

The findings and recommendations have been arranged in priority order. All are important, but they have been arranged hierarchically beginning with the planning and financial issues that must be resolved campus wide, moving to issues that effect colleges and departments, and moving finally to the support of individual faculty. The rationale is that, in the absence of change in planning and financing campus-wide, efforts to support colleges and departments will necessarily be hampered. Similarly, without change in the ways colleges and departments are supported, efforts to assist faculty will be limited.

5. Conclusions and Cost Summary

Many of the recommendations contained in this report concern policy issues rather than expenditures for staff and equipment. Furthermore, many of the recommendations concern issues about which the University needs to collect detailed information before an implementation plan can be developed. For these reasons, detailed cost estimates have not been included in this draft of the report except in a few limited cases. Cost calculations can be developed for others, if needed.

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APPENDIX 1

PLANNING FOR INFORMATION TECHNOLOGY

Findings and Recommendations

Findings

The UT-Austin implementation of information technology has shifted from being highly centralized to being largely decentralized. Planning for the implementation of information technology has, despite the FCC's efforts, also shifted from being highly centralized to being largely decentralized and, coupled with a similar shift to college-based (rather than campus-based) funding for information technology, has caused and will increasingly cause a variety of both technical and resource-related problems. Planning is now undertaken by a wide variety of communities that overlap in responsibilities and have little real power to influence campus-wide decision making.

During the next three years, the University can either continue to address its needs for information technologies in essentially the same non-optimal way it has in the past or it can revamp the process from the ground up. This section outlines plans for accomplishing the latter by rationalizing and reorganizing the campus IT planning process to address:

1. What levels of information technologies are truly appropriate for its teaching, research, and service purposes
2. What level of resources it is really prepared to provide for these purposes
3. How to better prioritize and coordinate the allocation of those resources in order to best meet the information technology needs of the entire University community.

In addition, the University currently lacks the factual information needed to satisfactorily assess the current status of the infrastructure, both human and technical, or the financial investment in information technology on the campus. Such information is crucial to measuring progress, identifying weaknesses within the University's information technology programs, and forecasting future demand for technology. Information must be collected from a number of sources on campus and off.

Recommendations

1. Establish a clearly defined planning process for information technology within the University, authorized by and making recommendations directly to the President.

The planning process should be led by the new Associate Vice President for Academic Computing and Information Technology Services. This individual should be charged with 1) identifying, prioritizing and resolving IT issues within the context of a comprehensive campus-wide IT masterplan; 2) convening campus-wide teams (*ad hoc* subcommittees and task forces) to research and define IT standards and policies; 3) publishing and promoting these standards and policies; and 4) maintain awareness of external IT standards and best practices among peer institutions and in industry.

The Associate Vice President should convene and chair an Information Technology Coordinating Committee to oversee the planning process. The coordinating committee should represent all academic units as well as the major IT constituencies on campus. The membership of this committee would involve melding together the membership of the FCC (which currently represents all colleges and schools as well as the General Libraries and Administrative Computing Services) and the Long-Range Planning Steering Committee (which currently represents major campus IT constituencies). Representatives of colleges and schools would be appointed by UT's Committee on Committees. Interest group representatives would be appointed by the President. These goals can be met with a committee of eighteen to twenty-four members, one third of the membership rotating annually.

The Associate Vice President may convene, as needed, *ad hoc* task forces and working groups to address specific IT questions and frame specific IT policies. These task forces and working groups would include members of the coordinating committee, but would also include faculty, staff, and students with special knowledge and interest in the issues being addressed.

Working groups and subcommittees would have clearly defined mandates and terms. All IT planning committees would be governed by a "sunset" rule enforced externally that would assess their effectiveness at least once every three years.

Actions Items

1. Create a campus wide IT Coordinating Committee
2. Review for consolidation and elimination all other campus-wide IT planning committees
3. Develop long-range planning report into campus IT masterplan

2. Establish clear responsibility for gathering and maintaining factual information about information technology on a campus-wide basis.

The goals would be that within three years the University would have : 1) an up-to-date information technology profile of incoming students; 2) an inventory of information technology resources, human expertise, and IT-enhanced academic courses available to the campus community; 3) an initial set of comparative benchmarks of similar information from peer institutions; and 4) an initial set of best-practices identified, both internal to and external to the institution.

Action Items

Chapter 2 - Academic Computing

1. Create a collaborative work group, led by a "Strategic Information Manager" within ACITS and involving staff from the Office of Institutional Studies, Administrative Computing Services, General Libraries, Student Affairs, colleges and departments, to oversee design and data collection.
2. Define the specific information elements to be collected; survey the information elements currently available from peer institutions; identify national initiatives underway by related groups (EDUCOM, CAUSE, ARL, etc.)
3. Refine accounting procedures and personnel classification categories so that critical information can be collected and tracked automatically. This information should be "self-collecting."
4. Carry out periodic "tactical" surveys of students, faculty, staff, and alumni at regular intervals.
5. Gather information from employers in industry and government about their expectations concerning student "exit skills."
6. View year 1 as a planning year, with the goal of being ready to gather and maintain local institutional data early in year 2.
7. Assess the success of this initiative if, by the end of year 3, the campus has successfully implemented a campus-wide information technology profile for two consecutive years, has identified a set of benchmarks from other institutions with which to compare UT, and has identified best-practices of effective information technology programs.

APPENDIX 2

FINANCING INFORMATION TECHNOLOGY

Findings and Recommendations

Findings

The Accreditation Study Committee has recently documented the fact that The University now spends over \$67 million annually on information technology resources of all types. These expenditures are made by a wide variety of different departments and offices with no formal procedures to maximize coordination and minimize unnecessary redundancy and duplication.

In its 1994 report "Improving Information Technology Integration at The University of Texas at Austin," the FCC found that "while informal collaboration among the major providers of access has created progress towards integration of its information resources, the University lacks institutional mechanisms and infrastructure for attaining effective integration." The FCC now concludes that a unified review of all major Information Technology budgets and expenditures would result in substantial progress toward both the integration for information resources and their efficient use.

While the FCC recognizes legitimate organizational needs for separate IT expenditures to originate from different offices, the Committee contends that central planning can 1) help to identify and eliminate redundant and otherwise unnecessary expenditures, 2) provide a formal mechanism for encouraging integration of services where applicable, 3) promote more innovative and efficient use of available resources; and 4) facilitate integrated reporting to external state agencies, such as the biennial operating plan.

In order to remain competitive, the University must use this coordinated approach to develop a wholly new and innovative model for funding, budgeting, and managing information technology resources which recognizes their unique and rapidly changing role in the institution. The FCC concurs with an article on IT financial strategies that appeared in *CAUSE/EFFECT Magazine*:

"New economics are driving campuses to reassess their financial strategies for managing information technology investments. Many institutions will be faced with the prospect of developing an entirely new game plan. This new plan will require collaboration among academic, financial, and technical leaders; a rejuvenation of the collective conventional wisdom on campus; a shift to life-cycle budgeting; an emphasis on technology replacement; explicit plans to recycle old technology off campus; and, most of all, a willingness to recognize and accept the significant financial challenge that evolving information technologies will bring."

A number of key trends are combining to reinforce the necessity for comprehensive reform of our IT financial practices. These drivers include the following factors that are simultaneously increasing at a rapid rate:

1. The overall strategic value of Information Technology to the core mission of the institution and, especially, the need to employ technology to remain competitive;
2. The pace of technological change;
3. The rate of technological obsolescence;

4. The variety and complexity of different technologies which are becoming essential to the operation of the institution; and
5. The overall costs to provide, support, and maintain this complex and dynamic technology environment.

The FCC concludes that any new financial model for IT resources must include three elements: a) life-cycle budgeting for IT resources, b) institution-wide asset management practices that recognize the unique characteristics of Information Technology; and c) rigorous "business case" analysis of major purchasing decisions.

Life-cycle funding is defined here as the practice of formally recognizing and budgeting for the periodic technological obsolescence and replacement of computer hardware and software. In many instances, life-cycle funding is also necessary for ongoing support costs such as training, maintenance, trouble-shooting, and repair. Life-cycle budgeting is intended to fund essential technology resources as perpetuities rather than viewing them as apparent one-time, ad hoc funding decisions. "The basic life-cycle equation (number of units x price/unit divided by life-cycle years = annual cost) converts the hardware expense of [the technology resource] into a reasonably stable long-term perpetuity. The financial strategy is to identify the perpetuity and manage it over time" (Oberlin 1996). Most of the current professional literature relating to financial management of IT resources concludes that the use of life-cycle funding models for major IT procurements is essential to both minimize costs and to ensure the effective ongoing performance of a complex distributed computing environment.

Asset management, as it is used in this report, refers to a set of structured financial management practices intended to identify, quantify, and implement cost-saving opportunities in consolidated procurement, deployment, technical support, maintenance, software volume licensing, metering, electronic distribution, and retirement of IT resources (figure 1).

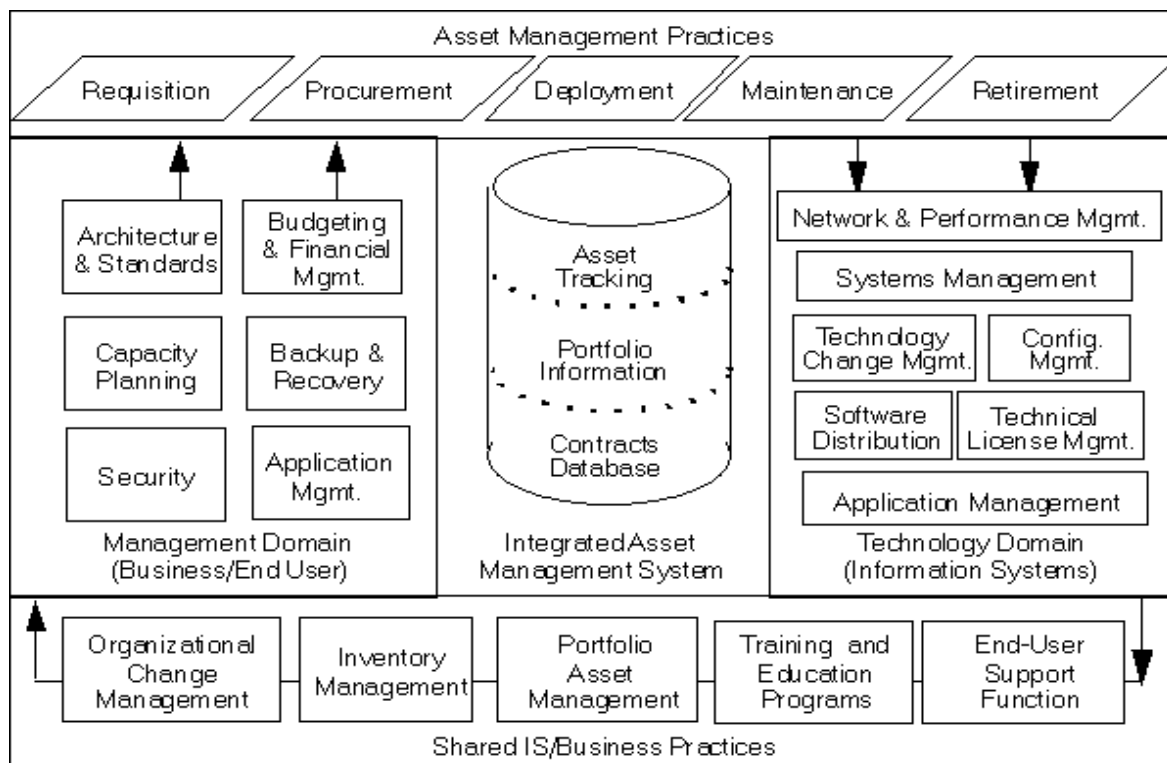


Figure 1. Framework for asset management employing a lifecycle strategy. Source: Germann, Pucciarelli and Smith 1997.

Specific asset management practices for IT resources include volume buying programs, comprehensive IT inventory measures, integrating inventory figures with financial auditing activities, and establishing standard specifications for widely-used hardware and software. ACITS's Bulk Purchasing Program (BPP) for desktop microcomputers is an excellent example of effective asset management practices already in use at UT Austin. The acquisition last year of over 1,200 BPP microcomputers, purchased for student labs and the Faculty Computer Initiative, demonstrated the utility, reduced support requirements, and overall cost-savings associated with adopting campus-wide standards and combining purchases.

The Gartner Group projects that by the year 2002, formal asset management for information technology resources will surface as a core management discipline, with dedicated staff and executive accountability, in most institutions with more than 2,500 desktop microcomputers (Germann, Pucciarelli and Smith 1997).

Applying a "Business Case" approach simply refers to the practice of conducting a structured cost/benefit analysis for major purchasing decisions. In the arena of IT resources, however, there are categories of both costs and benefits that are unique to IT and which may not be readily apparent. Hidden costs are most frequently associated with ongoing support. For example, a recent Gartner Group study demonstrated that the total, life-cycle cost of a microcomputer to an institution includes not only the original purchase price but also the costs for technical support, training, software, and repairs. This study concluded that the average microcomputer costs the owning institution a total in excess \$30,000 over the entire useful life of the machine when all these elements are taken into account (Gartner Group 1995).

Likewise, the benefits derived from many types of IT resources are often ignored, and "competitive advantage" represents the most important category of such benefits. Many new implementations of IT resources ranging from e-mail for all students to distance learning tools are necessary to maintain and extend UT Austin's relative competitive position with respect to other Research I institutions.

Finally, the FCC concludes that Desktop microcomputers represent a logical and clear choice to serve as the target of the first major, campus-wide life-cycle funding program. The desktop microcomputers used by faculty and professional staff have become essential tools for instruction, research, and administration. The University can no longer function effectively unless all faculty and professional staff have continuous access to current generation, networked microcomputers. These devices are now an integral and inherent component of the overall campus-wide computing infrastructure, and they represent an ongoing, re-occurring cost.

Historically, UT Austin has budgeted for and funded desktop microcomputers as one-time costs. This model does not recognize the costs associated with technical support, training, commercial software, repair, and replacement of the microcomputer when it becomes obsolete and unable to run the current generation software required for University operations.

Recommendations

1. Establish a Unified Budget Process and Business Plan for Information Technology Expenditures.

The FCC recommends that the University Administration establish a formal, centrally coordinated process for generating a unified, institution-wide annual budget for all major information technology expenditures. Specifically, the Committee recommends that the following organizational units submit the portion of their budgets allocated to information technology resources to the IT Coordinating Committee (discussed above) for analysis, planning, and forecasting.

1. Academic Computing and Instructional Technology Services (ACITS)
2. Administrative Computing Services (ACS)
3. All Colleges (through their annual Academic Vision Plans as submitted to the FCC)
4. General Libraries
5. Office of Telecommunication Services
6. Texas Union MicroCenter
7. Utilities and Energy Management, Telecommunication Division

This information would allow UT to make accurate forecasts of major IT needs and expenditures and to set targets for the revenues needed to meet these needs, including user and student fees, AUF funds, extramural grants and awards, as well as commercial and private donations made as part of UT's Capital Campaign and other general development efforts. The point is to consider UT's IT budget as a whole and to develop appropriate cost and revenue models for these expenditures.

2. Establish a Comprehensive New Financial Management Model for Strategic IT Resources

The FCC recommends that the new Associate Vice President and Provost for Academic Computing and Information Technology Services work in consultation with the IT Coordinating Committee to develop a new campus-wide model for funding, budgeting, and managing strategic IT resources. This new model should include at least three key elements:

1. Life-cycle budgeting and funding for all types of technology resources that legitimately represent recurring costs to the institution.
2. Professional asset management practices which take into account the unique characteristics of IT resources. In particular, these asset management strategies should include:
 - a) Recommending standard configurations and specifications for computer hardware and software wherever appropriate;
 - b) Encouraging volume or bulk purchasing of standard computer hardware;
 - c) Maximizing the use of standard software purchased under institution-wide site licenses;
 - d) Assessing the probable useful life of technologies as they are acquired to determine actual life-time costs;
 - e) Providing accurate, easy-to-obtain, institution-wide accounting and inventory information on total costs and number of units for all major categories of IT resources; and

- f) Recycling or re-deploying technology resources to recognize that as hardware and software become obsolete for their original purposes they may still have a valuable and useful life for other purposes.
- 3. Applying "Business Case" analysis to all major new IT purchases and deployments. The funding model should require a thorough cost/benefit analysis of all major purchases which recognizes that: a) benefits may include the competitive advantage in relation to other institutions and b) costs may include a wide range of life-cycle support and maintenance expenses.

3. Establish a Life Cycle Funding Program for Desktop Computers.

The FCC recommends that the University administration adopt a new budget procedure and funding model for institutionally owned desktop microcomputers which factors in:

- 1. replacement of machines on a lifecycle basis with the lifecycle being dependent on the technology deployed, for example twenty-four months for a notebook computer, thirty-six to forty-two for a desktop computer, etc.)
- 2. software costs for commercial products that are adopted and used institution-wide
- 3. personnel training costs.

The University should adopt a budget which a) provides for ongoing replacement of desktop microcomputers on the forty-two month cycle, and b) provides a "current generation" computer for all faculty and professional staff. The institution should further negotiate an optional institution-wide leasing program that gives departments the alternative to lease, rather than purchase, at competitive rates.

Costs for items requiring funding:

- 1) Annual Expenditure for Replacement of Microcomputers:.....\$8,265,000

This figure was reached by multiplying the 9,643 full-time faculty and professional staff at UT Austin times an estimated purchase price of a desktop computer of \$3,000, and then dividing by 3.5 because the recommendation calls for replacement of computers every 3.5 years.

- 2) Annual Expenditure for standard commercial software:.....\$3,375,000
(\$350 per unit * 9,643 units)
- 3) Annual Expenditure for maintenance, support, and training:\$4,821,000
(\$500 per unit * 9,643 units)

Total Annual Life-Cycle Costs for Faculty/Staff Desktops: \$16,461,000

APPENDIX 3

SUPPORT FOR DISTRIBUTED COMPUTING AMONG COLLEGES AND DEPARTMENTS

Findings and Recommendations

Findings

With the advent of personal computers and local area networks, University departments and colleges moved away from the centralized computing model to one where they managed their own machines, infrastructure, and IT destiny. However, there were new problems introduced. Professional growth for IT personnel became very restrictive and turnover was high among talented staff. University support for information technology was hindered by singular purchases, independent support operations, and a lack of standards.

Recommendations

1. Provide adequate and ongoing training to personnel supporting computing resources in departments.

The training needs to include just-in-time and on-line training, as well as workshops, pages, and tutorials. The program needs to cover the common hardware, networking, and software support needs in departments, as well as basic customer service skills and tools. The University needs to investigate certification programs suitable for the campus environment, not only as a training aid but as a hiring and management tool for departments employing local support personnel.

Action Items

1. ACITS needs to develop a training program specifically for IT support personnel on this campus.
2. ACITS needs to investigate IT certification programs for the campus.

2. Establish a collaborative process for determining campus IT standards and best practices.

One approach already in use at the University of California at Davis (see <http://titanic.ucdavis.edu/pubs/Solutions/>) is a modification of the Request For Comment process used by the Internet Engineering Task Force. Using this process they have created documents for student computer purchases, buying a modem, document management, email tools, and others. The process uses interested campus technical support people to review proposals in a well defined but timely manner, culminating in an acceptance vote. This or some other collaborative approach to allow IT standards and best practices to be proposed, reviewed and accepted by the campus is required.

Action Item

1. ACITS needs to propose, test, and evaluate one or more processes that will determine campus IT standards and best practices in a timely but collaborative manner.

3. Ensure that common hardware and software products required by departments will be simple to acquire and with pricing that reflects the volume.

Products identified as part of the standards and best practices efforts will clearly qualify as items to be negotiated as will products where substantial savings for the campus are practical. It is essential that information about these programs be readily available to purchasers and where possible, simplify purchase procedures. In addition, with the success of the Faculty Computer Initiative (see <http://www.utexas.edu/cc/fci>), a similar bulk purchase program or drop ship program for common desktop computers should be available every year.

Action Items

1. ACITS needs to regularly assess and prioritize which products require negotiations and keep the campus community aware of progress.
2. ACITS and/or the Microcenter needs to provide a regular bulk purchase program similar to the FCI program.

4. Move to centrally coordinated management of distributed computing resources.

This model delivers a set of services, cooperatively developed by each department and the central service provider. Centrally coordinated management will be used to guarantee consistency in service, better staff development, and enhanced interoperability and security through standards and practices. User assistance is customized for local needs, supporting the appropriate discipline-specific tools and standards. Local consultants are trained and managed centrally, learning how to take advantage of university-wide resources and developing an understanding of critical campus issues such as security and interoperability. UT will keep staff longer because talented people have a professional growth path in the larger organization. Departments and The University benefit from having consistency in the support of departmental infrastructure.

Adopting centrally coordinated management of distributed resources does not have to happen overnight. There are many departments that would be very uncomfortable in relinquishing day-to-day management of their IT resources. A stepped approach, involving the adoption of a la carte services would be one way of proving the reliability and utility of this new centralized model for distributed computing resources. For instance, file server management, departmental backup/archive services, and software license management can all be offered as stand-alone products.

It should be noted that many services and resources should not come from local support. Many services are already rendered on a campus-wide scale and departments should be strongly encouraged to use these services whenever feasible. For instance, UT supports a free e-mail service, has inexpensive Web space, and supports laser printer accounting. A department should only adopt a local solution when it cannot find a university-wide service that is as inexpensive, dependable, or flexible.

Action Item

1. Departmental Services of ACITS should develop an automated mechanism for determining the real cost of providing a la carte services to departments, based on the number of servers, workstations, age of equipment, operating systems, and applications supported.

5. Establish an Information Systems Security Initiative (ISSI) -- an interdisciplinary initiative for the learning and teaching of information systems security and systems management.

ISSI will have a practitioner orientation to managing security assurance and complexity at the enterprise level and create a body of best practices related to risk management, security assurance and systems management. The primary benefits will be effective security management of University IS/IT resources while providing learning opportunities for students.

Action Items

1. Develop interests and gather support
2. Secure commitments
3. Create a steering committee
4. Develop the research and teaching agenda
5. Deliver

APPENDIX 4

FACULTY ACCESS TO INFORMATION TECHNOLOGY

Findings and Recommendations

Findings

All faculty must have ready access to IT resources needed for teaching, research and service to the University and wider community. Faculty must be supported and rewarded for their efforts to innovate and experiment with new information technologies, especially in the classroom. This support should be offered in four areas.

Recommendations

1. Provide adequate computing power to faculty with teaching responsibilities.

Under the Faculty Computer Initiative (FCI) the University has made tremendous strides toward equitable faculty access to information resources (<http://www.utexas.edu/cc/fci/fcireport.html>). However, if this level of access is to be sustained beyond the lifecycle of the present equipment, additional investment will be required on a regular basis. New faculty should be provided with such equipment routinely as they arrive on campus.

Action Items

1. Develop profile of faculty requirements based on assessment of needs of tenured, tenure-track, and non-tenure track (clinical and visiting) faculty.
2. Obtain benchmarking data from other comparable colleges
3. Acquire regular sources of funds for purchase of equipment

2. Provide staff and resources to assist faculty with the development of instructional, research, and service applications of information technology.

The time required to learn and develop new IT applications is one of the greatest barriers to faculty innovation. In the absence of adequate support, faculty will either hesitate to become involved or be forced to expend valuable time retraining and developing their skills to the detriment of their other obligations. Much can be done to provide the training, resources, and support needed by faculty at a variety of levels from introductory to advanced. The University has never before had to consider offering extensive training programs to its faculty like it now must for IT. The current array of classes, assistance, and support should be expanded substantially over the next few years. New ways should be found for providing faculty with short and long-term staff assistance for new projects and means for acquiring funds for innovative projects.

Action Items

1. Expand the activities of the Center for Instructional Technology (CIT)
2. Develop staff resources within schools, colleges, and departments, including classified personnel, RAs and TAs
3. Expand resources linked from UT homepage including self-instructional materials for the Web (as done with Team Web efforts)
4. Create a University-wide funding pool to support innovative IT projects proposed directly by faculty

3. Cultivate and reward faculty achievement in the development of instructional media.

Even if offered adequate support, faculty are often hesitant to become involved in instructional uses of IT because so few rewards are offered for their investment of time. Some of the most exciting developments affecting the future of the University are occurring in instructional media, yet most faculty realize that time invested in these projects is not rewarded as highly as is time spent on research projects. The Web pages entitled *Tenure and Technology: New Values, New Guidelines* (<http://english.ttu.edu/kairos/2.1/coverweb/bridge.html>) offer guidance on some of the issues and conflicts involved. UT should consider developing a suit of incentives that reward faculty in a variety of ways.

Action Items

1. Develop a range of methods for rewarding faculty innovation through teaching-load credits, summer salaries, Dean's fellows, and University-wide grants and awards
2. Establish and promulgate clear guidelines for factoring faculty achievement in IT innovation into promotions and merit pay decisions
3. Hold a summer institute for faculty in the development of multimedia materials
4. Develop a collection of multimedia resources to support faculty needs
5. Do more outreach training within schools, colleges and departments
6. Hold seminars and demonstrations on curriculum design and pedagogical strategies to help faculty implement educational technologies

4. Develop a streamlined mechanism to promote faculty access to new software, especially the latest versions of commonly used packages.

Much can be done to streamline faculty access to software. At the moment, even simple requests for small upgrades can consume as much time as major purchases. The result is that faculty make do with down-level software that limits productivity and causes difficulties for the University in offering support and assistance. A system of volume licensing and software servers would go far to alleviate this problem.

Action Items

1. Negotiate with vendors for more site licenses
2. Acquire servers from which faculty could use software that they do not need to keep on their hard disks
3. Provide recommended standard tool sets for use in creating instructional materials
4. Setup license metering servers to allow sharing of expensive software among faculty and staff to reduce cost and increase accessibility
5. Establish a coordinated campus-wide summer institute to provide faculty with the opportunities to develop skills in the latest technologies

APPENDIX 5

ORPHAN ISSUES

Findings and Recommendations

Findings

A number of issues may have slipped through the net of the long-range planning effort. The FCC has attempted to identify a number of these. Some of these may have already been addressed by other committees. If not, it may be worth considering whether or not to pursue these issues further.

1. Year 2000 Problems Affecting IT Systems

Year 2000 problems do not affect only administrative systems; they can affect any computer or computer controlled device which uses a 2-digit year format and a program which misinterprets the year (e.g. 00 is recognized as 1900 and not 2000). Related date problems include calculation of the leap year in 2000 and also windows of time being exceeded (some programs calculate dates relative to a base). These problems can affect hardware (e.g. BIOSs in PCs), vendor supplied software, or user written programs. The Year 2000 problem is a timely and important issue and already has work underway involving a sixty-member interdisciplinary group representing departments all across campus. Currently, there are two coordinators on this campus (Gary Terrell and Cathy Lester) working with colleagues to identify solutions, including asset inventory of desktop computers and a risk analysis. The working group will seek funding for a university-wide project for risk analysis of the date rollover.

Recommendations

1. Assessment of risk, for which we need a thorough inventory and testing utilities. Estimated cost is \$500,000.
2. Purchase only compliant products and through contract language or certification make the vendor liable for compliance.
3. Certification of outsourced and EDI interfaces. Estimated cost is \$50,000
4. Replace or upgrade mission critical equipment and software. Estimated cost depends upon assessment.
5. Faculty/staff awareness, an organized campaign to alert and educate faculty and staff of the potential problems and solutions
6. Faculty/staff on demand training in popular and affected packages such as Excel, SAS, FM Pro, SPSS, etc. Estimated cost is \$50,000.

2. Emerging Technologies

Technology continues to change rapidly and it is important to the University that emerging technologies that look promising are evaluated early. ACITS should include in its capital budget requests blocks for evaluating emerging technology on behalf of the academic community. Initial evaluations can then be used as a basis for subsequent collaborative pilot projects with departments or colleges. Such technologies include network computers, video and audio servers, and networking technologies.

3. Strategic Alliances and Partnerships with Peer Institutions

Most of the University's strategic planning has been relatively inwardly focused. The question is how and to what extent UT should be looking outward. In part, this is a question of making sure we learn from the experiences of other universities, and this point is addressed in some of the long-range planning recommendations. But, perhaps more importantly, should UT be looking to forge new sorts of strategic relationships with other universities in terms of virtual research institutes and programs in the state, nationally, and internationally. There are plans afoot for some system-wide distance learning initiatives and, of course, the Western Governors' Virtual University, but perhaps UT should be forming partnerships in other critical areas.

4. Promoting Interdisciplinary Programs

Recent innovations in information technologies are creating new scholarly and scientific opportunities for cross-disciplinary research and education. Some universities are beginning to act rapidly to create new programs that speak to these new opportunities, for examples interdisciplinary programs for future "webmasters." It is often difficult to create such programs among the University's academic units. Should the University of Texas adopt a proactive approach to promoting such programs? A willingness to promote such programs might spur their development more rapidly.

5. The Role of the University of Texas Press and Union MicroCenter

The University of Texas Press and Union Microcenter might, in the future, be included in the IT planning process. Although both are semi-autonomous units, they play an important role in the university community. Both are faced with questions of how to respond to the challenges and opportunities presented by information technologies.

6. One-Stop Shopping for Information Technology and Support

The issue of "one-stop shopping" for information technology and support is an issue that cuts across all areas of the long-range planning effort. The University presently offers a wide range of services, but no single source offers all of the services required on a regular basis by faculty, students, and staff. One-stop shopping might be viewed as a goal for rationalizing all campus IT services.

Chapter Three

UT Austin Long Range Plan for Information Technology**Administrative Computing Issues****1. Introduction**

This chapter outlines the highest priority issues facing The University in the area of information technology support for administrative functions. In reviewing these issues, the Committee constructed a vision for administrative computing for UT Austin over the next three years which is comprised of four primary goals:

- 1) to provide virtually all major central administrative services directly to students, faculty, and staff over the Internet so that these services are convenient and easy to use, available 24 hours a day/seven days a week, and provide one-stop-shopping;
- 2) to provide University executives and managers with immediate access to accurate, timely, and appropriate decision support information that includes trend analysis, projections, and other services which are needed for effective management of University operations;
- 3) to re-engineer work flow so that duplication of effort is minimized, the time to complete processes is reduced, and efficiency is maximized; and,
- 4) to facilitate electronic communication and interaction with external entities including other universities, vendors, corporate partners, and governmental agencies by way of electronic commerce, electronic data exchange, and other appropriate technologies.

With respect to the first goal, the Committee specifically recommends that, within the next three years, The University formally adopt the policy that electronic, networked communication will be the "primary and preferred" means of interacting with students, faculty, and staff for: a) distributing official administrative information services; b) collecting and receiving "forms-type" information; and, c) conducting transaction-oriented business such as paying fees or updating records. The Committee concluded that an aggressive transition to electronic communications for routine administrative functions can save and/or offset substantial operating costs by reducing printing costs and reducing the staff time necessary to process administrative procedures. The Committee further concluded that the movement to electronic communications would simultaneously improve the quality of administrative services by making them convenient and available 24 hours a day, supporting self-service, and freeing staff time to focus more time on non-routine exceptions.

The Committee identified three broad categories of needs which must be addressed in order to achieve the four goals stated above: a) establishing an effective and orderly process to identify, integrate, and deploy new technology standards intended for adoption campus-wide; b) specifying and providing a secure, robust, and comprehensive campus-wide information technology infrastructure necessary to support electronic administrative services; and, c) obtaining adequate funding to keep pace with the demands to use rapidly expanding and changing new technologies.

The findings and recommendations in Section 3 are all intended to address these obstacles and describe the actions which must be taken to achieve the four primary goals listed above.

2. Methodology

In determining its findings and recommendations, the Committee considered requests, data, and other information from a number of sources both from within The University of Texas at Austin and from other institutions around the nation. Examples of sources consulted include:

1. "Report of the 1995 Information Technology Retreat"; The University of Texas at Austin Data Processing Department; January 1995.
2. "Report of the Automation Sub-committee to the Cost Savings Committee"; The University of Texas at Austin; August 1994.
3. "The University Plan 1996-97"; University of Minnesota Office of Planning and Analysis; May 1996.
4. "Observations on Benchmarking Information Technology Support" by The Office of Computer and Information Systems; Pennsylvania State University; CAUSE/EFFECT magazine, Spring 1995.
5. "The Financial Mythology of Information Technology: Developing a New Game Plan" by John Oberlin, Interim Director of the Office for Information Technology at The University of North Carolina at Chapel Hill; CAUSE/EFFECT magazine, Summer 1996.
6. "Campus Computing 1996: The Seventh National Survey of Desktop Computing in Higher Education" compiled by Kenneth Green; Claremont College; 1996.

3. Findings and Recommendations

After due study and collaboration the Committee determined that the following eight recommendations represented the most important actions The University can take toward achieving the goals stated in Section 1. Recommendations 3.1, 3.2, 3.3, and 3.4 were considered essential core steps which are vital prerequisites for accomplishing all the major goals. Recommendations 3.5 and 3.6 support goal number 1 for direct services to students, faculty, and staff. Recommendation 3.7 applies to goal number 2 for effective decision support services, and Recommendation 3.8 will assist with the accomplishment of both goals 1 and 4 - direct services and electronic commerce, respectively.

3.1 Provide Administrators with a Structural Role in Setting Priorities

Finding: The decisions on technology directions which are made within Administrative Computing Services (ACS) affect the entire campus. As official procedures and processes are increasingly automated, the relationship between the technology infrastructure supported by ACS and the operations of administrative offices becomes even closer. This relationship coupled with the rapid pace of technological change make it vital that University leaders have a recognized and participatory role in ACS decision making process regarding the adoption of new technologies, such as campus-wide imaging systems, networking standards, Data Warehousing, and smart-cards.

Recommendation: Administrative Computing Services should take three procedural steps to ensure that effective and appropriate campus-wide input is obtained and considered in all major technology decisions.

- 1) establish a "Executive Advisory Council" for ACS;
- 2) establish a policy for an ongoing program of customer surveys and focus groups to provide input into decisions; and,
- 3) work with the Executive Advisory Council to develop standard criteria and procedures by which new technologies are formally adopted for official campus-wide use.

Responsibility: UT Austin Executive Officers

Timeline: This item should be implemented by 1/1/98.

Costs: Incidental to ACS operational budget.

3.2 Adjust Pay Scales to Attract and Retain Skilled Technical Staff

Finding: The University faces a near crisis situation in the recruitment and retention of staff with adequate skills and training in the technical areas necessary to support the development and maintenance the institution's information technology infrastructure. The specific staff positions in shortest supply are programmers, systems analysts, networking technicians, and LAN and microcomputer support personnel.

This crisis is due primarily to a) the discrepancy between the pay scales for these positions at The University compared to those offered throughout the private sector in Austin and around the nation, and b) the increasing number of job opportunities in technical fields created by the rapid adoption of the Internet and the World Wide Web (the Web) for electronic commerce and personal communications. Because of the pay

scale discrepancy and the highly competitive market for technical skills, The University is experiencing historically high rates of attrition and low levels of average number of years experience in filled positions.

From 1991 through 1995, ACS reported an essentially steady staff turnover rate of approximately 12% annually. In 1996, the turnover rate nearly doubled to almost 22%, and the rate for the first four months of 1997 indicates that the turnover rate is continuing to climb.

The Committee considered this situation a crisis because as information technology increasingly plays a strategic role in University's primary mission, the ability to recruit and retain skilled and competent technical staff becomes even more essential for the institution to sustain its competitive position.

Recommendation: The University Administration should immediately adjust staff salary rates campus-wide by 30% for programmers, systems analysts, networking technicians, and LAN and microcomputer support personnel working to support administrative functions.

Responsibility: UT Austin Executive Officers.

Timeline: This item should be implemented by 9/1/98.

Costs: Permanent Annual Budget Adjustment for Staff Salaries \$ **4,200,000**

This figure is calculated as a 30% increase in salary rates for all information technology staff positions campus-wide based on the estimated total of approximately \$14,000,000 now budgeted for these positions as reported in the Accreditation Study Committee's report on "Information Technology Expenses 1995-96" for UT Austin.

3.3 Establish a Life Cycle Funding Program for Desktop Computers

Finding: The University of Texas and higher education in general have come to recognize that the desktop microcomputers used by staff and faculty are essential elements of the administrative computing infrastructure and that they represent an ongoing, recurring cost.

Because ACS has committed to delivering all new administrative information services via the Web and other client/server technologies, faculty and staff access to current generation desktop microcomputers is now necessary for their use of administrative services.

An article in the Summer 1996 edition of CAUSE/EFFECT magazine stated that "Recognizing the economic life cycles of information technology is at the core of understanding the new economics. Each new technology generation has an economic life cycle that is independent of its functional life cycle. Computers rarely wear out. Instead, they become economically obsolete and are replaced."

Historically, UT Austin has budgeted for and funded desktop microcomputers as one-time costs. This model does not recognize the costs associated with technical support, training, commercial software, repair, and - especially - replacement of the microcomputer when it becomes obsolete and unable to run essential current generation software.

Recommendation: Adopt a new budget procedure and funding model for institutionally owned desktop microcomputers which factors in replacement of machines every 42 months. The University Administration should adopt a new budget procedure and funding model for institutionally owned desktop microcomputers which factors in 1) replacement of machines every 42 months; 2) software costs for commercial products which are adopted and used institution-wide; and, 3) personnel training costs. The University should adopt a budget which a) provides for ongoing replacement of desktop microcomputers on the 42 month cycle; and, b) provides a "current generation" computer for all faculty and professional staff. The University should further negotiate an optional institution-wide leasing program which gives departments the alternative to lease, rather than purchase, at competitive rates.

Responsibility: UT Austin Executive Officers.

Timeline: This item should be implemented by 9/1/98.

Costs:

1) Annual Expenditure for Replacement of Microcomputers: \$8,265,000

This figure was reached by multiplying the 9,643 full-time faculty and professional staff at UT Austin times an estimated purchase price of a desktop computer of \$3,000, and then dividing by 3.5 because the recommendation calls for replacement of computers every 3.5 years.

2) Annual Expenditure for standard commercial software: \$3,375,000
(\$350 per unit * 9,643 units)

3) Annual Expenditure for maintenance, support, and training: \$4,821,000
(\$500 per unit * 9,643 units)

Total Annual Life-Cycle Costs for Faculty/Staff Desktops: \$16,461,000

Offset from Current Budgets \$6,000,000

Based on an analysis of departmental computer expenditures reflected in documents supplied by the Office of Accounting, the Committee estimates that The University is currently spending approximately \$6,000,000 annually on faculty and staff departmental desktop microcomputers.

Additional Institutional Funding Required Annually: \$10,461,000

3.4 Setting Minimum Standard Specifications for Desktop Computers

Finding: Desktop microcomputers are now essential for the delivery of official administrative information services over the Internet. For these computers to perform effectively, they must be capable of running current generation software which is used to communicate with central servers. Because Desktop microcomputers are increasingly used for networked communications, it is essential that they be compatible with and capable of running the software which is used campus-wide to provide networked services. In today's environment, examples of such software include electronic mail clients, Web browsers, and encrypted tn3270 clients.

Recommendation: In consultation with University offices and departments, ACS should periodically publish minimum supported technical standards for desktop microcomputers which are capable of running current generation software necessary for official, campus-wide services. These standards should include which Operating Systems are supported and the RAM and hard drive sizes which are minimally required. The institution should further negotiate an optional institution-wide leasing program which gives departments the alternative to lease, rather than purchase, at competitive rates.

Responsibility: ACS Management

Timeline: This item should be implemented by 1/1/98.

Costs: Incidental to ACS operational budget.

3.5 Conducting University Business via Electronic Mail

Finding: University administrative offices could save a substantial amount of money while improving the quality of service to their customers if they were authorized to conduct official business using electronic mail (e-mail). This is particularly true in the case of students where a single U.S. postal mailing to all UT-Austin students may cost in excess of \$20,000 while the cost of an e-mail message is inconsequential.

Recommendation: The University should: 1) require all students, faculty, and professional staff to declare a preferred e-mail address; and, 2) adopt an official policy statement declaring that e-mail may be used to conduct official business.

Furthermore, universal use of e-mail for official business is dependent on the resolution of other issues which are addressed separately in other items of this chapter and in other chapters of this Long Range Plan. Those issues include: a) privacy enhanced e-mail; b) universal access to networked computers; and, c) adequate network connections and capacity.

Responsibility: ACS and ACITS Management should reach consensus.

Timeline: This item should be implemented by 9/1/98.

Cost: (Note: Campus-wide E-mail Services are provided by Academic Computing and Instructional Technology Services.)

3.6 Facilitating Direct Administrative Services to University Constituents

Finding: University administrative offices could save a substantial amount of money while improving the quality of service by providing those services directly to their customers via networked information technologies. ACS has already adopted the Web as the standard protocol for delivering direct customer services; produced software development tools to make these services possible; and begun an informal effort to encourage administrative offices to move in this direction.

Recommendation: Institutionalize the ad hoc trend toward direct administrative services over the Web by requesting a policy memorandum encouraging and/or requiring offices to make widely used functions available over the Web. The University should further adopt the policy stating that electronic, networked communication will be the

"primary and preferred" means of interacting with students, faculty, and staff for a) distributing official administrative information services; b) collecting and receiving "forms-type" information; and, c) conducting transaction-oriented business such as paying fees or updating records.

Responsibility: UT Austin Executive Officers.

Timeline: This item should be implemented by 9/1/97.

Cost: Policy recommendation which is incidental to operational budgets.

3.7 Provide Funding for Effective Decision Support Services

Finding: Directors, department heads, and managers at all levels need easy access to management information about all aspects of their operations in order to provide the most effective and efficient leadership for their areas of responsibility. Modern management practices require high quality decision support information in the form of trend analysis, budget projections, and historical patterns.

Several successful Data Warehouse pilot projects on the UT campus have already demonstrated that this new technology can be deployed to provide cost-effective decision support services.

Data Warehousing represents an expense which goes beyond the basic information technology infrastructure historically funded out of the core Administrative Computing budget. New funding sources must be found to develop and support this additional service and to apply it to the re-engineering for existing transaction-based systems.

Recommendation: Fund Data Warehousing on a campus-wide scale for all major academic and administrative decision-making entities, including colleges via Compact 2000, Office of Institutional Studies, Budget Office, Office of Admissions, Registrar's Office, Office of Student Financial Services, Purchasing and HUB reporting, as well as all other major administrative offices.

Responsibility: UT Austin Executive Officers.

Timeline: This item should be implemented by 9/1/98.

Cost:	First Year Costs for Personnel and Software -	\$ 953,200
	Second Year Costs for Personnel and Software -	\$ 316,200
	Third Year Costs for Personnel and Software -	\$ 260,200

Total for First Three Years:	\$1,529,600
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This cost estimate is based on the recommendation sent to the Provost in the Fall of 1996 for funding of Compact 2000 and PBIS Data Warehouse services for all colleges. The cost figures shown here are double those from the 1996 recommendation in order to extend funding to cover Data Warehousing services for all major administrative offices outside of the colleges.

3.8 Fund a Pilot Project to Test the Viability of Smart-Card Technology

Finding: Smart-cards are wallet-sized plastic cards resembling credit cards but which contain an embedded computer chip capable of storing over 500 times the amount of data on the magnetic stripe of conventional cards. Because of this storage capability, smart-cards are able to support a wide variety of convenient consumer services including holding cash equivalent balances so that they can be used as debit cards for purchasing goods and services; storing personal document information like transcripts; and providing positive identification data to authenticate individuals for electronic services. Smart-cards are already in widespread use in Europe where over 10 million such cards were distributed in 1996 alone for services like long distance phone charges and vending machine purchases. At least one U.S. market research firm predicts that smart-cards and E-cash will account for half of the expected \$7 billion in on-line sales by the year 2000.

An increasing number of U.S. universities are now either deploying smart-cards or making plans to do so in the next three years. This trend is being driven by several factors: 1) the economics of smart-card technology is improving as the cost of both the cards and card readers has fallen sharply in the last two years, 2) the expanding use of the Internet for personal communications and electronic commerce has increased the need for a universal authentication mechanism, and 3) smart-cards can be used to improve the quality and convenience of services for students while providing the institution with a new revenue stream.

Recommendation: The University should conduct a thorough evaluation of the viability of smart-card technology to provide debit card services, document storage, and authentication for Internet services by funding a major pilot project in which smart-cards are distributed to faculty, staff, and students on a controlled but large scale basis.

Responsibility: ACS and ACITS Management should agree on joint-project strategy for management and oversight of the pilot.

Timeline: This item should be implemented by 9/1/98.

Costs: Budget for hardware, software, and staff for one year pilot. \$ 375,000

4. Priorities, Obstacles, and Interdependencies.

Priorities and Obstacles

The Committee determined that increased funding for technical staff salaries (Recommendation 3.2), life cycle funding for desktop microcomputers (Recommendation 3.3), and three year funding for decision support technology (Recommendation 3.7) should be given the highest immediate priority by The University Administration. In general, the single greatest obstacle for Administrative Computing services is to obtain stable and consistent funding for: a) recurring technology costs such as desktop computers and computer server upgrades; and, b) to support new technologies, such as Data Warehousing, which have been demonstrated to contain costs and/or provide vital information services. Inadequate funding is the primary obstacle to full and effective implementation of new technology solutions (see cost estimate in Section 5 below).

Interdependencies

Administrative Computing is now totally dependent on UTnet for the delivery of all Internet-based services on campus. This section assumes that full funding for UTnet and adequate

capacity to deliver reliable administrative services, as requested in other chapters of this report, will be fully funded and implemented.

Item 3.5 - Conducting official business via e-mail assumes that all recommendations in other chapters of this document for e-mail servers and privacy enhanced e-mail will be fully funded and implemented.

5. - Conclusions and Cost Summary.

The University is now positioned to achieve many of its long-standing key goals in the area of Administrative Computing within the next one to three years. The institution is already using the Web to make great strides toward providing virtually all major administrative services directly to students, faculty, and staff 24 hours a day/seven days a week. The college pilot projects have demonstrated how Data Warehousing can be deployed to provide University executives and managers with immediate access to accurate, timely, and appropriate decision support information needed for effective management of University operations. Web-based systems and the movement toward direct services are also driving numerous efforts to re-engineer work flow, and the explosion in standards and software tools to support Internet-based communication is propelling major advancements in electronic commerce. To ensure that these initiatives do not lose momentum and that they are ultimately successful, The University must provide the necessary funding to support the recommendations enumerated in this report.

Cost Summary for Items Requiring Funding

A. First Year Costs

3.2 Adjust Pay Scales to Attract and Retain Skilled Technical Staff	
Annual Cost	\$ 4,200,000
3.3 Establish a Life Cycle Funding Program for Desktop Computers	
Annual Cost	\$10,461,000
3.7 Provide Funding for Effective Decision Support Services	
First Year Costs, inc. Development	\$ 953,200
3.8 Fund a Pilot Project to Test the Viability of Smart-Cards	
One Time Pilot Project Cost	\$ 375,000

FIRST YEAR TOTAL	\$15,989,200

B. Second Year Costs

3.2 Adjust Pay Scales to Attract and Retain Skilled Technical Staff	
Annual Cost	\$ 4,200,000
3.3 Establish a Life Cycle Funding Program for Desktop Computers	
Annual Cost	\$10,461,000
3.7 Provide Funding for Effective Decision Support Services	
Second Year Deployment Costs	\$ 316,200

SECOND YEAR TOTAL	\$14,977,200

C. Third Year Costs

3.2 Adjust Pay Scales to Attract and Retain Skilled Technical Staff	
Annual Cost	\$ 4,200,000
3.3 Establish a Life Cycle Funding Program for Desktop Computers	
Annual Cost	\$10,461,000
3.7 Provide Funding for Effective Decision Support Services	
Third Year Operational Costs	\$ 260,200

THIRD YEAR TOTAL	\$14,921,200

THREE YEAR GRAND TOTAL \$45,887,600

Note: continuing expenditures of approximately \$15,000,000 per year would be required to sustain these items after the initial three year cycle.

Chapter Four

Telecommunications and Networking

I. Introduction

Telecommunication and network systems provide the information technology infrastructure for The University. The near term future of these systems is likely to be one of significant change. In particular, the committee foresees the need to address immediately changes in the following areas: 1) integration, 2) services, 3) planning, and 4) funding.

The integration of voice, video, and data distribution is inevitable and must be addressed from both administrative and technological perspectives.

The ongoing transition of UTnet from a relatively passive data conduit to an indispensable source of value added services for the entire UT community -- campus based and beyond -- must be treated as a paradigm shift that fundamentally changes how The University plans for, manages, and funds its telecommunications and networking system.

It is important to note that UTnet -- what we think of as the computer campus network -- is only one of several systems on campus requiring inter-building data communication. Emerging needs in such areas as campus security and environmental control should be considered in any discussion of The University's data communications infrastructure.

Planning for network capacity and services must be an ongoing and systematic process that involves the entire IT community and must figure prominently in The University's strategic and annual budgetary planning.

The funding model that supports the telecommunications and network systems (infrastructure and management) must change to ensure a predictable relationship between planning and implementation.

The centrality of the telecommunications and network systems to the future of The University is reflected throughout this Long Range Plan for Information Technology. What was once the province of a small research community now affects the daily routines of every member of the UT community. This transition has been accomplished to date with little or no change in how we fund, manage, or plan for network resources (physical and human). Continuing in this vein invites disaster.

II. Current Situation

The University's telecommunications and network services have evolved rapidly during the past decade both in scale and role. Ten years ago, less than one hundred hosts had access to the campus computer network, interactive video was an interesting experiment, dial access to campus timesharing systems was provided by 32 lines operating at 2400 bits/second (b/s), access to the Internet was being upgraded from 56 kilo-b/s to 1.5 mega-b/s, the largest telecommunication transmission facilities delivered voice services to campus from the local telephone company, access to administrative applications was provided via a dedicated network of dedicated terminals, and services such as electronic mail were

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available through a few specialized computers. Today, nearly 30,000 hosts connect to UTnet, interactive video is available in every building on campus and the University operates its own satellite up/down link facility, over 2500 dial access lines are provided by Telesys, access to the Internet is being upgraded to nearly 100 mega-b/s, the University's connection to the Greater Austin Area Telecommunications Network (GAATN) provides the greatest transmission capacity, administrative applications are universally available via UTnet, and nearly 80% of the University community uses electronic mail.

The role of telecommunication and networking services within the University has transitioned from that of an ancillary utility to one of an essential infrastructure required for the strategic missions of instruction and research. Students obtain assignments from the Web and submit homework via electronic mail. Researchers share resources and results via the Internet and collaborate via interactive video. Employee paychecks and insurance qualification information are routinely carried via secure Internet communications.

The changes in scale and role of telecommunications and networking services have not been mirrored by corresponding changes in administration and organization of the University units responsible for providing the services. The principle operating units involved are the Telecommunications Services Division (TSD) of the Utilities and Energy Management Department, reporting to the Vice President for Business Affairs, and the Telecommunications and Networking Services (TNS) group within Academic Computing and Instructional Technology Services, reporting to the Executive Vice President and Provost.

From a functional perspective, TSD is primarily responsible for providing voice telephone services and telecommunications media placement. TSD is operated as a full cost recovery service bureau. TNS is responsible for UTnet operations, video services, and GAATN operations. TNS is operated on a partial cost recovery basis. TSD and TNS have cooperated closely, if informally, in the design, development, and operation of the University's telecommunication infrastructure. Both units have contributed to the development of standards for building wiring, departmental networking, and campus network architectures. However, the resources provided to support and extend the infrastructure are distributed via the colleges and departments and development is, for the most part, tactical and reactive.

UTnet, the name applied to The University of Texas at Austin's campus computer network and affiliated communication services, is a modern production telecommunication utility. The network's role within the University has evolved rapidly. The pace of evolution has been driven both by the increased use of information technology in instruction, research, and administration and the simultaneous trend toward distributed information systems. As both of these forces can be projected to persist into the near future, the success of UTnet in meeting The University's needs will be determined by its ability to gracefully increase in all metrics of capacity, i.e., to "scale" well, and to support new applications and services.

The "size" of UTnet and its rate of growth can be quantified in several ways. Today, over 30,000 registered computers are connected to the network. This represents a 50% increase in the number of registered connections in the period of one year. The network provides direct connections to more than 120 University buildings. Within these buildings, UTnet provides a total of 555 departmentally administered networks, or subnetworks. This number represents a 82% increase during the past year. The UTnet backbone, operating at the Fiber Distributed Data Interface (FDDI) rate of 100 Mb/s, has experienced an 100% increase in traffic during the past year; aggregate daily traffic nominally exceeds one terabit. UTnet's connection to the Internet is implemented via a 45 Mb/s link to Sprint, a commercial Internet service provider. During the past year, UTnet's Internet traffic has doubled and routinely exceeds 20 Mb/s.

The communications services affiliated with UTnet can be similarly quantified. At present, the University Mailbox Service has 51,000 subscribers, or more than 70% of the University community. This represents a 100% increase in the number of subscribers during one year. More than 200,000 messages are delivered daily, totaling more than one gigabyte of electronic mail. This represents a four-fold increase in daily messages when compared with last year. Similarly, the UTnet dial access service, Telesys, currently provides 2,242 lines to serve approximately 34,000 subscribers, representing a 50% growth in subscribers during the past year.

The influence of two significant recent additions to UTnet has yet to be measured. The first addition, called the Greater Austin Area Telecommunications Network (GAATN), provides the University with high bandwidth, e.g., 600 Mb/s, links not only between its Main Campus, Pickle Research Campus, and System Administration complex, but potentially similar connectivity to Austin's schools, Austin Community College, city, county, and state government entities, and various telecommunication carriers. The second addition consists of the 6,500 new network connections recently activated in the University's 11 dormitories. This addition provides every dormitory resident with a direct connection to UTnet, initially configured for 10 Mb/s operation.

While UTnet directly serves the UT Austin community, it supports connectivity to several statewide services. The Texas Higher Education network (THEnet) provides regional Internet connectivity to approximately 350 colleges and universities, schools, libraries, and other public sector entities across the state. The Texas Education Network, TENET, is a tributary of THEnet, providing dial access for approximately 50,000 members of the Texas K-12 community.

As can be easily seen, the ostensive characteristics of the UTnet infrastructure are rapid, frequently geometric, growth and continuous change, change necessary not only to accommodate growth but also to support new services and applications. (As an example, consider that three years ago, the World Wide Web did not exist. Today, 30% of UTnet traffic can be attributed to the Web; during an average day, 80 Web sessions are being created each second via UTnet.) The characteristics of growth and change translate into several strategic challenges:

- human and fiscal resources must be extended to support and upgrade the expanding infrastructure and provide assistance to the University community in developing new applications of the technology.
- the network architecture must scale well and permit the seamless integration of new technology.
- engineering and operational practices must accommodate increasing complexity while striving for maximum reliability and availability.

Tactically, UTnet must be positioned to accommodate the impending convergence of isochronous, or constant capacity traffic such as video and voice, with the traditional asynchronous computer generated traffic.

The interactive voice and video applications of the embryonic Multicast Backbone (Mbone) are already being investigated by leading-edge University departments. A corollary to this requirement is that UTnet support qualitatively larger bandwidth to the desktop. Even if interactive isochronous applications are ignored, the increased multimedia content of future network traffic when coupled with inter-process communication across the campus backbone makes it imperative that bandwidth to the desktop be substantially increased.

Today, UTnet is implemented with a “hub and spoke” architecture employing multiple FDDI spokes that carry traffic from remote concentration points, or core sites, to a central switched/routed hub. Each of the core sites is itself a hub for multiple Ethernet (10 Mb/s) or Fast Ethernet (100 Mb/s) connections originating at switch/router hubs in buildings proximate to the core site. From both logical and physical perspectives, UTnet can be viewed as a hierarchical tree inter-network, with departmental networks serving as the leaves and the FDDI hub switch/router acting as the root.

At present, the FDDI spokes, or backbone links, nominally operate in the 10% to 15% of capacity regime, based upon one second sample averages. It can be assumed that the current implementation will operate usefully well into average loading of 75% to 80% of capacity. Therefore, given experiential estimates of traffic growth, backbone capacity is deemed adequate for the near future.

Measurements indicate that the situation with departmental networks is considerably different. Many of the hub interfaces supporting busy departmental networks carry average load traffic that exceeds 50% of the interface capacity. This observation indicates that network upgrades and new technology will need to be introduced earliest in the systems supporting departmental network connections.

Based upon these facts, the tactical plans for UTnet have led to the installation of several Fast Ethernet switches to concentrate departmental network links, replacing older, lower performance, routing devices and offering high bandwidth asynchronous transfer mode (ATM) interfaces for backbone connections. In addition, the first installation of ATM service employing local area network emulation (LANE) will be completed this spring in direct support of departmental network concentration. If the ATM pilot proves successful, it brings with it both the promises of scalability and higher bandwidth to the desktop in the long term.

As the capacity of UTnet is increased, the capacity of the University’s access to the Internet itself must be examined. Given the rate of Internet traffic growth and the change in campus traffic patterns, e.g., five years ago, 80% of campus network traffic remained on campus while less than 40% does today, additional Internet access capacity will be required within the next year. As discussed in Section XX in more detail, this access capacity is being addressed in two ways. First, THEnet and the State General Services Commission are seeking a contract for a second 45 Mb/s Internet connection to be supplied by an alternate carrier located outside of Austin. This connection would effectively double existing access capacity and also provide both carrier and route diversity in support of network availability. Second, the University has submitted a proposal to the National Science Foundation to obtain access to the national very High Speed Backbone Service (vBNS) in support of several research programs on campus. This access should shift load from the existing Internet connection when it becomes available.

At present, dial access to UTnet is able to meet demand. However, as has been shown above, the increase in demand for service is persistent. To meet the demand, a special Telesys access fee has been established that is used to recover not only the operational costs of the service, but also the capitalization costs involved in extending the service. The fee has proved to be a successful mechanism for matching service capacity with demand. In addition, the fee has made it possible to extend the basic Telesys service and initiate integrated services digital network (ISDN) access service this year.

High capacity access to UTnet has also been requested by private dormitories and local schools. Provision of this access has led to the development of a public key authentication infrastructure for the University in addition to specialized client and communication software. The public key services will be generalized for operation through the campus

X.500 directory to enable an enterprise-wide “electronic ID” and digital signature service for the University.

III. Findings & Recommendations

The committee has a series of recommendations to accommodate the near term future of telecommunications and networking at The University.

A. Network Master Plan

The convergence of voice, video, and data raises an important issue with respect to the campus inter-building fiber optic infrastructure. To date it has been installed incrementally and on an ad hoc, tactical basis. Little or no consideration is given to the strategic consequences of any given installation. This is an inefficient and ultimately very costly practice. This problem arises partly as a consequence of the administrative separation that often exists between the units responsible for media installation and those managing information across the media.

The picture is clouded further by the emergence of new demands for inter-building data transmission such as required by centralized security (alarm systems, card readers, etc.), environmental control systems, and smart cards. The imminent arrival of a vBNS connection and the additional demands it will place on UTnet puts yet a higher premium on an efficiently designed fiber infrastructure.

A strategic plan is required for several reasons. First, the cost of not using a strategic plan is going to be high. Second, it is imperative to determine whether the inter-building data transmission needs of all interested parties on campus can be simultaneously optimized by a single plan. If so, then The University has an obvious path to follow. If not then some important decisions regarding priorities and tradeoffs must be addressed. A third reason for a network master plan is its importance for the Pelli master plan for the campus. As The University moves forward with its physical master plan it is imperative that all due consideration be given to data pathways. A unique question confronting The University with respect to the Pelli plan is the location of the Network Operations Center (NOC), the main campus telephone switch, and any other central switching equipment associated with the emerging needs of security and environmental systems.

Recommendation

- A RFP should be issued for a Network Master Plan. The University should be prepared to pay for a comprehensive and well researched inter-building network design. The plan should account for all inter-building data transmission needs.

A. Organization and Administration of Telecommunication and Networking Services

The current organization of telecommunications and networking services is described above in the Current Situation section.

Recommendations:

Given the mission critical nature that telecommunications and networking services have assumed for the University, it is imperative that an entity be identified that can coordinate both the tactical and strategic planning and development of the infrastructure. Such an entity should possess an “enterprise” perspective of the infrastructure that would permit global optimization of the various college and departmental initiatives.

In the long term, the University may establish a single administrative unit with the responsibility for telecommunications and networking. In the interim, it may be useful to vest the existing Telecommunications and Networking Committee with the responsibility for general coordination and oversight of the design, development, and operation of the telecommunication infrastructure. The committee could serve as a central “clearing house” for major college and departmental initiatives as well as enterprise-wide planning by both TSD and TNS.

B. Staffing Issues

A fundamental principle of the architecture for the existing campus telecommunication infrastructure is that it can be separated into two distinct parts; one part provided and supported centrally by the institution, and the other part provided and supported by the various departments. In the case of UTnet, the Inter-Building Networking Standard recognizes this separation and provides for a point of “demarcation” in each building where the two parts of the system are joined in a common piece of equipment.

This principle has served the University well over an extended period of time for several purposes. Perhaps the most useful purpose served has been the definition of support staff responsibility for the overall operation of the network. In general terms, departmental staff have assumed the responsibility for the configuration, development, and operation of their departmental telecommunication infrastructure, including both computer networking and video facilities. Complementing the departmental staff, the central telecommunications and networking staff have been assigned the responsibilities of inter-building, i.e., “backbone”, communication and the provision and maintenance of external service connections, e.g., Internet service providers, wide-area video networks. This division of responsibility has enabled departments to optimize the level of support appropriate for their infrastructure independently of support from central facilities and staff.

The current and projected trends in telecommunication and networking technology augur against the degree that division of responsibility has assumed. As new services and additional network structure are implemented within departmental networks, the definition of the demarcation point between departmental responsibility and central staff responsibility continues to blur. Increasingly, central staff have to be involved with the configuration and operation of departmental telecommunication systems because the technology requires that parameters of the departmental configuration be projected into the campus-wide infrastructure.

These trends suggest that while staffing for the support of the campus “backbone” services may be adequate today, changes in technology may render it painfully inadequate in the near future. The issue is not simply that additional staff will be required, but also, and perhaps more importantly, the coordination between departmental and central support staffs will have to be closer and better organized. Departmental staff will need to become better aware of the structure and operation of the campus telecommunication infrastructure to effectively do their jobs. It will be the responsibility of the central staff to provide the

information required by departmental personnel and to ensure that design and operational standards are maintained across the campus.

As a direct result of its unabated growth, support of the telecommunication infrastructure will also require additional staff in both the central organization and the departments. The availability of qualified telecommunications and networking staff is limited nationally, and the University is not competitive in recruiting these personnel. This situation can be partially addressed by actively making use of students as interns and part time staff. Cooperation with the appropriate academic units could enable students to not only be paid for their work but also to obtain academic credit. An additional favorable outcome might be that a fraction of the students involved in this type of program might elect to remain employed with the University after graduation.

Recommendations:

- Encourage the development of “in house” talent through changes in degree programs, internships, and other opportunities
- Have the Office of Human Resources conduct a job title / compensation analysis of required staff positions

C. Telecommunication Equipment Infrastructure

The University’s telecommunication and networking equipment infrastructure is at a transition point, with the period of transition expected to extend over the next three to five years. UTnet is currently implemented as a, “network of networks,” or an internet. The basic unit of transmission is the variable length packet, or frame. The mode of transmission is asynchronous, or “connectionless.” The lingua franca of the network is the TCP/IP, or Internet protocol suite.

New technology is beginning to emerge in this environment that promises to increase network services to the user and permit the integration of voice, video, and computer generation traffic over the same medium. This technology, broadly termed, “ATM,” or asynchronous transfer mode, differs from existing paradigms in several aspects. ATM is a circuit switched and connection-oriented system. It employs fixed length cells as its unit of transmission. In achieving its promises of increased bandwidth and fully integrated transmission services, ATM obviates the need for intermediate protocols such as TCP/IP.

In planning the integration of ATM on campus it is important to understand the problems that this technology is positioned to solve. The first is the simple need for greater backbone bandwidth; a generic ATM system starts with a 155 mega-b/s transmission rate, compared with the current 100 mega-b/s FDDI backbone technology (the comparison between ATM and FDDI is not as simple as this suggests but the bottom line is a noticeable increase in available bandwidth). The decision to extend ATM technology beyond the backbone and into a LAN environment or to the desktop should be dictated by 1) the need use the more sophisticated network management tools available with ATM and / or 2) quality of service issues related to certain applications (e.g., high quality real-time audio and video).

The University is well positioned to begin the transition to ATM technology in that an extensive optical fiber inter-building network is in place and a number of its buildings have been wired with modern premise distribution systems that will support the 155 mega-b/s transmission rates that are associated with ATM. In addition, during the past two years,

the UTnet backbone has been physically reconfigured in anticipation of a centrally switched architecture.

The comprehensive changes attendant to a transition to the ATM-based network are far too disruptive and expensive to undertake in a single effort. Instead, it is planned that the transition will occur in a series of phased projects that will extend over the next five years. The first of these projects, familiarization with the operational characteristics of the technology, has been underway for the past two years. At this point, the initiation of the second project, the introduction of ATM switching into the UTnet backbone, is imminent. Assuming that this project is successful, a third phase project would begin to extend the ATM switching fabric into departmental networks.

As ATM technology is being introduced into UTnet, extensions and additions to the network will be monitored to ensure that any new equipment and media installations will be compatible with the phased ATM transition.

Recommendations:

- The introduction of new high bandwidth network technology must be done in accordance with a Network Master Plan.
- New high bandwidth network technology must be introduced on campus as part of UTnet, not as a parallel and physically separate network.
- Rigid hardware and software standards for all active network components must be established and enforced campus-wide to ensure the success of any new network technology.

D. Wiring Infrastructure

The wiring standards promulgated in 1995 by the erstwhile Physical Network Standards Committee remain the blueprint for intra-building wiring at The University for the 2-5 year long range planning horizon, and probably well beyond. The aim of those standards was to support the inevitable migration to higher bandwidths for data communication as well as to accommodate the potential integration of voice/data/video over a single wiring plant.

The minimum Building Distribution Standards advanced by the Committee on Physical Network Standards are summarized below:

- EIA/TIA category 5 unshielded twisted pair (UTP) copper cabling.
- Two faceplates (two UTP cables per faceplate) per faculty or staff office (150 sq.ft., or less); one additional faceplate per room per additional 75 sq.ft..
- Classrooms: two faceplates, regardless of size.
- Telecommunications closets separated from other utilities (e.g., Electrical power).
- 90 meters or less of cable between faceplate and closet.

At the time of the original wiring report Category 5 wire was rated to support up to 155mb/sec data transmission rates (I.e., ATM desktop bandwidth). It has since been rated by IEEE to support 1000mb/sec ethernet traffic (1000baseT). Combining gigabit bandwidth with the relentless improvement of data compression algorithms ensures that

this wiring standard will support any voice/data/video integration likely to emerge over the 2-5 year planning horizon.

Cost estimates for achieving ubiquitous Category 5 intra-building wiring on campus range from \$6-\$7 million (see attached spreadsheet). These estimates do NOT include the cost of active network components (e.g., hubs, routers, switches, etc.). The stated goal of completing the installation across campus of Category 5 wiring within two years is likely to be unrealistic absent a change in the decentralized funding model. With a 100mb/sec rating for Category 3 wire, it is possible that many of the applications likely to emerge over the next 2-5 years requiring higher bandwidth may ease the pressure to reach the Category 5 goal. Nonetheless, the stated goal remains worthy and for some imperative.

Recommendations:

- The campus should complete the Cat 5 wiring plan within the next three years
- All intra-building wiring plans should be vetted by ACITS Telecommunications and Networking Services.

E. Internet Connectivity

Telecommunications issues for The University transcend the campus environs, hence in future planning we must take into account external networks such as Internet 2, vBNS (very high speed Backbone Network Service), UT System telecommunications network (administered by the Office of Telecommunications Service - OTS), and statewide networks operated under the auspices of the General Services Commission (GSC). The University became a member of Internet 2 in January, 1997, along with over 100 other major universities in the U.S. The goal of this group is to work with private vendors to develop the architecture of the Next-Generation Internet, with partial funding from the Federal government. Internet 2 initially will involve communications among Internet 2 members only; participants plan to spend at least \$500,000 per year on improving campus telecommunications infrastructure to accommodate the higher bandwidths required for videoconferencing, distance education, multimedia, and large data sets.

In a related move, The University has submitted a proposal to the National Science Foundation to install a connection to vBNS, which currently connects major high performance computing (supercomputer) centers and government laboratories in the U.S. This proposal requests capital funds of about \$350,000 to install appropriate switches and routers to serve the Pickle Research Campus (High Performance Computing Facility) and the rest of the campus through GAATN. The University is obligated to lease a DS-3 data line (52MB/S) to Houston through MCI in order to connect to vBNS (cost of \$175,000/year). Ultimately vBNS and Internet 2 are expected to merge and become the core of the so-called Next Generation Internet. Internet 2 is expected to operate at speeds of OC-3 (3 times DS-3) and in the future at OC-12 (12 times DS-3 or 620MB/S).

The high cost of an OC-12 line to Houston (over \$1 million/year) is a driving force to consider the formation of a state wide network, in conjunction with UT System, University of Houston System, Texas A&M University System, Texas Tech University and State Government under the umbrella of GSC. The economies of scale and the market leverage obtainable through a state-based network should ensure that the lowest prices of service can be negotiated. It is also of strategic value to consider having OTS operate the state-wide network under contract to GSC. OTS performs that function now for the UT System as

well as THEnet, a collection of universities and public schools who route Internet traffic through The University. With this arrangement it would be likely that a Texas Gigapop (gigabyte point of presence) would be located in Austin (operated under the aegis of GSC), which would accrue to the benefit of The University. This suggests that The University maintain the expertise within ACITS to keep UT networking at the cutting edge and share this expertise with other partners such as GSC (it is likely that the existing UT System network operated by OTS would become part of the new statewide network).

Recommendations:

- The Network Master Plan should include explicit provision for the monitoring and maintenance of reliable and uninterrupted access to the commercial internet as we know it today and as it evolves.

F. Network Services

UTnet can no longer be thought of as a passive conduit through which bits and bytes are passed mindlessly from one computer to another. The network is the foundation for a wide range of services that provide a significant value added component to network connectivity. These services exist largely as a consequence of a movement towards the recentralization of computing and information technology on campus, and in computing more generally. This trend capitalizes on the combination of larger network bandwidth, better network management, and the economies of scale -- particularly those associated with hardware and software management -- associated with centrally managed information technology assets.

With the assurance of adequate network bandwidth on campus there is every reason to believe that network services will grow substantially over the next two to five years. The value of these services will add pressure to the need for careful strategic network planning on campus.

Current and emerging network services include:

The Information Trust Infrastructure

This service refers to a centralized, campus-wide system for authentication & authorization. Such a system offers the prospect of electronic commerce of every sort across campus and greatly enhances the potential availability of services to remote or otherwise insecure users.

Network diagnostics and troubleshooting

With greater hardware and software standardization of active network components (i.e., routers, switches, hubs, etc.) on campus it becomes easier to implement centralized network management and relieve department & college staff of some network management responsibilities.

Virtual Local Area Network (VLAN) management

One of the emerging network services that will see ever greater use on campus is the creation of VLANs to link research and academic groups as they seek more access to LAN based services. The creation and maintenance of VLANs is a service provided by central network managers.

Quality of Service

Emerging network technologies (e.g., ATM) offer the prospect of centrally managed quality of service. This refers to manage the need of some applications (e.g., real-time audio and video) to access dedicated bandwidth in order to ensure desired service quality.

Software distribution

The network is already being used for the distribution of Unix software (e.g., OS patches) by ACITS and offers a promising vehicle for the distribution of desktop software and upgrades. It is quite possible that this could become an automated process for a large segment of the campus to the extent that administrative staff and even faculty settle on common software suites.

Remote Access

Access from anywhere on and off campus to public and personal files and software on computers, including individual desktop machines, is both possible and practical with appropriate software and adequate bandwidth. This is one example of a practical application that follows from an information trust infrastructure.

Domain Name Service

This service entails the maintenance of a local database that matches IP addresses with local host names. Without it it would be impossible for internet users on campus to receive their email and other host-addressed information.

Mail Service

The UMBS is a very good example of the recentralization of services seen on campus in recent years and is likely to be followed by other specialized centralized services (see next item). As this model of computing continues to grow it is imperative that a planning process be established that anticipates usage and that identifies the funds required to maintain smooth and uninterrupted service.

Directory Service

The X.500 electronic directory, which is published by Academic Computing in cooperation with Administrative Computing, Office of Human Resources, and the Registrar, demonstrates the utility of truly central file serving and provides a model for future campus-wide database access.

File Servers

The immediate future for central fileserving on campus includes the emergence of both Digital Libraries (see separate section in the Long Range Plan) and Video Serving. Both of these services, particularly the latter, will put pressure on both inter- and intra-building network bandwidth.

Metacomputing (Clustering)

A highbandwidth, high-availability network offers the prospect of leveraging computing resources for solving large and complex problems by assigning computational tasks in parallel to otherwise idle cpu cycles across campus (and beyond). The creative use of java programming in this effort can minimize security and platform dependence problems that have hampered past metacomputing efforts.

All of the services described above depend on a robust campus network and, to varying degrees, active management by network administrators.

Recommendations:

- Institute a strategic planning process that is accountable for projecting growth in current network services.
- Institute a strategic planning process that both recommends and anticipates the emergence of new network services.
- Institute a strategic planning process that identifies funding needs and sources for current and emerging network services.
- Require a network impact statement to accompany the proposed introduction of any new network service.

H. Remote Access

The Telesys system currently provides the principal means of remote access to UTnet. The growth rate of regular Telesys subscribers is slowing and is likely to slow further as a consequence of RESnet and the Waller Creek initiative, which will connect directly to UTnet a number of private multi-unit residences in Austin starting this fall.

Remote access will and must remain a very important component of network access for the campus. Among other reasons, it is far more cost effective to provide remote connectivity than direct connectivity once the related costs to The University of overhead and equipment are considered (the laptop initiatives in Engineering and elsewhere lower the relative costs to some extent but probably not to the point of being a lower cost alternative).

Premium services such as access to lower user/modem ratios and ISDN are likely to see the greatest growth in the next few years. Given the increasing reliance on Telesys fees and the prospect of even declining use of regular services, the trend in premium services will need to be encouraged through further service innovations.

A common question often arises about the feasibility and desirability of contracting with a third party Internet Service Provider to manage all remote access to campus. UC-Berkeley was a pioneer in this using the approach on a scale approaching that of The University of Texas. Their experience with this approach was not good and they are no longer recommending it as a solution to remote access.

Recommendations

- Lower regular Telesys service user/modem ratios to ensure adequate peak load capacity.
- Support and augment premium remote access services.

I. Funding Model

Nothing has so fundamentally shaped the growth and character of telecommunications and networking services at The University than the way in which funds are raised and spent. Student fees are the foundation upon which the IT infrastructure has been built over the past four years. This has had several important implications for the campus.

First, the lion's share of relevant student fee money, whether it is raised at the university or the college level, is spent locally, by departments and colleges. This, in turn, leads to uncoordinated and occasionally uninformed technology decisions. The planning and implementation of a coherent and easily managed network infrastructure, not to mention a strategic IT plan, by The University is difficult under these circumstances.

Second, given the source of these funds (students), there is a strong and understandable mandate to showcase enduser technology (i.e., put computers in front of students). Expenditures on the telecommunications and networking infrastructure -- largely unseen and of benefit to others than students -- at the University are difficult to justify and, when made, often fail to account for their implications for UTnet as a whole.

Third, the central networking organization in ACITS does not have a reliable revenue stream. As discussed in an earlier section, the funding of telecommunications and networking services follows several different models, depending on what service is being provided and by whom. In broad terms, the Telecommunications Services Division (TSD) of the Utilities and Energy Management Department operates on a full cost recovery basis while the Telecommunications and Networking Services (TNS) group in ACITS uses a partial cost recovery model. The TNS group competes annually for a portion of the 25% of the general student Information Technology Fee given to ACITS.

Recommendations:

- In order to generate a reliable revenue stream to fund TNS hardware and software replacement create of a Network Services Fee based on the value added network services discussed above.
- In the spirit of Universal Access, lessen the reliance on increases in Telesys charges to fund future network expansion.
- Explore other bases for user fees, such as may be possible with new switching technologies (e.g., ATM), that relate more directly than Telesys to network usage.

Chapter Five

**LIBRARIES AND INFORMATION ACCESS FOR THE UNIVERSITY
COMMUNITY:
SUPPORT THROUGH COMPUTING AND INFORMATION TECHNOLOGY**

In pursuit of its primary mission to support and enhance the University's learning, research, and public service programs by providing access to information resources and library services, UT Austin libraries continue to follow a strategic plan of using computing and information technologies to enhance and extend this access.

Long Range Objectives

- Provide UT scholars, wherever they are located, with technology-based information resources and services needed to support University programs.
- Establish the human and technological infrastructure necessary to support outstanding digital libraries and library management services through superior information systems.
- Maintain a vigorous program of teaching essential information skills required for success in the electronic environment to the entire UT Austin community.
- Promote resource sharing and provide the most efficient services possible by working in close cooperation with campus organizations such as the Academic Computing and Information Technology Services (ACITS) and Administrative Computing Services (ACS), with statewide initiatives such as TexShare, and with similar programs at the national level.

Background

The University of Texas at Austin libraries have pursued a development plan for well over a decade that has been recognized internationally as model for other libraries to follow. The goal is to provide state-of-the-art services, not only for the Austin campus but also for the University of Texas System and beyond, through collaboration and resource sharing partnerships. The concept of a digital library encapsulates the vision.

Combining funding from the University of Texas System Board of Regents, external grant funding, collaboration with UT System component libraries, with consortial relationships among libraries of other publicly-supported institutions of higher education within the state of Texas, UT Austin libraries have created an array of information-technology based resources and services for the campus community. However, much more remains to be done to meet the increasing information needs of students and faculty.

Recommendations

Information Resources

- Assure a sufficient and competitive level of information resources for faculty and students of UT Austin.
- Develop a mechanism to address continuing inflationary pressures on and scholarly demands for information resources.
- Increase UT Austin base library materials budgets by \$4 million to achieve some parity with UCLA, Berkeley, and Michigan

Digital Library Program

- Expand and enrich UT Library Online, the digital library program of UT Austin libraries, and the supporting technological infrastructure so that faculty, students, and staff can obtain the information they want, when they want it, and in the format most appropriate to their need, regardless of where that information is physically located.

Integrated Library Management System

- Provide a standards-based, integrated library management system to assure state-of-the art access to the library holdings of UT Austin and to effectively and efficiently operate UT Austin libraries.

Conversion of Bibliographic Records

- Complete the conversion of bibliographic records to machine readable form for the cataloged collections held in UT Austin libraries.

Digitization of Library Materials

- Working in collaboration with other digital archive initiatives on campus, review and prioritize local resources to be digitized, actively seek external funding to supplement local programs, and take a leadership role in establishing a comprehensive digitization program within the UT System and the state.

Archival Responsibility

- Establish a campuswide Task Force to consider the policy issues relating to permanent archival responsibility for electronic intellectual property produced under the auspices of the University as part of the educational and research enterprise.

Information Literacy Skills for Students

- Appoint a task force to establish "scales of competencies" for students, ranging from those needed at the beginning of the university experience to advanced skills which should be acquired before graduation.
- Develop Web-based instruction modules to allow students to acquire basic skills in a self-paced environment. These instruction modules should be required for any student entering the University.
- Encourage collaboration between the library and individual faculty members. An open communication about the design of library related assignments should be expected to ensure that students get assistance with advanced skills and assignments focus on the best resources for that task.

Consolidation of Technical Support

- Establish a task force, with representation of appropriate campus agencies, to recommend the policies, procedures, and structure needed to provide a consolidated tier one, high demand support service.

Information Resources

Finding: The University's library information resources must be viewed broadly, encompassing not only traditional library materials located on campus, but also the increasingly rich and diverse world of electronic information located around the globe. Electronic information resources available today include full text, indexes, images, sound, video, and other formats. In most cases these sources complement the library's broad and rich collections, in other cases they replace traditional library materials. Library subject specialists work closely with faculty to develop the comprehensive information resources, both electronic and traditional, held locally and remotely, that are needed to support research and learning at the University.

The basic UT Austin libraries materials budgets have not kept pace with inflation nor provided for the additional expenses of electronic resources. In 1995/96, UT Austin ranked 29th in library materials expenditures among the 108 members of the Association of Research Libraries with an expenditure of \$6.7 million, continuing a steady decline during the past few years from a time of consistently in the top five. The corresponding materials expenditures of Berkeley, UCLA, and Michigan ranged from \$9.4 million to \$11.4 million during 1995/96.

The following table puts this "information deficit" in perspective by illustrating relative spending on information resources per faculty members at UT Austin and competitive institutions.

Expenditures per Faculty Member ¹ :	Journals	Books
Berkeley	\$4,595	\$3,457
Minnesota	\$3,691	\$1,570
UCLA	\$2,660	\$2,560
Michigan	\$2,640	\$1,547
Texas	\$1,794	\$1,017

UT Austin currently spends 39% of the dollars per faculty member on support for scholarly journals that Berkeley spends per faculty members, 54% of what Minnesota spends, 57% of UCLA, or 71% of Michigan.

Recommendation: Assure a sufficient and competitive level of information resources for faculty and students of UT Austin.

Recommendation: Develop a mechanism to address continuing inflationary pressures on and scholarly demands for information resources.

Recommendation: Increase UT Austin base library materials budgets by \$4 million to achieve some parity with UCLA, Berkeley, and Michigan.

Digital Library Program

Finding: UT Library Online is a nationally recognized digital library program, providing services not only to UT Austin scholars, but also to scholars around the world. This comprehensive digital library program is essential to the success of the University's mission in today's competitive environment. The digital library, with carefully selected information resources which complement the University's programs, with interactive reference and consulting services, and with digitized representations of the University's unique holdings, is central to the teaching, learning, and research of the University community and to the lifelong learning needs of citizens throughout the state.

Delivery of information content and information services directly to the desktop is available today through UT Library Online, which must continue to develop as an integrated delivery system for information and interactive, real-time library services. It is essential that the University have such information resources and delivery systems in place as well as an ongoing program of leading edge technological development. The success of this effort rests upon the availability of skilled and talented digital library designers combined with a robust technological infrastructure.

¹ Association of Research Libraries. ARL Statistics, 1995/96. Washington DC, 1997.

Recommendation: Expand and enrich UT Library Online, the digital library program of UT Austin libraries, and the supporting technological infrastructure so that faculty, students, and staff can obtain the information they want, when they want it, and in the format most appropriate to their need, regardless of where that information is physically located.

Integrated Library Management System

Finding: While a digital library is designed to deliver information content directly to the user, an integrated library management system (ILMS) is the software used to manage the operations of the library. Users of the online catalog are actually viewing the “public window” into ILMS software, as does the circulation system. The ILMS is used by library staff for acquiring and processing materials, scheduling resources, management information, inter-library loan, and other library functions.

In an ILMS, one logical database is used to support several functions, with resulting benefits for information services and operational effectiveness. With the exception of Tarlton Law Library, UT Austin libraries do not have an ILMS. In 1997, the General Libraries uses a library system, begun in 1985, composed of locally developed software for circulation, online catalog, and bibliographic control interfaced with a vendor system for materials acquisitions and serials control.

This current library system environment does not adequately support library operational functions that are generally available with vendor systems. Some functions are missing entirely while others are only partially implemented, resulting in concerns about level of services for users and staff efficiencies. Standard library information retrieval protocols (i.e., Z39.50) are not currently met, while near-term interoperability standards of commercially available systems appear to be even more difficult to achieve in the current library system environment (i.e., patron-initiated inter-library loan / document request).

The UT Austin libraries must secure a standards-based ILMS, built upon an open systems architecture, that will fit comfortably into the distributed computing environment on the UT Austin campus and that will meet the needs of the General Libraries, Tarlton Law Library, the Ransom Center, and the Center for American History. Most of the ten largest research libraries in North America have recently moved from mainframe-based systems to the purchase and implementation of a distributed system for their campus. UT Austin must do the same to ensure the appropriate level services for library users.

Recommendation: Provide a standards-based, integrated library management system to assure state-of-the art access to the library holdings of UT Austin and to effectively and efficiently operate UT Austin libraries.

Conversion of Bibliographic Records

Finding: For maximum benefit to University library users, all UT Austin libraries holdings should be represented in UTSNetCAT online catalog. That is, the bibliographic information once available only on catalog cards must be converted to machine readable form in order to be available through the online catalog. UT Austin libraries have made substantial progress, using both Regental and external funding, towards the goal of complete retrospective conversion of bibliographic records, yet more remains to be done. The bibliographic records of the General Libraries Undergraduate, Benson, Public Affairs, and branch libraries, and the Center for American History have all been converted. 186,500 bibliographic records for cataloged materials in the Ransom Center remain to be converted, with 240,000 already in machine readable form; a somewhat small number of records from the Tarlton Law Library remain to be converted. Substantial portions, but unfortunately not all, of the materials in PCL have been converted; approximately 500,000 records await conversion.

Recommendation: Complete the conversion of bibliographic records to machine readable form for the cataloged collections held in UT Austin libraries.

Digitization of Library Materials

Finding: Enrichment through digitization of locally owned materials is one hallmark of an outstanding digital library program. UT Austin libraries hold significant unique treasures, often fragile and badly in need of protection, that are currently only available to qualified researchers able to use them on-site in campus libraries. These treasures include literary manuscripts in the Ransom Center, historic Texas documents in the Center for American History, and 43 *Relaciones Geográficas*, reports from the Conquistadores to the Spanish throne prepared in 1577, in the Benson Latin American Collection.

The Perry-Castañeda Library Map Collection has garnered national attention for the more than 2,000 digitized maps it provides. One of the most used web services on the campus, this site regularly receives over 1.2 million requests per month. Materials like these should be digitized and made available to the scholarly community for learning and research.

Recommendation: Working in collaboration with other digital archive initiatives on campus, UT Austin libraries must review and prioritize local resources to be digitized, actively seek external funding to supplement local programs, and take a leadership role in establishing a comprehensive digitization program within the UT System and the state.

Archival Responsibility

Finding: Within the world of print materials produced by the University community, the responsibility of permanent archiving is generally clear. UT Austin libraries receive and retain copies for general use. Copies of UT Austin theses and dissertations are deposited with the General Libraries and are microfilmed by UMI Inc. The Center for American History maintains a permanent archival repository for University publications as well as the formal University Archives.

The same issues must be revisited for the electronic publications currently being produced by University faculty, students, and staff. The issue of digital dissertations is being considered by the Graduate Assembly. However, issues relating to the permanent archiving of electronic journals, informational web pages of lasting value, and similar electronic intellectual property produced under the auspices of the University as part of the educational and research enterprise have yet to be examined and University policy has yet to be established.

Recommendation: Establish a campuswide Task Force to recommend policy, procedures, and responsibility for permanent archiving of the electronic intellectual property produced under the auspices of the University as part of the educational and research enterprise.

Information Literacy Skills for Students

Finding: Within the past five years, there has been an explosion of digital information resources. Today, students are challenged to not only excel in their courses but to master new skills related to choosing appropriate information resources, defining information needs, constructing effective search strategies, evaluating the quality and bias of information, and organizing and citing electronic resources. Although these skills were necessary when students dealt solely with print materials, digital media demand more careful scrutiny due to less rigorous publishing processes and require students to adapt to new interfaces and tools. Larger issues beyond basic computer skills become important. Nationally, the emphasis is on "lifelong learning." By understanding the personal importance and broader implications of this digital revolution, students will be better prepared to deal with new electronic settings while on campus, to function in the workforce, and to act responsibly when dealing with issues such as online etiquette and copyright.

Internet resources are of mixed quality. For example, one search engine indexes more than 50 million Web pages. On our campus within the past five years, the General Libraries has added more than 50 databases, including many with full-text articles offered in an broad array of formats. To successfully teach students the basic skills needed to take advantage of digital information requires an increase in University support. Increased support can provide a strong foundation in research strategies and information literacy which would help students achieve academic success. An increasing number of students

are becoming distance library users, accessing digital resources from home or other locations during a broader spectrum of hours. These trends argue for a more organized and efficient system of training students to become self-reliant. In partnership with computing agencies, individual colleges and departments, and other entities offering undergraduate services, the UT Austin libraries can dramatically enhance the student experience and offer students skills which will benefit them throughout their lives.

Recommendations:

- Appoint a task force to establish "scales of competencies" for students, ranging from those needed at the beginning of the university experience to advanced skills which should be acquired before graduation.
- Develop Web-based instruction modules to allow students to acquire basic skills in a self-paced environment. Completion of these instructional modules should be required for any student entering the University.
- Encourage collaboration between the library and individual faculty members. An open communication about the design of library related assignments should be expected to ensure that students get assistance with advanced skills and assignments focus on the best resources for that task.

Funding: To develop Web-based instruction, the library would require \$50,000 to acquire computers, software, scanners, and related technologies. Additional professional staff will also be needed to develop instructional materials, work collaboratively with faculty on assignments and provide information literacy instruction.

Consolidation of Technical Support

Finding: In view of the diversity of hardware, software, connectivity and digital resources available throughout campus, it is essential that University agencies work cooperatively to establish an integrated information technology support system to furnish help services and assist users with the complex processes required to achieve goals in a distributed computing environment. Users of campus information technology should not have to know which agency is providing the service nor the intricacies of campus connectivity in order to get solutions to problems. An integrated information technology support system which provides a single point of contact for initial phone, online, and in-person inquiries would take overall responsibility to see that questions were answered and problems were resolved. Steps in the direction of such an integrated support service have already been taken.

Campus agencies responsible for technical support should work cooperatively to develop a baseline for providing tier one, high demand support services. Each agency should develop service level agreements (SLA's) which clearly define and delimit the level of support provided to different classes of users for specific tasks, applications, electronic resources, operating systems and hardware platforms. Priorities need to be established for phone, walk-up, by appointment, email and online interactive help services. There should be a single consolidated consulting desk for support of base level student needs on a first-come, first-served, in-person basis. There should be a single Web page and email address which members of the university community can use as a launchpad to initiate all electronic help requests. The feasibility of acquiring software, providing staff and developing a system for offering a single help phone number for all agencies should also be investigated. Referral protocols for second tier support by specific agencies should also be developed.

Software packages for public distribution and configurations of public equipment should be standardized as much as feasible and supported across campus agencies. Training and documentation should reflect standards and SLA's and should emphasize areas in which there is high demand for technical support. Release of new software and information services should be coordinated with availability of technical support. Existing communications among agencies should be solidified and formalized by encouraging listservs, newsgroups and regular meetings among support personnel and supervisors from different agencies, including departmental liaisons and supervisors of public labs. SLA's, documentation, and announcements about downtime, software releases, and new information services should be consolidated at a single Web location. along with FAQ's,

troubleshooting tips, and help request forms. Agencies providing support should cross train first tier generalists, with each agency assuming responsibility for developing competency standards and training for first tier support in areas emphasized in its SLA's. Departmental liaisons and staff in public labs who provide technical support outside of the traditional organizational structures dedicated to technical support should be encouraged to attend training sessions and participate in support related communications.

Recommendation: Establish a task force, with representation of appropriate campus agencies, to recommend the policies, procedures, and structure needed to provide a consolidated tier one, high demand support service.

Chapter Six

Long-Range Planning for Multimedia Instruction

1. Introduction

The University of Texas at Austin will soon enter a new century characterized by rapid change in technology for human communication. Digital information technology will provide expanded opportunities for educational systems unbounded by physical, institutional, geographical and temporal limits. This technology will unquestionably change the nature of instruction in the University in fundamental ways.

Many of the issues concerning the educational uses of information technology focus on the nuts and bolts: computers, systems and networks. This report is primarily concerned with the "soft side" of the equation; it outlines strategies to create an environment at UT in which innovations in educational methods can co-evolve with new information technology. It recommends actions on how these innovations can be integrated into the mainstream of academic life at our institution.

Programmatic recommendations to promote technology-based instruction have been divided into four general categories:

- Curriculum development,
- Faculty, staff and student development,
- Networked learning environments, and
- Access to digital resources

Cutting across all these categories is consideration of two fundamental issues: administrative organization and availability of financial resources. In the sections which follow, recommendations are summarized for actions in the four areas presented above, and a discussion of organizational and resource issues is presented. The recommendations and supporting data are discussed in detail in Appendices 3 through 7.

2. Methodology

This report was prepared by the Multimedia Instruction Committee (MIC), which is comprised of 27 faculty and staff representing all schools and colleges in the University, as well as administrative units with a major role in instruction (e.g., Center for Teaching Effectiveness, Center for Instructional Technology, General Libraries and ACITS). Most of the leaders on the UT campus in the application of multimedia instructional technology in higher education are either members of the committee or are closely represented (Appendix 1).

A planning study was initiated in the Fall of 1996. The committee was divided into preliminary planning groups to formulate the key issues and recommend a working structure to address them. In December, a one-day workshop was held in which permanent working groups were formed, each representing one of the topical areas identified above; initial goals and strategies were defined. These working groups met throughout the Spring 1997 semester to formulate specific recommendations, outline needed actions, and consider organizational and resource needs to implement them. Finally, the committee members prioritized their recommendations (Appendix 2).

The recommendations presented here represent the collective experience and judgment of the members of the MIC; further development of these recommendations will be undertaken in the future, subject to availability of committee support funding.

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3. Summary of Findings and Recommendations

The committee's recommendations are divided into two priority groups: Urgent and Important. Urgent Priority items are those which must be addressed immediately and substantively if UT is to keep pace with other leading institutions, in other words, if we are to remain "a University of the first class" vis a vis the implementation of instructional technology in our academic programs. Important Priority items are those which are necessary for sustained progress and for which planning should be undertaken for implementation in a 2-3 year period. In all, 17 recommendations are proposed, 9 of which are classified as Urgent and 8 as Important.

Curriculum Development (Appendix 3)

Historically, curriculum planning in higher education has been primarily in the province of individual faculty or, at most, small groups of faculty responsible for a particular area or discipline. This approach has been appropriate to a system in which the lecture is the primary delivery system and in which chalkboards and classrooms are the primary infrastructural needs. In an age where capacity is defined in terms of gigaflops of bandwidth rather than classroom seats, a higher level of curriculum planning will be needed.

In order to encourage an environment which promotes improved teaching and learning at all levels through the use of appropriate new technologies, we must encourage curriculum planning and programmatic action in all academic units to respond to availability of new media technology.

Urgent Priority Recommendations

1. Encourage all academic units to prepare technology integration plans for incorporation of new technology, as appropriate, into curriculum and degree plans. (Rec. C1, Rank 4/17)

2. Conduct and support research into the effects of technology on teaching and learning in the university environment. (Rec. C2, Rank 5/17)

Important Priority Recommendations

1. Promote the utilization of formalized instructional design, assessment and evaluation practices in technology-based instruction at the university level. (Rec. C3, Rank 9/17)

2. Provide academic units with continuously updated information on emerging instructional technologies for consideration in curriculum planning efforts. (Rec. C4, Rank 12/17)

Faculty, Staff and Student Development (Appendix 4)

Changing modes of higher education will demand a major reorientation of the human resources that make up the University: faculty, staff and students. Much attention is being given in administrative circles to the hardware delivery systems associated with new instructional technology: computers, networks, and hi-tech classrooms. It is imperative that at least equal attention be paid to the University's human capital, the developers, maintainers and users of the hardware and software. This will entail establishment and continuous upgrading of training programs, providing adequate incentives for engagement in courseware development, and providing the technical support and facilities needed for development of a variety of courseware types.

Urgent Priority Recommendations

- 1. Provide programs to support a diverse menu of training in instructional technologies at all levels for faculty, staff and students. (Rec. FD1, Rank 1/17)**
- 2. Provide incentives for faculty to undertake new courseware development. Rec. FD2, Rank 3/17)**
- 3. Provide first-class facilities for continuing media development. (Rec. FD3, Rank 6/17)**

Important Priority Recommendations

- 1. Provide incentives for students to participate in the process of courseware development. (Rec. FD4, Rank 13/17)**

Networked Learning Environments (Appendix 5)

Explosive growth of the Internet as a medium of information distribution and personal communication has profound implications for higher education. An important goal of the University must be to promote and develop the potential of computer networks, and the Internet in particular, as a complement to conventional instructional environments. The current anarchic structure of the World Wide Web, while appropriate as a first-generation paradigm, will not adequately serve the more rigorous requirements of a formal educational system. Some degree of coordination, collaboration and integration of instructional media will be needed to insure uniformly high quality and availability to the diverse constituencies we serve.

Urgent Priority Recommendations

- 1. Develop processes, procedures and infrastructure for acquisition, archiving, storage, retrieval and distribution of digital media. (Rec. N1, Rank 8/17)**
- 2. Encourage exploration, development and support of network-based communication/collaboration tools and their application to the University learning environment. (Rec. N2, Rank 10/17)**

Important Priority Recommendations

- 1. Provide online support and consultation services to assist users of networked learning resources. (Rec. N3, Rank 11/17)**
- 2. Promote the employment of multisensory mechanisms to facilitate use of networked learning environments by all the University's constituents. (Rec. N4, Rank 15/17)**
- 3. Provide for appropriate security and privacy in access to digital information resources and services on campus. (Rec. N5, Rank 17/17)**

Access to Digital Resources (Appendix 6)

As educational resources in digital form become more widely accepted, limitations on access to these resources by faculty and students will become a critical impediment to their adoption unless measures are taken early to assure that they are truly available to all who want to use them. This includes the tools that faculty and staff need to develop instructional media, the facilities and infrastructure to deliver them, and the tools that students need to use them.

Urgent Priority Recommendations

- 1. Provide faculty with access to necessary delivery systems for use of advanced instructional media both inside and outside the classroom. (Rec. A1, Rank 2/17)**
- 2. Provide support for production of and access to instructional media in a variety of formats. (Rec. A2, Rank 7/17)**

Important Priority Recommendations

- 1. Establish standards for student-supplied hardware and software to assure compatibility with University-provided instructional resources. (Rec. A3, Rank 14/17)**
- 2. Develop mechanisms for providing access to digital resources for members of the University community located remotely from the campus. (Rec. A4, Rank 16/17)**

4. Organizational Considerations

Many and diverse organizational entities within the University are currently studying the issues and implementing opportunities associated with information technology and its use in the academy. These include numerous committees and task forces within the schools and colleges, University-wide committees such as MIC, FCC, NIC, and administrative units such as CIT, CTE, and ACITS.

Facilitating the rapid adoption of new media in instruction is a delicate organizational problem: how to encourage the creativity engendered by a fundamentally decentralized culture while at the same time capitalizing on the economies of scale (both in dollars and in human effort) of centralized organizations. In designing an optimal organizational environment, both needs

must be considered. Above all, we must not discourage innovation by building in institutional barriers.

The Multimedia Instruction Committee favors a distributed model of organizational responsibility for implementing advanced instructional technology. We envision a sort of "wagon wheel" organizational structure, in which much of the training, media development, and instructional delivery activity resides in local academic units, with the hub of the wheel representing central support services and facilities to assist these local centers. Thus, for example, individual departments would carry on basic training activities in development and use of new media for faculty and students, and local computer labs would be equipped with basic-level media development tools. Acquisition, maintenance and management of multimedia classroom facilities would, similarly, be mainly the responsibility of academic units. In some colleges, media centers, such as those which already exist in Engineering, Fine Arts, Natural Sciences, Business and Pharmacy, would provide additional staff and facility support, particularly to provide for more sophisticated and special-purpose needs.

In this model, formal University-wide centers such as CIT, CTE and ACITS will primarily serve to "teach the teachers", research and evaluate new equipment, media and methods, develop templates to simplify instructional media development, and provide a state-of-the-art experimental laboratory where lead faculty can "push the envelope" of existing technology and its application.

A critical need in the future will be to more clearly define the role of faculty/staff committees and their relationship to administrative organizations in advancing the cause of instructional innovation. The traditional role of the Faculty Computer Committee will need to be evaluated vis a vis the roles of recently formed committees such as Networking and Infrastructure and Multimedia Instruction. The mandates of each of these committees, who they report to, what resources they control, and the extent of their authority (if any) need to be clearly articulated. A mechanism for coordination of their activities must be created to avoid duplication of effort.

5. Resource Considerations

A variety of resources will be needed to implement the recommendations put forth in this report, including staff support, faculty support, student support, hardware, software and space. These resources will need to be provided via fees, allocated budget items, corporate and individual donors and foundation grants. Some of the needed resources already exist within the academic units (Appendix 7) and University-wide centers.

No detailed business plan has yet been formulated to quantify the human and material resources needed to implement the recommendations put forward in this section. This time-intensive activity was beyond the scope of what the Committee could reasonably undertake within the given time and resource constraints. without financial resources. We hope to obtain additional resources to provide for support staff and data collection needs in the coming year so that we can move into the next phase of implementing the recommendations.

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Priority Ranking of MIC Recommendations

RAN K	RECOMMENDATION	Score
1	Rec. FD1 (Appendix 4): Provide programs to support a diverse menu of training in instructional technologies at all levels for faculty, staff and students.	4.00
2	Rec. A1(Appendix 6): Provide faculty with access to necessary delivery systems for use of advanced instructional media both inside and outside the classroom.	6.17
3	Rec. FD2 (Appendix 4): Provide incentives for faculty to undertake new courseware development.	6.50
4	Rec. C1 (Appendix 3): Encourage all academic units to prepare technology integration plans for incorporation of new technology, as appropriate, into curriculum and degree plans.	6.75
5	Rec. C2 (Appendix 3): Conduct and support research into the effects of technology on teaching and learning in the university environment.	8.33
6	Rec. FD3 (Appendix 4): Provide first-class facilities for continuing media development.	8.33
7	Rec. A2 (Appendix 6): Provide support for production of and access to instructional media in a variety of formats.	8.50
8	Rec. N1 (Appendix 5): Develop processes, procedures and infrastructure for acquisition, archiving, storage, retrieval and distribution of digital media.	8.92
9	Rec.C3 (Appendix 3): Promote the utilization of formalized instructional design, assessment and evaluation practices in technology-based instruction at the university level.	9.42
10	Rec. N2 (Appendix 5): Encourage exploration, development and support of network-based communication/collaboration tools and their application to the University learning environment.	9.42
11	Rec. N3 (Appendix 5): Provide online support and consultation services to assist users of networked learning resources.	9.67
12	Rec. C4 (Appendix 3): Provide academic units with a continuously updated source of information on emerging instructional technologies for consideration in curriculum planning efforts.	10.42
13	Rec. FD4 (Appendix 4): Provide incentives for students to participate in the process of courseware development.	10.67
14	Rec. A3 (Appendix 6): Establish standards for student-supplied hardware and software to assure compatibility with University-provided instructional resources.	12.67
15	Rec. N4 (Appendix 5): Promote the employment of multisensory mechanisms to facilitate use of networked learning environments by all the University's constituents.	13.67
16	Rec. A4 (Appendix 6): Develop mechanisms for providing access to digital resources for members of the University community located remotely from the campus.	13.75
17	Rec. N5 (Appendix 5): Provide for appropriate security and privacy in access to digital information resources and services on campus.	14.00

Curriculum Development

Goal: Encourage an environment which promotes improved teaching and learning through the use of appropriate new technologies at all levels of instruction. Promote curriculum planning and degree program actions in academic units to respond to changes in new media and information technology.

Recommendation C1: Encourage all Colleges and Schools to prepare technology integration plans to incorporate new technology as appropriate in curriculum and degree plans. These plans should include information about infrastructure, resources, administrative procedures and personnel to initiate and support needed instructional technology use with 1, 3, and 5 year timelines . [Committee ranking: #4/17]

Action C1.1: Create or locate a template intended to help colleges and schools make integration plans when curricular designs call for support by information technologies.

Discussion: The useful integration of information technologies into existing curricula requires considerable effort and planning. The MIC feels that some coordination will prevent excessive duplication of effort, and will help to prevent the repetition of mistakes and errors. This can be done by providing information on recommended and successful ways in which new technologies might be used in curricula. This body of information, or template, would serve as a source of suggestions and a guide to innovators, but would not be imposed or required.

Resources needed: The primary resources to carry out this recommendation would be the staff time of the CIT or ACITS to keep information on successful and unsuccessful experiences with implementing new technologies in teaching. This material, together with that collected in Action C1.2, could be housed on a Web-site.

Organizational responsibility: This recommendation would be primarily carried out by the Colleges and Schools, with technical assistance from ACITS and CIT.

Action C1.2: Create and make available a resource describing the current funding allocated by departments, schools, and colleges for instructional technology use and how it is implemented, including information on infrastructure, resources and personnel.

Discussion: It would save time and minimize duplication of effort if departments that have not yet adopted procedures and policies with regard to technology could have some existing models to examine. The availability of such models might also encourage some standardization of policies across the campus. It would be particularly useful for there to be multiple models from which departments can choose the strategies that best fit their situation. For that reason, we are proposing that this resource be established, most likely as a set of Web-based documents. The documents would consist of brief descriptions of how various offices on campus have funded and staffed their use of technology in teaching.

Resources needed: The primary requirement for this recommendation would be staff time, either of ACITS or CIT, to create the Web-site to house this material and

to add it to the site. There would also be some time expenditure on the part of departmental and college representatives to write the initial documents for inclusion in the site.

Organizational responsibility: Before this material could be placed on a Web-site, departments and colleges would have to produce it and the sponsoring agency (ACITS or CIT) would have to create the space for it on their site.

Action C1.3: Academic unit heads should develop policies and procedures that will allow faculty to more readily propose and experiment with new courses or course-structures that take advantage of instructional technology.

Discussion: Experimentation is risky and time-consuming. Some existing policies and procedures used by academic units, e.g., current procedures for assigning courses and calculating teaching load credits, may discourage faculty from taking the risks and investing the time needed to try new methods of instruction. To encourage experimentation and early adoption, more flexible administrative policies may be needed.

Resources needed: No new resources will be needed to develop more innovative policies to encourage experimentation with instructional technology.

Organizational responsibility: Organizational responsibility will lie primarily within departmental and college executive staff.

Action C1.4: In line with the FCC's Vision Plan, colleges and schools should explore opportunities for distance education curricula, extension courses or additional venues using multimedia and other information technologies to serve previously underserved populations.

Discussion: The Committee believes that it is critical to the mission of the University to use distance learning technologies to forge new and better ties with previously underserved populations. The University will increasingly find itself competing with other educational entities for customers who are willing to pay for University resources delivered at a distance. For the purposes of this committee we will be defining the term "underserved" to apply to the following groups: those separated from University access by geography, physical limitations, resources and funding. Partnerships between UT-Austin and underserved populations should be facilitated at the College or even departmental level in cooperation with the UT System office when necessary (e.g., joint degree programs or degrees offered via distance education.)

Resources needed: Financial support will be needed for a person or office to facilitate and support the development of sanctioned distance education courses. Guidelines and approval processes should be clearly spelled-out to avoid frustration, confusion and delays in proposing programs of study. Financial support will also be needed for a person or office to research and evaluate effective strategies for sharing resources at a distance and maintain these via a web-site. Financial support will also be needed for a person to develop and maintain a web-site that showcases cooperative projects throughout UT-Austin and advertises cooperative project needs.

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Organizational responsibility: CIT, EIMC, ITAL, UT System, Office of the Vice Chancellor for Information Technologies, and key personnel in individual Colleges will all be involved.

Recommendation C2: Establish and support a collaborative program for faculty/graduate student research into the effects of technology on teaching and learning in the university environment. [Committee ranking: #5/17]

Discussion: As noted in Recommendation C1 above, there is a need to be aware of the impact of technology and whether or not its expense is justified. In addition, as we learn more about how technology impacts teaching and learning, we can be more proactive in its design and future use. In this recommendation we propose that a conscious effort be made to conduct basic and applied research into the effects of technology on teaching and learning. This can be done both at the individual faculty member level as well as a larger programmatic level that cuts across disciplinary lines. To direct this effort, individuals from CTE and CIT would be designated to seek out research opportunities and funding and to support faculty who wish to do research on technology in their classes, both technically and in terms of assistance in seeking funding for such research. In addition, this program would recruit graduate students interested in both the technological end and the learning process end of multimedia instruction and provide an organized way in which they can assist faculty or conduct research consistent with the program's mission.

Resources needed: The intent of the program would be to use UT money to leverage outside grants and to seed the early stages of projects to make them attractive for outside funding. The program would have the University's permission to seek outside funding independently or jointly with faculty and to commit some University resources as matching support where appropriate.

This basic program would need primarily staff and student support. For example, one individual from the CTE could be designated as the program coordinator with his/her salary (amount dependent on the person chosen) completely or partially covered as part of the program. Other staff members would be called upon as needed for their special expertise at no cost to the program. Student stipends to support up to four students a year would be available for the general research program or as support for students assisting faculty to conduct research on their particular use of technology (up to \$48,000). Some graduate students could be recruited from programs such as the division of Instructional Technology, department of Curriculum and Instruction. Also, faculty from other departments could have graduate or undergraduate students in their departments designated as program assistants with the department providing half the student's stipends and the other half coming from this program's resources. Such arrangements would allow more students to be supported.

A small fund (\$5,000) would be made available for incidental expenses associated with the conduct of the research. These funds would pay for materials reproduction, research subjects, and dissemination efforts, for example.

Since both CTE and CIT are already short on space, the addition of these new responsibilities would require a small amount of additional space. The most likely place would be in the Tower on a floor adjacent to CTE. In addition there would be

some start up costs associated with preparing the research space and providing equipment for the graduate student researchers. CTE could provide the ongoing physical office support, such as phones and access to office equipment of various sorts.

Organizational responsibility: Cooperation between CTE, CIT and departments such as Instructional Technology would form the base for this program. Therefore, those entities would have to be willing to participate.

Recommendation C3: Develop and promote appropriate methods for instructional design, performance assessment and evaluation for technology-based instruction. [Committee ranking: #9/17]

Action C3.1: The CIT and CTE should create a web-resource on instructional design and evaluation that can be used by faculty to guide design decisions for technology-based instruction and curricular changes.

Discussion: The integration of technology into the curriculum can be a costly activity, in terms of both finances and time. In an effort to increase the probability that a project proposing to incorporate technology into teaching will be successful and cost-effective, those executing the project could benefit from the application of more systematic planning and evaluation. Since there are not many faculty who have had any training in these areas, we propose that some self-instructional materials be prepared to guide them as they embark on their project design. The materials would cover issues of the appropriate uses of technology to meet their needs, the statement of intended outcomes and their relationship to the technology design, the consideration of student variables such as skills and needed equipment, and the incorporation of formative and summative evaluation methods to guide and document development. As more faculty begin designing course materials using technology, other topics will undoubtedly be added.

Resources needed: The primary expenditure for this recommendation would be staff time of both CIT and CTE to create the Web-site to house this material and to develop the material that will be available through that site. We estimate that this would require a full-time professional-level staff member for CTE and one for CIT for the year it would take to develop these materials. After development, the site could probably be maintained by part-time personal, provided no major expansion of the materials is needed.

Organizational responsibility: CTE and CIT

Action C3.2: The CTE should offer, on a limited enrollment basis, instruction on the use of instructional design and evaluation principles pertinent to curriculum development for technology use.

Discussion: In addition to the Web-site resources, the Center for Teaching Effectiveness has agreed to provide support and instruction in instructional design and evaluation to those faculty who wish to have a more group-oriented setting to develop their skills. Periodically throughout the year the Center will offer seminars on these topics. The Center staff will also be available to provide seminars tailored to a particular subgroup, such as a department or college.

Resources needed: We estimate that this seminars could be offered by the same individual who prepares the Web-based instruction. This would be a full-time professional-level staff member. This individual would prepare materials, maintain the website on behalf of CTE and organize and present the seminars on design and evaluation of technology-based instruction.

Organizational responsibility: CTE

Action C3.3: The CIT staff should offer, on a limited enrollment basis, instruction on the use of specific technology pertinent to curriculum development. This training is intended to plant seeds and begin localized mentoring programs so that faculty can serve as mentors for their colleagues.

Discussion: This is a service that is provided in the mission of the CIT. Recent staff additions, particularly in the area of web design for course delivery, will be offering this assistance to faculty, in addition to other CIT services. Faculty leaders in the use of technology will be identified as content providers. Through the CIT, these faculty will be introduced to or involved with the use of emerging technologies so that they may determine the appropriateness of such technologies for curriculum development.

Resources needed: Depending on the popularity of the program, CIT might need additional staff to coordinate and conduct these programs in the future.

Organizational responsibility: CIT

Action C3.4: The CIT and CTE should work jointly with faculty or faculty committees indicating an interest in making curriculum changes that might require instructional technology to ensure adequate instructional design considerations.

Discussion: Facilities and staff are in place to provide this service. The CTE offers expertise in the techniques and strategies for design and delivery of instruction. The CIT offers expertise in the design and delivery of instructional technologies. Collaboration of the CTE and CIT is well-suited to address a changing paradigm for the processes of teaching and learning.

Resources needed: Depending on the future popularity of the program, there might be a time in the future where additional staff might be needed to coordinate and conduct these programs.

Organizational responsibility: CIT and CTE

Recommendation C4: Provide Colleges and Schools with current information on emerging instructional technologies for consideration in curriculum planning. [Committee ranking: #13/17]
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Action C4.1: In line with the FCC's Vision Plan, the MIC should publicize instructional uses of technology that are compatible with the standards of hardware, software and infrastructure for multimedia technology in use at the University.

Discussion: It has been the case in the past that groups or individuals seeking to incorporate technology in their work have had difficulty in obtaining information

about the appropriate software, hardware and infrastructure to make their work compatible with other sites at the University. The result has often been a patchwork of systems that cannot talk to one another and a frustration on the part of instructors with the difficulty of having their materials capable of being run at a wide range of sites on campus. We anticipate that if there are some standards that are commonly used at the University and those standards are made public, individuals will make an effort to use equipment and software compatible with those standards. Such standards might also assist those not familiar with technology to make rational decisions about what to use as they begin.

Resources needed: The primary resource needs for this recommendation would be staff time, either of ACITS or CIT, to create the Web-site to house this material and to add it to the site.

Organizational responsibility: Making such information available will depend on the explication of University standards by the Faculty Computer Committee.

Action C4.2: The CIT should designate staff members to be liaisons with each college for the purposes of sharing information about technological developments. Faculty wanting to experiment with new uses of technology will work on pilot projects with CIT staff.

Discussion: It is important that colleges and departments have regular updates on and the opportunity to test and explore emerging technologies,. The procedures for establishing and maintaining contact with organized units of the University are in place through the liaison program established by ACITS, and many CIT staff have designated assignments. Additionally, the CIT will be responsible for coordinating technology updates with other ACITS staff to ensure that timely information is disseminated throughout the campus. The facilities of the CIT are available for faculty, students, and staff wishing to explore the instructional use of technology.

Resources needed: In order to maintain their own knowledge level, CIT staff will need to have funds to travel to state-of-the-art conferences, possibly inviting faculty to accompany them when a specific discipline is targeted. Otherwise the expenditures for this item would be in terms of staff time.

Organizational responsibility: Primarily within CIT.

Action C4.3: CIT should develop web-based resources describing how individual faculty members or groups can incorporate new technologies into their teaching. This resource will include a list of technology integration examples both locally and nationally, and information describing emerging technologies. Example and relevant software applications and hardware should be listed and described.

Discussion: The proposed web site would bring together some resources that would be useful to professors looking for ways to use computers and other kinds of instructional technology in their teaching. The more useful potential contribution of this resource would be to address questions like, "How can instructional technologies really improve teaching and learning?" What approaches solve problems, rather than create more? Along that line, the resource would provide access to the growing research base on how well new media and new technologies actually work in teaching. As a complement to other ACITS and TeamWeb materials, the web resource would also provide something that is useful as a how-to

guide for teachers exploring new possibilities. Also in conjunction with other materials that are available, including others proposed in this section, it would act as a guide to the technologies and approaches that are available.

Resources needed: The Center for Teaching Effectiveness has already developed a prototype for this resource. The primary expenditure for this recommendation would be staff time of members of the CTE and CIT (or other parts of ACITS), to develop the Web-site further.

Organizational responsibility: This recommendation would require the cooperation of the CIT (or another part of ACITS) and the CTE.

Action C4.4: Through the provision of special funds, colleges and schools should be encouraged to gather and publicize information on the use of technology in teaching in the disciplines of that college or school to their faculty. Funding can also be used to support pilot projects that experiment with new uses of technology in teaching and learning.

Discussion: There is much that can be learned about technology use that is idiosyncratic to a discipline. To encourage faculty to be aware of new uses of technology in their own field, it would be useful to set aside some small funds to bring in disciplinary representatives from other institutions to demonstrate their specific uses of technology. Or UT faculty could be sent to conferences in the discipline that emphasize the uses of technology and then bring back the best ideas for use in their own departments.

These funds could also be used to support pilot projects in which faculty experiment with new technology in their classes. The funds could support hardware and software purchase on a small scale, support students to assist faculty in material production, and provide small scale evaluations of these pilot tests. Results of these pilot tests (including the concept and techniques of pilot testing itself) would be publicized to the faculty in the department, college and University as a whole to encourage other components to experiment with that methodology.

Resources needed: The amount of funds set aside by each college would depend on the size of the college and its general resources. Estimating that a small project might cost around \$5,000, larger colleges, such as Natural Science, would set aside funds for five such project per year (\$25,000), while smaller college, such as Social Work, might allocate funds for only two projects (\$10,000). Administrative costs would be absorbed by the colleges.

Technical support for these projects would be available from both the CTE (for design and evaluation assistance) and the CIT (for technical and production assistance). As noted under Recommendation C.3, some additional personnel would be required in each center should this project be implemented.

Organizational responsibility: CTE and CIT, with administrative support from the colleges.

Action C4.5: Each college or school should be encouraged to form a cross-department network to regularly exchange information about new media in the various disciplines. A similar network of users will be formed across college/school lines.

Multimedia Instruction Committee
Appendix 3: Curriculum Development

Discussion: Intra- and inter-exchange of information within and between organized units is probably the most common form for updating faculty. Peer interaction and tutoring are widely recognized as excellent vehicles for increasing faculty involvement in the use of technology. Most colleges and many departments now have staff designated as technology coordinators. These could serve as organizers for the regular exchange of technology information.

Resources needed: No additional resources would be required for this to be accomplished.

Organizational responsibility: Ad hoc organization comprised of LRC and media lab directors from schools and colleges.

Action C4.6 : Create a campus-wide listserv for announcements about new services and resources related to multimedia design, content, and production. The Center for Instructional Technologies, Academic Computing and Instructional Technology Services, General Libraries, and Center for Teaching Effectiveness should create and promote a listserv, with open subscription. This can happen immediately.

Discussion: On such an expansive campus, it is difficult for anyone to be aware of the useful resources and services available to them. Brief and timely messages would help interested faculty, staff, and students keep updated. The collaboration of various agencies is important. The listproc software is already organized and managed by ACITS. This mechanism would be cost-efficient and timely.

Resources needed: No additional resources would be required for this to be accomplished.

Organizational responsibility: CIT or ACITS, with input from GL and CTE

Faculty, Staff and Student Development

Goal: Create an environment that encourages faculty, staff, and students to explore and master the potential of instructional technologies through training, incentives, and technical support.

Recommendation FD1: Provide a diverse menu of training in instructional technology at all levels for faculty, staff, and students. [Committee ranking: #1/17]

Action FD1.1: Colleges should encouraged to provide introductory-level training in instructional technologies for faculty, staff and students.

Discussion: Introduction, training, and subsequent integration of instructional technology can occur only with administrative support at the departmental and college levels. Many departments and several colleges have instituted training programs of varying degrees for faculty and staff. ACITS offers regular technology training seminars specifically for faculty, in addition to short courses for faculty, staff and students. Participation in, and expansion of, these opportunities should be encouraged for faculty, staff and students by administrative levels.

Resources needed: This recommendation will require (a) increased staff in academic departments and in ACITS instructional programs, (b) adequate teaching facilities, (c) faculty involvement at various levels. Several sites on campus are training students that could be hired to teach introductory courses. Successful model courses have been taught in several departments and are available for export across campus.

Organizational responsibility: Information, and in some instances, resource sharing between colleges, departments and ACITS will be needed. The newly instituted ACITS Liaison Program will be of benefit in coordinating these processes.

Action FD1.2: Advanced instructional technology programs should be developed for training of students. Colleges should be encouraged to develop formal programs that provide academic recognition and reward to students developing instructional technology skills appropriate for the discipline.

Discussion: Faculty should earn Teaching Load Credits (TLCs) in this process, which will require planning within the colleges and departments where the courses are offered. Course credits could be offered immediately through the “Projects” courses offered in virtually every department.

Additionally, a Technical Certification Program should be considered. This could enhance efficiency of student placement within UT and with external employers. A certification program could recognize plateaus of accomplishment in (a) software proficiency, (b) media production experience, and (c) project management experience.

Resources needed: Successful implementation will require (a) technical assistance, (b) project managers, (c) adequate production facilities and, (d) product

distribution assistance. These requirement conditions are being met by a growing number of departments across campus. The certification program will require (a) development of standards, (b) an implementation procedure and, (c) coordination with local technology companies.

Organizational responsibility:: Faculty involvement in this process will be required at different levels. Interaction at a variety of administrative levels (deans, department chairs, FCC, ITAC, ACITS, A&E Services; Official Publications) will be required to insure that instructors, classrooms, laboratories, networking, and accreditation are assembled in a coordinated fashion.

Action FD1.3: The University should define new job descriptions with appropriate and competitive compensation levels for classified staff with skills needed to provide training and support in instructional technologies.

Discussion: Trained human resources are in high demand across campus and throughout the Austin community. In order recruit and retain qualified staff in instructional technologies, the University must define a new set of job categories and descriptions with commensurate and competitive wage scales.

Resources needed: The primary resource required for this recommendation is staff time from appropriate University organizational units in defining and approving the new positions.

Organizational responsibility:: Personnel teams from Human Resources, ACS , ACITS and representatives from academic units will be required to define, concur, and receive University approval for the new categories and descriptions.

Recommendation FD2: Provide incentives for faculty to undertake new courseware development. [Committee ranking: #3/17]

Discussion: Innovative design and development of instructional technologies within the academic community deserves recognition and reward on a par with other scholarly endeavors. University promotion and tenure procedures usually do not recognize the creation of significant multimedia scholarly works as an activity that substantially contributes to the awarding of faculty promotion and/or tenure. Unless the creation of these works is recognized as a worthy endeavor, development of such works will be greatly restricted.

For faculty, incentives beyond promotion and/or tenure could be in the form of summer salaries, teaching load credits or reductions, assistance with product distribution, product royalties, awards or other recognition.

Resources needed: Beyond the formal recognition that reviewed and quality instructional technology development is a scholarly endeavor that should be supported, the primary resource required for this recommendation is additional funds to support courseware development efforts. Summer salary support would be especially effective, since this is a period when many faculty can devote the extensive time needed to get courseware projects started.

Organizational responsibility: Cooperation and agreement within and among departments that instructional technology development is a legitimate scholarly enterprise is required. An organized program to provide support for courseware development could be handled in a way similar to the University Research Institute, and would probably be administered out of the Provost's Office.

Recommendation FD3: Provide and support first-class facilities for continuing media development via a distributed model that includes departments, schools and colleges as well as centralized development and support facilities. [Committee ranking: #6/17]

Discussion: Experience has shown that faculty are most likely to use media development facilities and technical support if they are accessible nearby within their own academic units. To promote widespread use of instructional technology on campus, individual academic units must incorporate local multimedia development capability in budgeting, staff and space allocation procedures, particularly for the most basic kinds of activity, such as class web site development. At the same time, for more sophisticated functions, such as video editing and CD-ROM production which require more specialized facilities and expertise, sharing of resources between academic units and establishment of centralized support capabilities will be appropriate.

Resource needs: This recommendation requires that individual academic units allocate resources for multimedia instructional development. These resources could include the space, money and staff required to establish a site within the unit, the sharing of a site with other units, as well as some mechanism for cost-sharing with a central unit such as CIT for providing special services which are unavailable locally. Staff support will be needed to provide for a coordinator within CIT to integrate these efforts and serve as a focal point for communication.

Organizational responsibility: Each school or college should have professional staff and a standing committee charged with responsibility for developing and maintaining local media development facilities. These entities should maintain close communication with one another (see Recommendation C1.2). ACITS, CIT and the various academic units should work together to develop a synergistic support system. The Center for Instructional Technologies (CIT) should be a coordinating point for instructional technology labs and staff across campus. CIT should establish technology standards where appropriate, that serve to provide the widest possible knowledge base for supporting specific technologies. CIT could also provide a centralized evaluative function that would test new technologies and make recommendations for their application by the various development sites. Finally, the CIT might be viewed as a "server" in a distributed client-server model of distributed multimedia development and support.

Recommendation FD4: Provide incentives for students to participate in the process of courseware development. [Committee ranking: #14/17]

Discussion: Students should be used as support personnel. Colleges should implement a system whereby students trained in instructional technologies can be used as support personnel for faculty. Students completing one or more of the training options defined above could be assigned to a “support pool” within the college or department and assigned to projects as appropriate. This is a technique used by several Division I universities, including the Massachusetts Institute of Technology.

Resources needed: As pointed out above, this recommendation also requires a commitment at the college and departmental level for facility and staff support. Facilities must be available where faculty-student "teams" can work in the design, development and production processes. Staff will be required to oversee and coordinate student assignment and team designations.

Organizational responsibility: While in many cases students from the same academic discipline as the faculty member are best suited for team pairing, there are occasions where students could be selected from a general support "pool." ACITS/CIT could serve as a coordinating point for assignments.

Networked Learning Environments

Goal: *Promote and develop the instructional potential of networked environments as a complement to conventional instructional environments.*

The growth of the Internet as a medium of information distribution and personal communication has profound implications for higher education. To leverage this potential as a complement to conventional instructional settings, the University should foster computer mediated networked learning environments. This can best be accomplished by creating and enhancing mechanisms for support, interaction, and collaboration while protecting information security and intellectual property.

Recommendation N1 - Develop processes, procedures, and infrastructure for archiving, storage, retrieval, and use of digital media, with special consideration of copyright and intellectual property issues, authorship, origin, format, and intended educational use, and including music, videos, and images, as appropriate. [Committee ranking: #8/17]

Action N1.1: UT and System legal offices should develop guidelines, procedures, and documentation formats for copyright and intellectual property agreements appropriate to:

- a. Inter-institutional collaborations and shared applications
- b. Student, contract or work-for-hire, and non-faculty university employee contributions
- c. Licenses for proprietary industrial or commercial software

Action N1.2: To the extent practical, operational procedures should be such as to minimize recurring or periodic copyright or other release requests.

Resources needed: Staff will be needed to manage the acquisition and distribution of digital media. Dedicated servers and appropriate backup capability will also be needed for archiving.

Organizational responsibility: ACITS and the Center for Instructional Technology should develop facilities and procedures for archiving, storage, retrieval, and use of group specific digital media such as class notes, videos, music, and images. Intellectual property aspects of this recommendation will require close collaboration between the legal staff at UT Austin and the UT System Office.

Recommendation N2 - Explore, develop, and support Internet-mediated ways for faculty and students to interact within and beyond the classroom and collaborate in a range of projects. [Committee ranking: #10/17]

Discussion: Many "group-ware", conferencing, and scheduling tools for collaborative interaction are just becoming available (e.g. Netscape Communicator / Collabra and AltaVista Forum). We expect tools like these to fill a need and be widely used on campus within the next few years. The instructional potential of such communication tools must be explored and implemented where appropriate.

Action N2.1: ACITS, through the Center for Instructional Technology and Team Web, should be encouraged to evaluate and make available (through site licenses if necessary) the most appropriate internet-based collaboration software for use by the University community.

Action N2.2: ACITS should establish and/or adopt where appropriate, standards for the interoperation of software (for example collaboration, conferencing, scheduling, and group-oriented internet-based tools).

Action N2.3: In cooperation with the Center for Teaching Effectiveness, ACITS should be encouraged to develop templates and guidance materials for faculty exploring how they might incorporate these new tools into their teaching.

Action N2.4: We encourage the CIT to take as part of its role the exploration of other network and internet-based communication, such as text-, audio-, and video-based conferencing. They should be given the budget (in cooperation with other labs and entities) to keep abreast of emerging technologies, and to communicate the results of their research to the University community.

Resources needed: An additional full time staff position will be required in the CIT to lead the recommended product evaluations.

Organizational responsibility: This recommendation will require minimal organizational adjustments. These recommendations can be carried out within ACITS with a reasonable degree of coordination with other offices such as the Center for Teaching Effectiveness.

**Recommendation N3 - Provide integrated support and consultation services to University users of instructional technologies via networked and collaborative tools and systems, modeled on the services currently provided by existing campus entities in the form of "help desks" and "hotlines".
[Committee ranking #12/17]**

Action N3.1: Provide real-time, technology-based assistance connecting people regardless of location. ACITS should test software for real-time person-to-person communications, then make recommendations for which ones will be supported on campus. Similarly, they should continue to investigate and acquire new software which fulfill campus needs.

Discussion: Software should be available to the University community from software FTP servers as well as bundled in UTConnect. Examples of types of communications necessary include: text-based communications (Chatbox, IChat), audio-visual connections for conversations (CU-SeeMe, PictureTalk, ProShare), remote control or display of computer screens (Timbuktu, Remotely Possible), and collaborative groupware tools (shared whiteboard).

Resources needed: ACITS should create a full-time position responsible for noting new available software, testing, evaluating, and approving particular packages to become campus standards.

Organizational responsibility: Primary responsibility should reside in ACITS.

Action N3.2: Create an integrated online documentation Web site. Team Web should coordinate an organized Web site pointing to sources of online help from all related departments, colleges, and other campus agencies. This would provide a one-stop-shopping Web location, so people can become more self-sufficient in solving their problems when staff are not available.

Discussion: Team Web should solicit a volunteer to collect information from all interested departments and create one organized collection of online documentation and user's tips. Each department which routinely answers many of the same questions should be encouraged to create an organized collection of these answers on their site. These questions might relate to computers, information seeking, multimedia creation, Web publishing, and other related topics. This process could begin immediately and should have a search capability if possible.

Action N3.3: Provide training for use of the support software. Team Web, ACITS, Administrative Computing, and the General Libraries should extend their support and training to include the software "approved and supported" as recommended above. Additionally, the Center for Teaching Effectiveness should offer pedagogical training to faculty interested in using this technology within the curriculum.

Discussion: Short classes, modeled after those currently being offered, would help people understand how to use these collaborative and consultative tools. All sessions should be free and should be offered as soon as the software is distributed to faculty, staff, and students on campus. To extend these training services, the training staffs for each of these groups should increase where it is necessary and appropriate for developing training. Members of each group should meet to discuss a unified solution to training.

Resources needed: A full time staff position in ACITS should be allocated to coordinate and oversee the recommendations in this strategy. Additionally, this strategy is dependent on the adoption of the recent TeamWeb II proposal which increases staff for TeamWeb.

Organizational Considerations: This strategy will require ACITS to coordinate a campus-wide effort by all departments which provide I.T. infrastructure and support services, training services, and/or and help desk services. New project management and coordination tactics will need to be developed to ensure that staff from different offices are able to work together efficiently on joint projects and assignments.

Recommendation N4: Develop and promote use of multi-sensory environments to enhance the effectiveness of network-based, collaborative teaching and learning. [Committee ranking: #15/17]

Discussion: Virtual learning environments such as text- and Web-based MUD's and MOO's, two- and three-dimensional graphical environments, and environments such as Xerox PARC's Jupiter, will play an increasingly important role as the UT System moves toward implementation of the Virtual Campus and UT Austin becomes increasingly involved in distributed teaching and learning over distance.

In this context, a multi-sensory environment provides online access to digital instructional resources as well as real-time interaction with other members of the learner community and with the information environment itself. These environments must provide support for full access to teaching and learning by all qualified participants in geographically dispersed groups working on complex tasks that involve the use and production of a variety of data formats such as text, graphics, video, animation, music, speech, etc. User interfaces must support multiple types of input methods and devices, including spoken commands and speech-to-text conversion, tactile "displays" (e.g., refreshable Braille devices, touch screen, keyboard overlays, joysticks, puff-sticks, etc.).

Action N4.1: All UT academic and administrative units should meet nationally and internationally recognized guidelines for accessibility of networked information, including those concerning accessible Web design. UT should actively support the Web Accessibility Initiative announced in April 1997 by the World Wide Web Consortium (W3C), which is supported by IBM and other major vendors. Information environments designed to support instruction at the University should optimize multimedia capabilities to facilitate successful teaching and learning for all members of the University community, including those with limited telecommunication and audio-visual capabilities, people with disabilities, and people whose learning styles are auditory or kinesthetic.

Discussion: For additional information see Dr. John Slatin's web page on Computer Resources for People with Disabilities. Of particular note are the detailed guidelines for accessible Web design drafted by the Director of Trace Center for Research and Development at University of Wisconsin, a leading center for disability research. <http://www.cwrl.utexas.edu/~slatin/disability/disability.html>. See also the W3C Web site at

Action N4.2: Provide resources (staff, etc.) to Team Web and CIT to provide consultative services to UT agencies as they implement the above design standards.

Action N4.3: CIT will collaborate with CTE to develop resources to support the design of instructional environments that support multi-sensory instructional and learning alternatives. These resources should be widely publicized and easily accessible.

Discussion: Such designs and applications would support the delivery of information and instruction in different forms to people with different needs and mental processing styles. Designs should use communication options that encourage multiple forms of communication.

Action N4.4: Team web, CIT, and Human Resources should develop an ongoing series of information and training sessions to develop multi-sensory information literacy for faculty and staff.

Discussion: Information resources, courseware, and other applications designed for learners, instructors, and staff who have disabilities are better able to meet the needs of all members of the UT community. UT agencies should be educated in the use of multiple media in ways that do not presume uniform capabilities and preferences on the part of students and instructors. Faculty and support staff should be equipped with technology that encourages experimentation and development of alternative instructional formats.

Action N4.5: University faculty and administration will work directly with software and hardware vendors to ensure development activities that support multi-sensory instructional applications.

Resources needed: The recommendation will require one new technical support and training staff position each in TeamWeb, the Center for Teaching Effectiveness, the Center for Instructional Technologies, and the Office of Human Resources..

Organizational responsibility: This recommendation will require the existing inter-departmental TeamWeb organization to expand to embrace collaboration with the Center for Teaching Effectiveness, the Center for Instructional Technologies, and the Office of Human Resources.

N5 - Provide for appropriate security and privacy in access to digital information resources and services on campus. [Committee ranking: #16/16]

Action N5.1: The University should create a new full time professional staff position with the title of Computer Security Administrator who would be assigned to:

- Oversee University policy relating to information resource access and security.
- Develop standards and procedures to maintain compliance with all University policies related to information resource access and security.
- Review data security reports and security processes.
- Work with LAN Coordinators and other staff to ensure all computer resources are fully secure in compliance with policy.

Discussion: As more educational materials are exchanged electronically, issues of security and privacy will become increasingly important. For example, students and faculty will need to be able to store and exchange exams, papers, and other communications with confidence that they are secure. Measures need to be built into the system to insure security of private communication and restrict access to limited-distribution archives. To illustrate the nature of the problem, security of the University's class newsgroup system is routinely breached by broadcast advertising, much of it offensive, on class newsgroups.

Most major universities, as well as large institutions of all types, now recognize that the development, implementation, and monitoring of computer security measures and policies must be administered by dedicated professional staff in order to be fully effective.

Action N5.2: The Computer Security Committee and the Computer and Information Technology Use Policy Committee (CITUP) should conduct a comprehensive review the University's Security Policy Memorandum 6.302 to assess whether substantial additions and revisions are needed to bring the institutions security policies up to date.

Discussion: The University's Security Policy (Presidential Policy Memorandum 6.302) was last revised in September of 1993. Since that time, use of the Internet and the World Wide Web for widespread academic and interpersonal communications has largely transformed the security issues facing the University. Our security policy needs to be updated and revised to recognize this new environment.

Resources needed: The recommendation will require the establishment of a new high level, technical position with the title of Computer Security Administrator.

Organizational responsibility: This recommendation will require all offices on campus which provide Information Technology resource services to participate in, conform with, and comply with campus-wide direction and standards for network security. This strategy will require the establishment of a formal, permanent committee of departmental computer security officers.

Access to Digital Resources

Goal: Assure universal access by faculty, staff and students to the digital technology tools and resources necessary to create, deliver and use multimedia instructional content.

Recommendation A1: Provide faculty access to necessary delivery systems to assure ease of use of advanced instructional media both in and outside the classroom setting, including access to high bandwidth networks where appropriate. [Committee ranking: #2/17]

Action A1.1: Wiring classrooms. Campus classrooms must include an adequate number of network connections of sufficient bandwidth to allow delivery of multimedia materials from remote servers.

Discussion: The University is in the process of wiring all of the buildings on campus. Priority should be given to connections in classrooms. The campus network planning should include scenarios that include video delivery from multiple points to multiple classrooms.

Action A1.2: Classroom projection technology. Campus classrooms must be equipped with projection technology as they have been previously equipped with overhead projectors and blackboards. Colleges, departments and Official Pubs are encouraged to upgrade equipment in all classrooms.

Discussion: The goal here is to supplement or replace one set of instructional technologies with another. A priority list of classrooms to be upgraded should be developed. This will require defining specifications for the projection technology, which could be done by the CIT. The CIT could also set standards for determining the priority list of classrooms (using standards such as number of students served, availability for use by multiple departments, etc.)

Action A1.3: Client machines available for checkout. Colleges will work with central campus units to implement a system whereby faculty can reserve and checkout a standard computer for use in a classroom.

Discussion: Faculty should be able to teach in a classroom using a computer without providing their own equipment. Using the model of the overhead projector, faculty should be able to provide the content (like transparencies) without having to lug a computer across campus. Implementing this recommendation will require extensive policy and procedure coordination with the central audio-visual units and departments.

Action A1.4: Provide for high-bandwidth access as needed within departments, schools and colleges.

Discussion: The University should continue to develop its network backbone as needed to handle high bandwidth applications. Colleges should provide the appropriate routers. The University and Colleges will share responsibility for providing an adequate network infrastructure to support multimedia applications as they are deployed across the campus.

Action A1.5: Student Lab Access. The University should provide access to the minimal level of computing resources on a convenience basis. Colleges and departments should provide student access for high bandwidth computers where needed.

Discussion: Facilities such as the SMF should be operated analogous to the provision of public telephones. Students will be assumed to have reasonable access to computer technology sufficient to satisfy minimal productivity and connectivity demands. Instructional requirements for access to higher bandwidth applications, which vary widely across academic programs, will drive the development of college and departmental access facilities. ACITS should provide an advisory service in terms of assisting the departments and Colleges with the development of these labs and the selection of appropriate technology.

Recommendation A2: Provide support for production of and access to instructional content in multiple delivery models, including classroom, network and CD-ROM. [Committee ranking: #7/17]

Action A2.1: Multiple models of multimedia content. Decisions about the appropriate delivery modality for multimedia content will be driven by human and social needs rather than availability of technology.

Discussion: The University must provide for a variety of ways in which multimedia content can be developed by faculty and accessed by students, The CIT could provide services such as CD ROM publishing. ACITS could provide server archiving of materials in multiple formats - audio, video and text. Student facilities would include those that allow for small group access and access by students with special needs.

Recommendation A3: Establish standards for student-supplied hardware and software to assure compatibility with instructional media. [Committee ranking: #14/17]

Action A3.1 Create standards group. A group comprised of representatives from ACITS and the Colleges should be created to establish minimum standards for student supplied computer systems.

Discussion: This will most likely be a similar recommendation of the Universal Access group of the Long Range Planning Team. This group will need to re-evaluate the standards at least once per year, taking into account both the demands of multimedia instruction and the need to reduce the number of upgrades required of students during their matriculation at the University.

Recommendation A4: Develop mechanisms for providing access to digital resources to remote members of the University community. [Committee ranking: #16/17]

Action A4.1: : Network Access. The University should provide telecommunications technology that not only allows people to connect to the campus network, but will authenticate the status of users to determine accessibility of resources.

Discussion: ACITS is already developing these capabilities. Providing toll-free phone access may be a necessary requirement for meeting the needs of students not living in Austin.

Action A4.2: Content access. The University should provide a publication and distribution mechanism for multimedia instructional content that can be delivered as a stand alone or non-networked product.

Discussion: ACITS should provide a system for the production and distribution of multimedia materials on CD-ROM. The University should explore options for publishing titles through the University Press or through new units created for such a purpose.

Survey of Resources for Multimedia Instruction

Summary

The results of a 1996 Fall semester survey of the 14 colleges shows a significant amount of human and financial resources are currently being invested in multimedia instruction. Eleven colleges responded to the inquiry and the detailed results can be found in this Appendix. College deans were asked to respond to two fundamental questions:

1) Indicate those fees charged by your college to students in support of information technology and/or multimedia instruction. Deans were also asked to report how much was collected from such fees annually and specifically how these fees were used.

2) Indicate the specific types of training, fellowships, grants or other forms of faculty development provided by your college which are designed to assist faculty in multimedia instruction. Deans were also asked to provide a dollar amount directed toward such initiatives annually.

Responses to Question 1

Those deans who responded to the MIC inquiry indicated course-related fees that ranged from \$20 to \$306 per semester as a blanket charge per student. Other colleges have chosen to charge a fee per semester credit hour ranging from \$2 to \$7. Some colleges charge fees for specific courses and may combine this income with a general technology fee charged to each student. The total income from such fees ranges from \$61,000 to \$273,174. Figures quoted do not include ITAC funds. It is important to note that some colleges did not indicate annual total fee incomes in their responses. All fees were listed as required and in some cases specifically described as "learning resources fees," "technology resources fee," "instructional technology fee," or "incidental course fee." One college indicated that no technology fee was currently being charged but one would be implemented by fall 1997.

Fees are being used for several purposes including salaries for: technology support staff, lab costs including equipment and supplies, classroom instructional materials, student wages for those assisting faculty in developing computer assisted instructional materials, resource materials including audio tapes and instructional software. Of the 11 colleges responding, eight clearly indicated that fee income was being used to pay salaries of staff or student workers concerned with instructional technology and lab management.

Responses to Question 2

Of the 11 colleges responding six indicated that some form of support was being provided to faculty concerned with professional development in the area of multimedia instruction and information technology. Forms of support cited by college deans included travel assistance to attend conferences, personnel, equipment, tuition and release time. One college surveyed provides about six summer fellowships to faculty pursuing multimedia instructional projects. Dollar amounts expended annually to such areas of faculty development ranged from \$50,000 to \$480,000, however, since forms of assistance varied substantially from college to college, these figures should be considered as only rough estimates.

The specific kinds of formal instruction provided for faculty locally by their colleges include assistance in Web page construction, digitizing images, developing multimedia presentations for the classroom, use of databases, data capture, and CD-ROM creation.

Some colleges indicated that training was provided for learning resource center managers (lab assistants) on some regular basis so that support could be provided for faculty on an as needed basis. Other colleges referred faculty and staff to ACITS to receive instruction. Some colleges also indicated that many faculty were writing their own grants in support of their work.

Conclusions

Most colleges seem to be implementing student fees in an effort to provide students and faculty with the technological resources necessary to provide contemporary forms of instruction utilizing multimedia and information technologies. Income from these fees, however, is vastly different and no doubt reflects the vast difference in the demand for technology based instruction throughout the campus. Taking into account these differences in course content that exist between colleges, and the resulting differences in their need for technology, it does seem clear that there continues to be a need for faculty support. It may be safe to report that student needs are being generally more satisfied than faculty needs in this regard.

While no conclusive data currently exists, it seems that policies vary radically across campus in regard to the way in which student fee income is used to support multimedia activities. Some colleges are clearly utilizing these fee resources to assist faculty as well as students while other colleges are reserving fee income exclusively for varying forms of student support.

Chapter 6 - Multimedia Instruction

COLLEGE/ SCHOOL	FEES					TRAINING	
	Per Student	Total	Opt/Req	Purpose	Mech-anism	Description	Funding
LBJ PUBLIC AFFAIRS	\$50/sem	\$24,000	required	2 PT lab assts.	registra-tion	one-day seminar on www instructional opportunities class on using HTML to develop a Web Page	none
FINE ARTS Learning Resource Center	\$23/sem	\$100,756	required	lab staff & technology support personnel	registra-tion		
Art & Art Hist Instructional Technology	\$37/sem	\$52,614	required	lab costs	registra-tion		
Art & Art Hist Design Media Ctr	\$306/sem (design majors)	\$39,780	required	staff	registra-tion		
Music Instructional Technology	\$20/sem	\$31,560	required	lab costs	registra-tion		

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Theatre & Dance Instructional Technology	\$52/sem	\$48,464	required	lab costs	registra-tion		
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COLLEGE/ SCHOOL	FEES			TRAINING		Description	Funding
	Per Student	Total	Opt/Req	Purpose	Mech-anism		
ARCHITEC- TURE		\$48,500		PT lab assistant new equipment and supplies	registra-tion		
		\$20,500		to acquire and digitize slides for faculty/stu-dent use and to purchase new equipment and supplies			

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<p>ENGINEERING</p>	<p>\$7/sch</p>						
<p>Information Technology Fee</p>							
<p>Learning Resource Center fees:</p>	<p>\$110/sem</p>						
<p>Aerospace Engr/ Engr Mechanics</p>	<p>\$70/sem(\$52/9-wk,\$35/6-wk) \$75/sem</p>						
<p>Chem Engr</p>	<p>\$142/sem \$85/sem</p>						
<p>ECE</p>							
<p>Mfg/Mech Engr</p>							
<p>Pet/Geo Engr</p>						<p>Use ACITS courses, one-on-one with LRC directors, self-teaching, Instruc. Media Lab staff training for course development materials.</p>	<p>Ad hoc funding (e.g. travel to conference on Learning with Technol-ogy)</p>

Chapter 6 - Multimedia Instruction

COLLEGE/ SCHOOL	FEES					TRAINING	
	Per Student	Total	Opt/Req	Purpose	Mech-anism	Description	Funding
<p>NATURAL SCIENCES Instructional Technology Fee</p> <p>(The College receives an additional \$1 million from ITAC which is used for equipment purchases)</p>	\$7/sch	\$2 million	required	75% personnel 25% equipment for departmental operations	registra-tion	'93-'96 College Multimedia Center (CMC) CIT Departmental support for multimedia presentations, (data capture, materials preparation, materials distribution) classroom projection equipment, WEB servers, CD-ROM creation facilities	\$100,000/yr \$80,000/yr \$150,000/yr personnel \$150,000/yr equipment
<p>SOCIAL WORK no current fees Instructional Technology Fee requested for Fall 1997</p>							

COLLEGE/ SCHOOL	FEES				TRAINING		
	Per Student	Total	Opt/Req	Purpose	Mech-anism	Description	Funding
LIBRARY INFORMATI ON SCIENCE	\$30/sem	\$36,000	required	Multi-media software, video tapes, and classroom instruction materials (NOT hardware or printed supplementary materials)	registra-tion	Lab staff provides individual instruction or workshops for 3-4 faculty on PowerPoint, HTML, the Lexis-Nexis and Dialog databases, Adobe PhotoShop, etc.	College believes that need-to-know (just in time) instruction is as effective as a formal training conference
	Learning Resources Fee						
Technology Fee (effective Fall '97)	\$2/sch	\$25,000	required	<p>\$8,000 for wages of students to assist faculty in developing computer assisted instruction</p> <p>\$12,000 for hardware & software</p> <p>\$4,000 for on-line databases used by faculty for course content.</p>			

Chapter 6 - Multimedia Instruction

COLLEGE/ SCHOOL			FEEES			TRAINING	
	Per Student	Total	Opt/Req	Purpose	Mech-anism	Description	Funding
LAW Learning Center Services and Automation Fee		\$201,000	required	operation of the Student Computer Learning Center and electronic reference materials maintained by the library	registra-tion	not specifically provided	research funds provided to each faculty member can be used for training purposes
NURSING Learning Center Utilization Fee		\$32,000	required	Software specialist and lab assistants	registration	Learning Center and Information Technology Staff offer short courses,	tuition and release time for distance education and teledistance education programs.
Incidental Course fees		\$32,000	required for specific courses	instruc-tional software for clinical courses	registration	demonstrations at faculty meetings and individual training sessions per faculty request.	

COLLEGE/ SCHOOL	Per Student	Total	FEES Opt/Req	Purpose	Mech-anism	TRAINING Description	Funding
CONTINUING EDUCATION EIMC: Distance Education Center	\$4-\$25 dep		varies by course	for audio tapes	registra-tion	Individual training. EIMC matches the technology options to the course and assists faculty in designing the course. Training provided for teaching via computer conferencing, WEB, email, audioconferencing , interactive video, CUSeeMe, and CD-ROM. Considering offering faculty courses in Web course design this summer with add-ons for specific subject area (e.g., integration of MIDI files in music)	

COLLEGE/ SCHOOL	FEES				TRAINING		
	Per Student	Total	Opt/Req	Purpose	Mecha-nism	Description	Funding
PHARMACY Instructional Technology Fee	\$130/ sem	\$180,000	required for all students	3 LRC professional staff and LRC M&O	registra-tion	Systems Analysts are hired to provide assistance individually and in workshops on various software programs, HTML, interactive teledistance learning, , etc.	\$50,000 approx. for support to faculty for multimedia instruction. \$500 honorarium for presenting at multimedia Teaching Academy many faculty write their own grants to gain MM support

Chapter Seven

Distance Education

Introduction

With the increasing ability of computing and communications networks to reach people wherever they are—at home, at work, in their cars, in the middle of the Sonoran Desert—interest in distance education is on a rapid rise. It also is no accident that the interest is growing at a time when information is increasing exponentially, and knowledge is exponentially more difficult to distill from the information tidal wave. (Note: The Center for Instructional Technologies has developed a distance education primer, located at <http://www.utexas.edu/cc/cit/de/deprimer/deprimindex.html>, for the reader who is relatively new to the concept of distance education. The primer includes an overview, brief history, information about faculty, student and instructional issues, and a glossary.)

Innovative programs abound at all levels, from pre-schools in rural communities to postgraduate institutes in urban universities. Those age-old barriers to learning of time and space and affordability appear to be yielding at last to technological advances. It is now possible to provide appropriate learning environments to anyone, anywhere, at any time. The greatest problem will be discovering how to craft these new environments so that learning is enhanced, whether it is developing skills, analysis, or abstraction.

The implications of this impending change in the way we teach and learn—and where we teach and learn—have not been lost on the American University. Most institutions of higher education, including the University of Texas and the University of Texas System, have been weighing the possibilities seriously. Penn State will launch its “World Campus” in the fall, a concept that will include all forms of distance education delivery along with the implementation of more technology-enhanced classroom teaching on the campus. In addition, a Virtual University Project of the California State System is well into development.

The question, most agree, is not whether we should get involved. We must. Peter Drucker, for example, predicts the demise of the American University in the next 20 years if costs continue to escalate (<http://www.forbes.com/forbes/97/0310/5905122a.htm>). If universities are unwilling to change, private industry will be happy to supply remotely the learning environments that students need to achieve their educational goals. Thus, unless universities act soon, “degrees” or “certifications of knowledge” from Sears or IBM may one day be as prestigious as the college or university degrees now offered.

No, the question of distance education is now a more practical one: how will we do it? How will we find the people to craft the new systems? How will we reward them? How will we create the labs and the materials and the access to communications media that we need? Above all, how will we overcome the natural inertia of educational systems that have gone largely unchanged for a thousand years?

The changes required are both technologically demanding and sociologically revolutionary, shifting our academic culture from a narrow “campus community” to an inclusive “virtual community” while retaining effective learning. The dichotomy of research and teaching has become a trilogy - “teaching research” for almost every class!

Office of DE

This chapter addresses the issues associated with moving The University forward into the 21st century while utilizing distance learning and technology-enhanced teaching techniques. Findings and recommendations will be made throughout the document as they relate to

specific areas. However, in order to implement any of the recommendations found in this chapter, some general recommendations must be made.

1. A fully-staffed distance education office should be established. Currently, there are two staff in the Center for Instructional Technologies who work on distance education activities for the campus. In addition to the two, a student services professional, an instructional designer, a multimedia specialist and at least two support personnel should be added.

Faculty

In order to progress in the area of distance education, the UT Austin faculty must be involved in all aspects. Time and again the lack of faculty involvement has proven disastrous for distance education programs and their administrators (ie, University of Maine System and the recent controversy at Washington State University). Faculty must be involved in the direction The University chooses to take in this area, from decisions to offer programs to policies and procedures that will govern the activities. The following issues must be addressed in the long range plan regarding faculty:

Findings

Recommendations

An advisory committee consisting of faculty who are currently teaching resident credit courses (undergraduate and graduate), as well as those who will represent colleges who plan to offer such programs in the future, must be established.

Faculty development must be made readily available that prepares faculty for distance education delivery (all formats). Faculty must be made comfortable with any technology used to deliver a course in order to insure concentration on the content during class. In addition, faculty must be made aware that a variety of technologies exist that can be used to deliver a course.

A task force should be established that studies faculty promotion and tenure policies as they relate to teaching courses at a distance. Faculty must be reassured that the amount of time necessary to develop and teach quality distance education courses will be rewarded. Also, procedures must be established that allow faculty the appropriate amount of time and resources to develop such courses.

Faculty must be provided an infrastructure that gives them ample opportunities to access students both synchronously and asynchronously.

Faculty should have the opportunity to work with distance educational professionals, instructional designers, graphic artists, and multimedia experts in order to develop course materials for delivery through a blend of technologies which are most appropriate for the content.

Faculty should be provided incentives and resources to attend and participate in state and national distance education conferences and organizations as they choose to do so.

Set up routine rewards for faculty members and others who make significant contributions developing this new mode of education. Since they provide an essential service to The University, critically needed at this time, this is an important step toward attaining parity for teaching research. As a first step in this direction, The Provost's Office has just announced winners of the first awards program for innovative uses of information technology. These advances must rank in prestige with research

publications and basic discoveries, because this is what they represent.
(<http://www.utexas.edu/cc/cit/iitap/>)

Encourage retired faculty and staff to develop distance education courses. Retired faculty and staff can now stay connected to UTnet for a modest monthly fee. Let's give them a way to keep on teaching, interacting with students.

Reconsider the intellectual property rules to permit faculty members and others to receive greater financial rewards for distance education efforts on the job.
(http://www.utsystem.edu/BOR/RegentsRules/2XII_.htm)

Use distance education with our own students, our own classes. Offer portions of UT courses on the web, thus "at a distance." (<http://www.utexas.edu/cc/cit/>) UT foreign language and science courses, for example, have made advances in doing this. Work for universal access for students, faculty, and staff.

Students and the Student Market

In order to better understand the potential student market for UT Austin's distance education programs, descriptions of current distance education offerings are provided. The broad spectrum of courses and programs described indicate wide-spread use of distance education technologies to reach students at other component institutions and beyond.

The students involved in distance education courses and programs require special considerations. These students can make or break the future of distance education at a campus; therefore, serious attention must be paid to their unique needs as distance students. Because the Texas Higher Education Coordinating Board has no authority over out-of-state institutions (ie, Stanford, Harvard, etc.), these universities are able to bring degree programs into the state via a variety of technologies. For example, Harvard Business School and Duke University are currently offering their MBA programs via the Internet. The University of Texas at Austin must provide quality programs and services to Texas students in order to stay competitive in this growing field of distance education. Student services and student development (preparation for the distance education experience) are addressed later in this section.

Findings (DE Programs)

Graduate School of Library and Information Science (GSLIS)

GSLIS offers complete master's degree programs delivered to students at UT El Paso and UT San Antonio. Beginning in Fall 1991, one or two DE courses/semester for the MLIS have been offered to these sites, resulting in 74 graduates in El Paso and 49 in San Antonio by the end of 1996.

Currently two courses are offered to each city each semester; several of the San Antonio students also commute to Austin to take courses. Class size in San Antonio has averaged 19; in El Paso 32. The market remains strong in both sites, and the faculty is considering expansion to other UT System locations such as UT Pan Am or UT Tyler. In these programs GSLIS has included courses of particular interest to students at El Paso or San Antonio, such as public-library-oriented courses when the new San Antonio Public Library opened, learning resource courses which are in high demand in both locations, and Resources and Services for Hispanic Americans.

Chapter 7 - Distance Education

College of Communication

[to be supplied by Pam McQuesten]

Marine Science Institute

The Marine Science Institute offers two-way video classes between their dedicated classroom in Port Aransas and the UT Austin campus classroom. They offer one or two graduate classes per semester to currently-enrolled UT graduate students, mainly in marine sciences, but occasionally in geology and other branches of natural sciences. The classes usually contain a total of five to eight students. There are students in both Port Aransas and Austin, and the instructor can be in either place. The technology has worked well, and Marine Science has tentative plans to expand to an undergraduate program in the future.

College of Pharmacy

The College of Pharmacy has used interactive television between UT Austin and UT San Antonio since the late 1970s for both undergraduate and (lately) graduate education. A number of courses have been taught over the years. This semester, for example, approximately 25 semester credit hours serving about 225 students are being taught via interactive television. One of the current courses, Resident Rounds, involves practitioners at distant sites.

Additionally, Pharmacy is developing the resources by which they will teach pre-pharmacy courses via interactive television in El Paso as part of their cooperative pharmacy program with UT El Paso. If the School decides to begin a nontraditional doctoral program they will utilize multi-media, and other interactive formats to deliver coursework.

Educational Administration (College of Education)

The Department of Educational Administration has offered a doctoral program by interactive television to UT Pan Am since Summer 1994, providing at least one or two televised classes each semester. One cohort of approximately 15 students has entered each year; thusfar five students have graduated. Students from UT Austin may also enroll in these classes. Televised offerings have been supplemented by professors traveling to UT Pan Am to teach onsite; in addition, students take courses offered by UT Pan Am faculty.

Curriculum and Instruction (College of Education)

In Spring 1997 Dr. DeLayne Hudspeth used two-way video to teach Instructional Technology graduate students who are located in Kwanju, Korea. His course originates from a "two-way video teaching station" which provides him with total control of two cameras, an online computer, and a video tape player. Dr. Hudspeth can also remotely control cameras and audio in the classroom located on the campus of Chonnam National University (NCU) in Kwangju. In addition to two-way video, the course is supported with Internet functions such as e-mail, a list serve, and WWW pages. Computer graphics are used, for example, to share ID photographs of the graduate students in Korea. A second course taught by Dr. Elaine Fowler, teaches grammar methods to elementary English teachers at NCU.

College of Engineering

Petroleum and Geosystems Engineering (PGE) offers one-two graduate classes via video tape, e-mail and fax each semester including occasional summer classes. All students are enrolled UT M.S. students who can be anywhere in the world. The classes are mixed with existing campus classes, usually with five or fewer remote students in a class of 15-20. Although PGE has been doing this for eight years and would like to expand, the numbers

don't appear to be there at this time. PGE is not sure why there are so few students; 15+ students have graduated since the program began. An undergraduate program might be more successful.

A second PGE initiative is an affiliation of the College (via UT Austin) with the National Technological University (NTU) to teach in Trondheim, Norway. No state supported institution in Texas is currently affiliated with NTU, so PGE will be the first if approved. PGE will offer courses either as part of the NTU master's degree programs or separately from NTU to the industries and other entities that have download sites with NTU. Many of the high tech companies in Austin have these sites; thus PGE can begin to meet some of their demand for courses. PGE has had a long-term relationship with NTU in student exchanges.

In Electrical and Computer Engineering, Suzanne Barber will be offering two courses in software engineering to the Applied Research Laboratory at the Pickle Campus in 1997-98 via a physical hookup between the campuses now being completed. That program should continue for several years.

IC² Institute

The Master of Science in Science and Technology Commercialization degree program prepares experienced managers for the rapid commercialization of new technology. The curriculum is interdisciplinary and consists of 36 credit hours of instruction in twelve months. Students must enroll for the full course of studies and pay a fee of \$22,000 for the year-long program. Areas of study include all phases of the technology commercialization process within a global context and span the boundaries of the disciplines of creative and innovative management, organizational behavior, intellectual property management, technology assessment, technology transfer, strategic analysis, marketing, entrepreneurship, policy studies, and product development and production.

The student market for this degree program is highly diverse and global in scope. In addition to being qualified to pursue graduate-level study at the University of Texas (holding a bachelor's degree from an accredited institution with a grade point average of 3.0) students in the program have a minimum of five years of professional experience, generally in managerial positions, research and development, legal practice, engineering, or government and military service. The program seeks to gather a student cohort that is global in national origin and that represents a wide variety of professional backgrounds and disciplines. The program is designed to accommodate the schedules of the full-time working professionals, with classes that meet on alternating Fridays and Saturdays.

The program is currently offered from two sites, one in Austin, TX and the other in the Washington, D.C. area, and students must attend classes at one of those sites to participate in the program. Instruction is presented via compressed video with fully interactive voice and video and originates alternately from one site or the other. In all cases there is a program faculty member at the site receiving instruction remotely. This faculty member facilitates the interaction between the instructor at the originating site and students at both sites.

In addition to conducting interactive class sessions via video conference, course material is delivered and student/faculty interaction occurs through Internet-based e-mail and the World Wide Web, and collaborative work is conducted over the Internet using Lotus Notes groupware. Since program faculty and staff spend time at both sites, student advising can take place in person. However, advising is also done through electronic communication when it is more convenient and timely. Admissions, registration and other interactions with University administration are facilitated by program staff working with students attending classes at the remote site as well as with students in the Austin area.

Chapter 7 - Distance Education

The future plans of the program include expansion to additional sites, both in the United States and around the world, offering interactive instruction through multi-point video conferencing. The program will be offered to students at these additional sites as either a wholly University of Texas degree, as a joint degree, or as a certificate program with appropriate partnering institutions. Current sites under examination for potential expansion include: the University of Washington, Instituto Superior Tecnico in Lisbon, Portugal, and the Academy of National Economy in Moscow. Plans are also being developed to deliver modules of the program's content through short courses in an executive education format.

College of Fine Arts

The College of Fine Arts is in the beginning stages of distance education program development. A planned distance learning facility was expected to be complete in the spring of 1997; however, due to design and construction delays, the completion date has been moved to the fall of 1997. While much of the equipment has been purchased, several items remain. This remaining equipment will be purchased and installed over the summer or in early fall 1997.

In Spring 1997, Fine Arts offered an undergraduate music theory course to students at UT Brownsville. The instructor, Ciro Scotto, used the distance learning facility in the College of Education, and approximately 16 students enrolled in the course—12 at UT Brownsville and 4 at UT Austin. Although the first distance education course was well received, Fine Arts does not have plans to deliver courses this fall. The School is well aware of interest around the state in Fine Arts courses, and will continue its distance education efforts once new personnel and facilities are in place.

EIMC: A Distance Education Center, The Division of Continuing Education

EIMC, the distance delivery arm of the Division of Continuing Education, includes Independent and Distance Learning, TeleLearning, and Extension courses. EIMC delivers asynchronous instruction to college and high school students by print, e-mail, fax, telephony, computer based instruction, and the Web as well as synchronous instruction by audio and extension courses.

University faculty teach departmentally-approved courses for distance delivery on an overload basis. Independent and Distance Learning, which began as a correspondence program 87 years ago, currently lists 195 courses taught by 95 faculty; student enrollment is approximately 16,000. The Distance Education Design Center specializes in developing and adapting courses in which the delivery technology is matched to the curriculum and the student. Their Web courses have earned national recognition, for example, The Chronicle of Higher Education's Site of the Day. In addition to faculty development, EIMC has 4 student development specialists who offer distance students support. A Testing Center provided at Lake Austin Centre also works with other testing centers for student evaluation at remote sites. For more information see www.utexas.edu/dce/eimc.

Current Student Services for Distance Learners

Examples of student services provided by UT Austin DE programs include:

- advising in person and by e-mail
- 800 number so that remote students can call the Austin location toll free
- assistance with class projects, homework assignments, etc. by the instructor via phone, e-mail, and in person
- teaching assistants hired for the distant site who hold office hours, tutor students, etc.
- onsite technology demo sessions to teach skills such as database searching

Chapter 7 - Distance Education

Services which may be provided by the receiving institution:

--library facilities (reserves, reference services)

--parking assistance

--tutoring

--laboratory facilities

--volunteer liaison or assistant (class member or local volunteer) who distributes material for the class mailed in advance, collects assignments and mails them to the instructor, and sends and receives faxes.

Student Development

Most UT Austin programs offer very little advance preparation for students in remote locations. Students new to the DE experience are expected to show up on time and watch TV and take notes, as one student expressed it.

After class begins many professors make an effort to involve the distant students in discussion and encourage their participation in the class. Instructors often have students at both sites introduce themselves on the first day, telling something about themselves. The operator may zoom in for a close-up so that students see themselves on TV and begin to feel more at ease in the televised environment. An instructor may supply a photo sheet (via a digital camera) of all students at both sites to help them get acquainted. And all students should have e-mail addresses of everyone in class early in the course.

Many teachers call on students by name regularly at both sites, not waiting for volunteers. Class projects may involve individuals from both sites, while joint presentations may be conducted with students from each site contributing alternatively or one student presenting while the other handles the visuals. In joint research projects, students from both sites may cooperate in data collection and then prepare their report together via e-mail.

Direct Costs and Fee Structures

The cost to UT Austin programs of offering courses by DE varies considerably, one factor being whether the school owns their own studio. Studio costs are typically \$40-\$45 per hour per semester; thus a three-hour semester course would cost a total of \$1800 to \$2025 (with an additional \$120-\$135 if a final exam is given).

In addition, faculty members may travel to the distant site from time to time to originate a session from that site and to meet with and advise students face-to-face. For example, travel costs for the GSLIS faculty for a one-semester course average \$400 (San Antonio) and \$740 (El Paso), assuming four faculty trips per semester. To help defray costs of the GSLIS DE program, Dean Brooke Sheldon received permission from the University Administration to charge \$150 per course (\$50 per semester hour) in addition to standard tuition and fees.

Recommendations

Develop distance education programs for graduates of the University who need specialized master's programs. These people need courses they can take on their own time, at their own pace. They find it difficult to "go back" to the university for traditional classes. As a starter, let's let alumni maintain their e-mail addresses at the University. This is an important first step toward establishing lifelong learning partnerships.

A student advisory committee must be established made up of students who have taken distance education courses via a variety of technologies, including print, audio, Web, multimedia, videoconference, and satellite.

A set of policies and procedures for distance students must be developed that are sensitive to student needs.

Student services for distance students include Internet and library access, information related to the policies and procedures for distance students, and information related to the home campus, including important dates, library hours and phone numbers for admissions, the registrar, all libraries and financial aid.

Student development should be a key component in any distance education program offered by The University. This development model is in addition to the traditional services offered. Recent research indicates that successful distance education students are independent, self-motivated, have the ability to persevere under pressure, able to work alone, and are committed to the course. Research also indicates that most distance education students are unaware of these characteristics until the class is underway. Therefore, a series of information pieces in video, print or Web-based formats must be developed and provided to students prior to the first class meeting. In addition, information and counseling should be made available to students who feel they are lacking in any of these areas.

A needs assessment should be administered to potential students in the state to determine which types of programs The University should offer.

Technology Issues

While the idea of delivering education at a distance may seem like a recent development to some, involving various forms of cutting edge technologies, techniques for distance education have been around for a long time. Correspondence courses for example, require nothing more exotic than printed textbooks and mail service, while teleconferencing can be accomplished with standard telephone equipment that has existed for decades. Classes have been taught via broadcast services such as television and radio since their inception in the first half of this century. More recent technologies such as satellites, compressed digital video networks, computer multimedia and the Internet have added to the repertoire of the distance educator, but the majority of distance education efforts use them in ways that aren't very much different from the earlier triumvirate of correspondence, teleconference and broadcast.

A brief survey of distance education methods in use today at the University is shown in the accompanying chart. The chart shows both synchronous and asynchronous methods arranged by relative cost. Consideration has been given to the type and amount of equipment needed, session costs, the amount and type of preparation required, and advantages and limitations of each method.

The "blending" of techniques

While some educators have been developing and advocating each of the various delivery methods shown on the chart, others have realized that a blending of various technologies can improve the experience of both the instructor and student while reducing the overall cost. In a recently taught course between UT Austin and UT Brownsville (footnote course title and number?), a compressed digital video network was employed to provide the traditional synchronous classroom situation, while an Internet Web page was used to distribute asynchronous, high-quality graphic and sound materials. While it was important to have those materials supporting the instructor's efforts in class, they were also available for students to review after hours. An Internet "Chat" room was implemented so that remote students could visit with the instructor during an "office hour" and it was also

possible for students to discuss the course with each other at any time. An added benefit of the video teleconference/Internet blend was that the teleconference portion didn't rely on any proprietary technology. Standards-based Codecs and computer equipment were already in place at each site and no further investment was required. Instead of simply delivering course lectures to a remote classroom, a blend of technologies and techniques was employed to provide an enhanced learning experience for students regardless of location.

Future Directions

Recent developments in technology have accelerated the rate at which the various techniques are converging. As outlined in the previous example, benefits accrue when various techniques and technologies are used to provide students with an enhanced learning environment regardless of location. The combination of good classroom and individual teaching, along with support materials (such as video, sound, text and graphics) provide information about a topic to each student in a variety of ways -- thus creating the optimal environment for each student to comprehend and assimilate the information. Computer networks, such as the Internet, are capable of delivering information in all of these ways.

The Internet

Software

The viability of Internet teleconferencing rests in three areas: suitable software, available bandwidth and widespread, affordable subscriber connection methods. A couple of applications that use the underlying technology of Apple Quicktime on the Macintosh PowerPC are CU-SeeMe Pro and Connectix Videophone. Both provide two-way video, audio, text chat and shared whiteboard. With the addition of a software reflector, CU-SeeMe Pro can also interactively connect more than a dozen users or provide a one-way broadcast to hundreds on the Internet. On the WIntel platform, various applications exist including CU-SeeMe Pro, Connectix Videophone and Ilink. Starting in about August, most new WIntel machines will be equipped with basic teleconferencing capability.

Network

The real bottleneck to Internet teleconferencing for the foreseeable future is available bandwidth. While various efforts are being made to expand the capacity of the Internet, the high cost of the infrastructure combined with the general vagueness of the funding model make it impossible to predict how bandwidth will be improved or how long it will take.

A similar problem exists with subscriber connection methods. Most individual users now connect to the Internet using modem technology that has been around for decades. This low-cost approach isn't really fast enough for real teleconferencing. Two new technologies, Asymmetrical Digital Subscriber Line (ADSL) and "Plain Old Telephone Service" (POTS) combined with a cable-TV modem could dramatically improve the situation. Both schemes rely on existing wiring to carry large amounts of data to the user from a central network while returning a much smaller amount of data back to the network. Both approaches are undergoing testing at a few locations around the country and both use the existing wiring infrastructure to greatly reduce the initial cost.

To sum it up . . .

A variety of methods are now in use to deliver education at a distance. They include everything from simple correspondence and telephone technology to digital video teleconferencing and the Web. One-to-many-connection teleconference technologies including video, sound, graphics and text have been successfully demonstrated on the

Internet, and recent improvements in computer technology mean that the Internet could become the preferred distance education medium of the future. Currently however, limited Internet bandwidth and lack of widespread connectivity have reduced its usefulness as a distance education medium to all but a few. Prudent educators will consider technology purchases carefully with an eye toward avoiding obsolescence, while being wary of technologies that are not yet mature.

Partnerships to Extend the University Through Distance Learning

Opportunities for UT Austin to Develop Partnerships to Extend the University

There are both short term and long term opportunities for the University related to Telecommunications Infrastructure Fund (TIF). In the short term, the university should focus on collaborating with small, rural, resource poor K-12 schools in the state. In the long term, UT Austin should encourage collaboration, joint planning and collaboration between the emerging telecommunications infrastructures within the UT system, the Texas A&M system, University of Houston, Texas Tech, Regional Service Center, state libraries, medical networks, and others with the goal of increasing state-wide access to instructional and information resources particularly in remote and underserved parts of the state. Efforts should be made to bring together resources within the university to enhance delivery of instruction in a variety and mix of modes.

The use of computer-mediated communications and the development of web-based courses needs to be encouraged and supported within the university. An example is the present collaboration between Continuing Education, the Learning Technology Center and the Department of Curriculum and Instruction in offering a web-based course that also uses groupware to support instructor student communication and collaborative projects between students.

Long term, the university may provide leadership and expertise within the state in identifying critical policy issue barriers and solutions, and effective evaluation strategies for distance education.

Potential partnerships with K-12 and/or other organizations (e.g., healthcare)

The university should expand efforts to extend the university's instructional resources and telecommunications-mediated course offerings for teachers across the state to support their on-going professional development. development of new distance-learning systems to provide for the professional development of K-12 teachers as well as other adults. It should also, through Continuing Education, expand advanced placement and dual credit courses available to rural schools.

Special efforts should be made to assist the small rural schools within the state in developing proposals for TIF funds. Many of these schools have limited resources and/or experience in the preparation of proposals. The university, in collaboration with the regional service centers, may help them in developing high quality proposals and in planning and implementing their telecommunications projects and in evaluating telecommunications delivery systems that may best address their needs. UT Austin may provide a valuable service to the K-12 school community by identifying important distance education system options, selection considerations as well as reliable cost and performance guidelines.

Small schools within the state have been besieged with vendors trying to sell their systems, and often have difficulty in making appropriate system acquisition decisions. The expertise and resources of UT organizations such as the Institute for Technology-Assisted Learning

(ITAL), Texas Telecommunications Policy Institute (TTPI) and the Learning Technology Center (LTC) may provide valuable assistance to the small rural schools in the state applying for TIF funds. Efforts such as the LTC's collaboration with the Texas Association of Community Schools to address the planning and implementation needs of small rural schools should be expanded in the future. Basically, UT Austin must be proactive in developing partnerships with K-12 education - they (the schools, at least) will not be coming to us.

The projects supported by Microsoft, Apple, Southwestern Bell suggest that the private sector may be interested in partnering with schools and universities. The university should not overlook them as possible collaborators.

One healthcare idea would be to work with Pharmacy and Nursing on some community health care management distance education program. There are tremendous needs for community services in rural/poor areas, and people in these departments would be logical developers. The campuses with Medical Schools also would be logical collaborators.

The Pharmacy Department is interested in developing a distance learning program for different purposes, possibly for a gerontology-related seminar (available to the UT Austin campus and non-campus students), as well as for developing an advanced clinical management system which would entail participation with the professional community. This could be a nice demonstration/pilot project for UT Austin.

The university may also be able to assist small community libraries across the state in planning and expanding their role as distance education sites and in access to global information resources through the web. TTPI is currently engaged in such efforts. More generally, libraries are in the front end of the queue for Internet connectivity, and they can become an important community resource for distance education and to enhance community access to global information resources.

Future implications of TIF with regard to higher education

TIF is increasingly interested in fostering partnerships to make better use and provide wider access to existing intellectual and learning resources. Therefore, institutions like UT Austin should focus now on cultivating strategic partners in rural areas, or with institutions that lack access to many of the programs available on campus. The university should continue to establish high visibility pilot programs using telecommunications (e.g., the Four Directions project) so that we can advise the TIF Board on how they might proceed.

Possible projects that might be implemented

The previous sections identify types of collaborative projects needed. Other possible areas include:

- Providing distance education serving professional programs - business management, education, nursing, pharmacy, engineering, library, certain communication programs (wweb design, multimedia skills, etc.), social work, etc. It should provide Just-in-Time professional development and instructional courses/workshops/information.
- Programs at UT with highly specialized faculty, e.g., language courses, certain engineering courses, bilingual education, instructional technology, etc. Distance education makes most sense with universities who don't have the resources Austin enjoys.

- A near-term idea would build on programs/projects that already collaborate with institutions at a distance on research or education projects so that we could enhance/improve/extend those projects. These would not be limited only to collaboration with “resource poor” institutions but may also include collaboration with other institutions and agencies involved in innovative and “cutting edge” distance learning applications.
- A critical first step is for the university to develop a comprehensive and current listing of distance education projects and activities within UT Austin.
- Cooperate with ongoing projects in the UT system and with other universities. It's not “us versus them” in this field; it's “us with them” for the best results.
- Cooperate with existing efforts to build better links to K-12 schools and community colleges. Education really is seamless, “pre-K through Gray”. Why do we emphasize the differences? If we want better students entering UT, why not help teach them now? If we want better educated adults, why not start now - with ourselves? (<http://www.ital.utexas.edu/>)

Relationship of UT Austin to other DE Initiatives

With the establishment of the Western Governor’s University (WGU) and the proposed UT System Virtual University, there will be concerns and questions as to how The University may or may not play a role. Although UT Austin is a research university with a cap of 50,000 students, we may be called upon to provide courses and services to one or both of the latest virtual universities. The University must be prepared to respond when and if such requests are made. In order to do so, the following issues must be addressed:

- A task force should be established that will closely study the virtual university concept in order to better understand how courses will be provided and to determine what services, if any, The University might provide.
- While The University may or may not choose to actually provide courses for either of these organizations, it may indeed be able to provide services such as assistance with course development, faculty development and Internet access

The University of Texas Virtual University
Darcy

Western Governors University:

The WGU concept encourages collaboration between government, education, and industry. Institutions in 14 states and 1 territory (Utah, Colorado, Oregon, New Mexico, Wyoming, Arizona, North Dakota, Washington, Nebraska, Montana, Hawaii, Nevada, Idaho, Alaska and Guam) are currently participating in the WGU. The goal is to deliver “anywhere, anytime” competency-based education while maintaining high standards in educational quality and social awareness.

At this time there are no opportunities for The University of Texas at Austin and all other institutions in Texas. Governor Bush has given a verbal commitment to the WGU, but he

has not signed the official agreement. Institutions in non-signatory states can not offer courses through the WGU nor can they be part of the policy and procedure discussions. The WGU is proactive in addressing the needs and concerns of students (access to and affordability of education), the concerns of education providers (how to serve an expanding and diverse population), and the needs of industry (available workforce educated and trained to perform in today's global market).

Foremost needs and issues for the WGU are funding, accreditation/credentialing processes, and cooperation and commitment. It is estimated that the WGU will need \$25 million in funding during its first eight years; after that time profit should be realized. Participating governors have each committed \$100,000 with additional grants totaling over \$1,600,000 coming from AT&T, The Sloan Foundation, IBM, Sun Microsystems, and International Thomson Publishing.

Four regional accrediting commissions (SAC's excluded) have created a new entity to review and provide accreditation for the WGU. Still to be determined is tuition cost (will it be a set fee or determined by individual provider?) and how will student service costs be shared. The Department of Education has endorsed the WGU and has publicly stated that it will work to resolve financial aid issues related to the virtual university system.

Texas remains uncommitted and California, originally a major contributor in the formation of the WGU, has pulled out of the project and is working to establish its own virtual university system. Establishing a firm base on which to build continues to be an issue.

Recommendations:

If Governor Bush intends to sign the agreement with the WGU, it should be done immediately so that The University of Texas at Austin can participate in the formation of policies and procedures.

The University should view the WGU as an opportunity to work with other schools in addressing the needs of business and community. It also provides a market for faculty who create products and courses delivered by distance education modalities

Lone Star College

According to House Bill 2652, The Lone Star College will be a special college program “established to provide an alternative to traditional university programs through which an adult may earn a college degree that is equivalent in quality to a degree earned at a traditional accredited college or university and that is obtained through equally rigorous academic course work.” The primary market will be those persons who - for personal, economic or other reasons - require a more flexible, self-paced program not available through traditional programs.

The “college” will act as a clearing house for courses, and it will be administered through an institution designated by the Texas Higher Education Coordinating Board.

Opportunity exists for educational institutions to voice opinions and play an active role in its formation. Because both associate and bachelor of arts and science degrees will be offered, universities and community colleges will have the opportunity to work together to meet the educational needs of the community and beyond. Given UT Austin's conservative view of distance and alternative education, the LSC provides an avenue to offer specialized course offerings while staying within the traditional college structure.

The Lone Star College is a concept, not a reality. Its structure will be different when compared to other virtual projects. In order to enroll, a student must have accumulated not

less than 30 semester credit hours from one or more regionally accredited institutions of higher education and a degree plan must be established. In addition, credit will not be given for prior learning, educational activities, life or work experience or other activities performed outside a collegiate setting.

Recommendations: HB 2652 states that the board of regents must seek accreditation by a recognized accrediting body. If the college is not accredited by August 2003, it will be disbanded. Therefore, UT should contact the Coordinating Board to express interest in playing a major role in the formation of the project. Departments, staff and faculty should be included with the possibility of including community advisory boards.

Virtual College of Texas

The Virtual College of Texas (VCT) isn't viewed as a college but as a voluntary consortium of colleges that share distance learning courses throughout the state and service areas. Its role will be to facilitate; it will not be a credit granting institution.

UT would have the opportunity to offer distance learning courses statewide through participating colleges. VCT would be an avenue to market non-credit courses and professional development programs. It is a way to build community partnerships.

VCT is a vision; there are no official documents, only ongoing discussion. Numerous administrative issues must be including funding and distribution of instructional fees. For example, it is possible that member institutions will have to agree to provide support services to students residing within their service area who access distance learning courses offered by other member institutions.

Recommendations: UT Austin representatives familiar with non-credit courses should be actively involved in the ongoing discussion and possible formation of the VCT.

Findings

Supporting Documentation

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Center for Instructional Technology. <http://www.utexas.edu/cc/cit/> Current on 2 May 1997.

Chapter 7 - Distance Education

The President's Ad Hoc Task Force on Internet Services for Retired Faculty and Staff.
“The Report of the Ad Hoc Task Force on Internet Services for Retired Faculty and Staff.”
15 Dec. 1994.

The University of Texas System. The University of Texas System Regents Rules and Regulations: Part 2, Chap. 12, “Intellectual Property.”
http://www.utsystem.edu/BOR/RegentsRules/2XII_.htm. Current on 2 May 1997.

Chapter Eight: High Performance Computing

1. Introduction

For the past forty years the University of Texas at Austin has provided support for High Performance Computing (HPC) as part of its research and educational infrastructure. In 1966, the University of Texas was one of the first institutions in the nation to purchase the CDC 6600, considered to be the premier high performance computer of that era. In the 80's the University of Texas System purchased the Cray X-MP and Cray Y-MP vector supercomputers as part of the Center for High Performance Computing. This long standing investment in HPC has rewarded the University with the creation of many campus-wide research programs of international acclaim. There is overwhelming evidence that high performance computing provides for high impact, high visibility research in science and engineering and is one of the metrics by which nationally recognized research programs are measured. The University has produced many graduates who are now considered leaders in the field of HPC who have made substantial contributions to society through their own nationally-recognized programs. With the phase out of the UT System Center for High Performance Computing and the subsequent return of the HPC facilities to UT Austin, there exists an opportunity to create a bold new vision for the future of high performance and research computing. This vision for the University's future in HPC should not only serve the campus-wide research community, but also play a larger role in the emerging research infrastructure in the State of Texas and the Nation.

Mission Statement

The mission of High Performance Computing at UT Austin is to provide the necessary facilities, staff, and support infrastructure to enable cutting-edge research in the development and deployment of advanced computational technologies. This mission will be carried out with a coordinated effort by UT faculty, staff, and students through activities which embrace the following thematic areas:

- 1) *Enabling Technologies*: The integration of emerging technologies to enable new capabilities in creating, accessing, and organizing digital-based information.
- 2) *Distributed Infrastructure*: The development and deployment of a geographically distributed infrastructure to integrate UT Austin and the State of Texas into the Nation's computational research community.
- 3) *Education and Outreach*: The application of advanced computational technologies to leverage leading-edge research programs into broad-based educational initiatives.

Scope

The charge of the HPC Subcommittee was to develop a long term strategic plan for the provision of access to high performance and research computing which will lead to research programs of national and international reputation at the University of Texas. This plan would be implemented through a series of policy recommendations for continued support and funding based on data collected over the course of the Subcommittee's investigations. In section 2, the methods and procedures for data collection are outlined. Section 3 provides an overview of the subcommittee's findings based on the data obtained, while section 4 provides an overview of the strategic plan with a set of policy recommendations and procedures outlined for its implementation. Section 5 describes a

budget justification which is consistent with the Subcommittee's findings and recommendations. Finally, section 6 provides conclusions of the HPC Subcommittee.

Background

In 1993, the National Science Foundation (NSF) commissioned a Blue Ribbon Panel to study HPC and the rapid evolution of computation and information-based technologies in academia [NAB 93-205, "From Desktop to Teraflop: Exploiting the U.S. Lead in High Performance Computing"]. The panel, chaired by Harvard physicist Lewis Branscomb, developed what has come to be known as the "Branscomb Computational Pyramid" which describes computational infrastructure as a "pyramid", with the apex representing the peak of computational performance and the base representing broad computational desktop systems. If this model for computational infrastructure is applied to activities within UT Austin, the picture which emerges is shown in Figure 1.

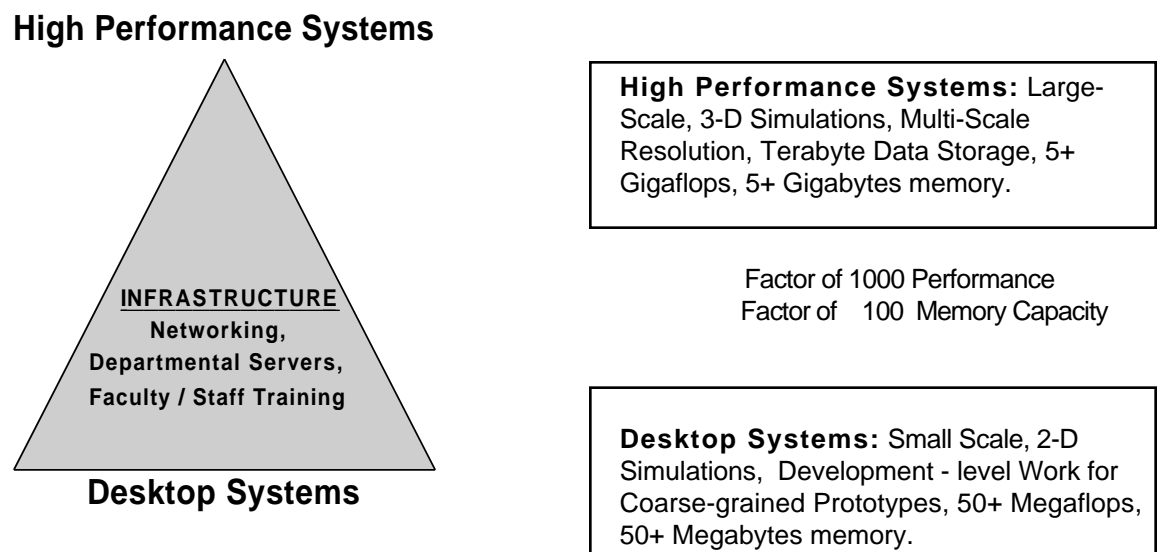


Figure 1. Branscomb Computational Pyramid for U.T. Austin.

The peak of the pyramid represents those system resources available at UT's High Performance Computing Facility (HPCF), while the base is represented by the thousands of PC's and workstations located throughout the UT campus. The middle of the pyramid is simply "Infrastructure" as applied to campus-wide networking, faculty and staff training, and departmental servers for support of distributed desktop facilities, software license distribution, web service, etc.

In recent years, UT's Faculty Computer Committee (FCC) has provided policy guidelines for desktop systems and department-scale servers as part of the on-going ITAC funded Vision Plans updated periodically by the individual Colleges. These plans provide a roadmap for charting the course of academic computing at the College and Department level. *There has however, not been a corresponding institutional plan or set of policy guidelines for continued support of high-performance, research-oriented computing for the peak of the "Branscomb Pyramid".*

In August 1996, UT consummated a partnering relationship with the University California at San Diego and the San Diego Supercomputer Center (SDSC) through a successful proposal to the NSF's Partnership for Advanced Computational Infrastructure (PACI) program. This partnership will provide additional funds for the operation and capital

expense of providing high performance computing resources in exchange for a significant fraction of UT Austin computing resources for the Nations' research community. The funding period will be for five years, with the possibility of an additional five-year extension following a fourth year review. This long-term commitment to the continued support of high performance computing demands a new vision for the role of high performance computing at the University of Texas and its overall economic impact in the State of Texas. Thus, the need to develop a sound policy and funding profile for continued support of campus-wide access to high performance and research computing is driven by several fundamental issues:

- (1) the recent announcement of UT Austin as a nationwide resource partner for high performance computing under the NSF's Partnerships for Advanced Computational Infrastructure (PACI) program;
- (2) the emergence of desktop systems, department-level servers, and other ITAC-funded resources fulfilling the role of educational computing, traditionally serviced through centralized resources at UT Austin;
- (3) the changing role of high performance computing to develop and deploy future computing and information-based applications through "Enabling Technologies";
- (4) the dependence on HPC technologies and applications by regional industries in the private sector;
- (5) the need to educate and train students and researchers in innovative applications of HPC and high-end information-based technologies (e.g. digital libraries, parallel databases) ;
- (6) the availability of high-speed networks to deliver critical bandwidths essential to making effective use of remote computer systems and newer interoperable technologies.

Vignettes

New technologies are being created through the integration of emerging technologies, e.g. scalable, parallel computers, high-speed networking, Java-enhanced browsers, etc. These so-called "Enabling Technologies" can be combined to create new capabilities for data access and data management with remote systems. Ultimately, the ability to create useful information, i.e. knowledge, from large data sets, whether they be generated through computation or experiment, will have a significant impact on the way research and education is conducted in the future:

A undergraduate student in the College of Engineering is interested in the complex flow of ground water in an anisotropic porous bed. Previously generated data from three-dimensional numerical simulations of these beds resides on a remote digital library at another university several thousand miles away. The data set of interest was generated on a Teraflop HPC system at extremely high resolution and is therefore multiple gigabytes in size. Through a web-based customized interface, the student is able to access the pertinent data, select only the subset of interest, and display the data in three dimensions. Images generated from the raw data may be sampled and stored as 3-D object files for further investigation on the student's local desktop system.

Distributed computing, coupled with high-speed networks, offers the possibility of remotely interacting with scientific equipment and other unique apparatus which might not

be available at local institution facilities. These “Interoperable Environments” open up new possibilities for education and research applications:

A faculty member in molecular biology wishes to collaborate with a colleague at another institution several hundred miles away. Their mutual interest is the application of a unique electron microscope which is located at the National Institutes of Health (NIH) in Bethesda, Maryland. Using a web-based interface, the two researchers are able to collaborate using a video-teleconferencing capability with compressed video. Simultaneously, they are able to access the electron microscope using a custom browser, which enables each researcher to select from a database of slide specimens for examination. Each researcher takes turn in remotely operating the microscope while simultaneously viewing high resolution images of the specimen transmitted over the network. The microscope is fully steerable and interoperable through software controls built directly into the browser.

High performance computing coupled with high performance visualization systems offers the potential for real-time analysis through Virtual Environments. These environments can be linked directly to desktop web browsers through emerging software technologies such as “Virtual Reality Modeling Language” (VRML):

A graduate student has developed a Computational Aerodynamics application to study flow past the Space Shuttle as a function of angle-of-attack. To analyze the results, she initiates an interactive job on UT's Cray T3-E located at Pickle Research Campus (PRC). Opening a socket to the SGI Onyx located in Taylor Hall, the application sends data pertaining to the flowfield at very high data transfer rates. Using the Onyx, a rendering program converts the raw data to three-dimensional streamlines which are continually updated via the high bandwidth network between the T3-E and the Onyx. The streamlines are “visualized” in an immersive environment, allowing the student to manipulate the angle of attack of the simulation by interacting directly with the visual image of the Shuttle. The student sees the resulting changes in the flowfield immediately and is able to navigate the flowfield in 3-D for in-depth analysis. A VRML file is created as part of the interactive session for a laptop presentation at a national aerospace conference the following month.

These examples of “Enabling Technologies” are not simply futuristic possibilities, but represent actual research investigations being carried out at *other universities and research institutes*: Interoperable Environments - Scripps Institute, Teraflop Computing - UCSD, Scalable Web Browsers - Syracuse. Although the technologies highlighted exemplify meritorious applications in science and engineering, it is clear that other disciplines would benefit greatly from these technologies as well - business, liberal arts, architecture, journalism, etc. A broad based infrastructure for HPC would serve to strengthen the research community at The University, while providing leverage for externally funded research opportunities.

2. Methodology

Data was collected by subcommittee members from a variety of sources, including policy and funding data from other peer-level institutions, industrial profiles in Texas and neighboring states, and funding resources for computing and information technologies from within The University. The major findings of the Subcommittee are provided in Section 3.0.

3. Findings

Using the data collected from peer institutions, the HPC Subcommittee have developed a set of findings with regards to the future role of high performance computing.

Finding 1: Compared to peer institutions around the nation, the total budget for high performance and research computing at UT Austin is insufficient to support a competitive computation-based research program of national recognition, even with the additional financial leverage provided by NSF PACI funds.

NSF PACI academic partners are shown in Figure 2, based on data collected from the UCSD and NCSA proposals. Facilities were ranked in accordance with the total number of CPU's (resources) available at each institution. The number of CPU's reflects not only overall system performance, but also the number of researchers which can be simultaneously supported, overall problem size which can be solved, and overall system throughput. First tier facilities were ranked as those sites having 512 or more CPU's, second tier facilities were ranked as those sites having between 128 - 512 processors, while third tier facilities were those institutions having fewer than 128 processors. *Clearly, UT Austin falls into the third tier category, making it computationally insignificant when compared to resources and facilities available at other PACI-funded institutions.*

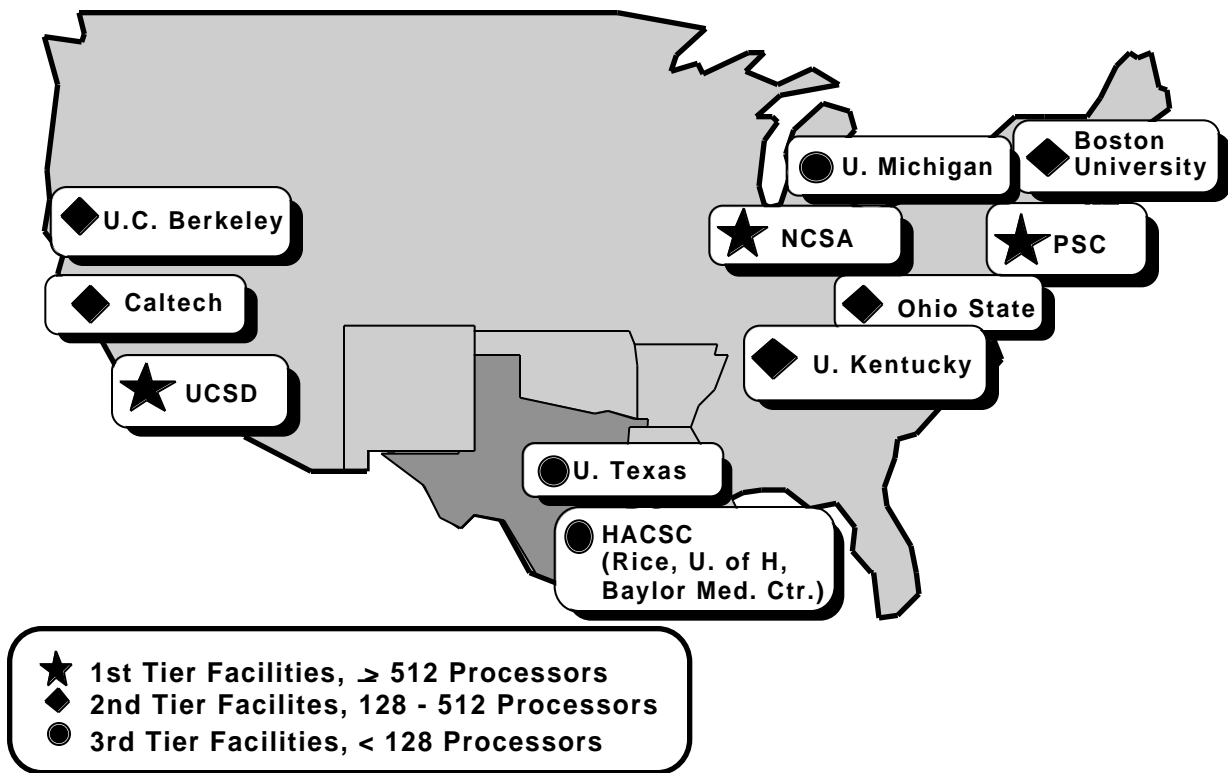


Figure 2. NSF PACI Program: Academic HPC Resource Partners.

It is documented that the University of Texas spends some \$65 million on academic and administrative-based computing each year. In a previous study by a Faculty Computer Committee Subcommittee on High Performance Computing, it was recommended that a minimum annual budget of \$1.5 million (in 1993 dollars) was required to maintain a competitive computational research program for UT Austin [FCC Report FCCGEN336, Policy Recommendations for High Performance Computing at the University of Texas at Austin]. Under the current PACI plan, the total budget commitment by UT Austin, for both capital and operational expenses for high performance computing and visualization is \$900,000 per year for the five-year duration of the program, or approximately 1.4% of the total university computing budget. Results from the institutional surveys show that this amount is disproportionately small when compared to other State-supported institutions (See Appendix I).

Finding 2: The State of Texas and neighboring states support an unusually high level of activity in high performance computing and related technologies. This level of support is derived from both private and government sources and is important to the economic vitality of the State of Texas.

Data was collected from a variety of computer vendor sources to capture the level of *non-academic* support for high performance computing, both in Texas and neighboring states. These results are shown in Figure 3. This high level of activity is rooted in the petroleum industry, which requires very high-end systems for seismic imaging and reservoir analysis. Results from these types of computations are used in design/decision support and are literally worth several hundred millions of dollars in revenue to the petroleum industry. This level of activity helps maintain a healthy, and diverse economy in the State of Texas.

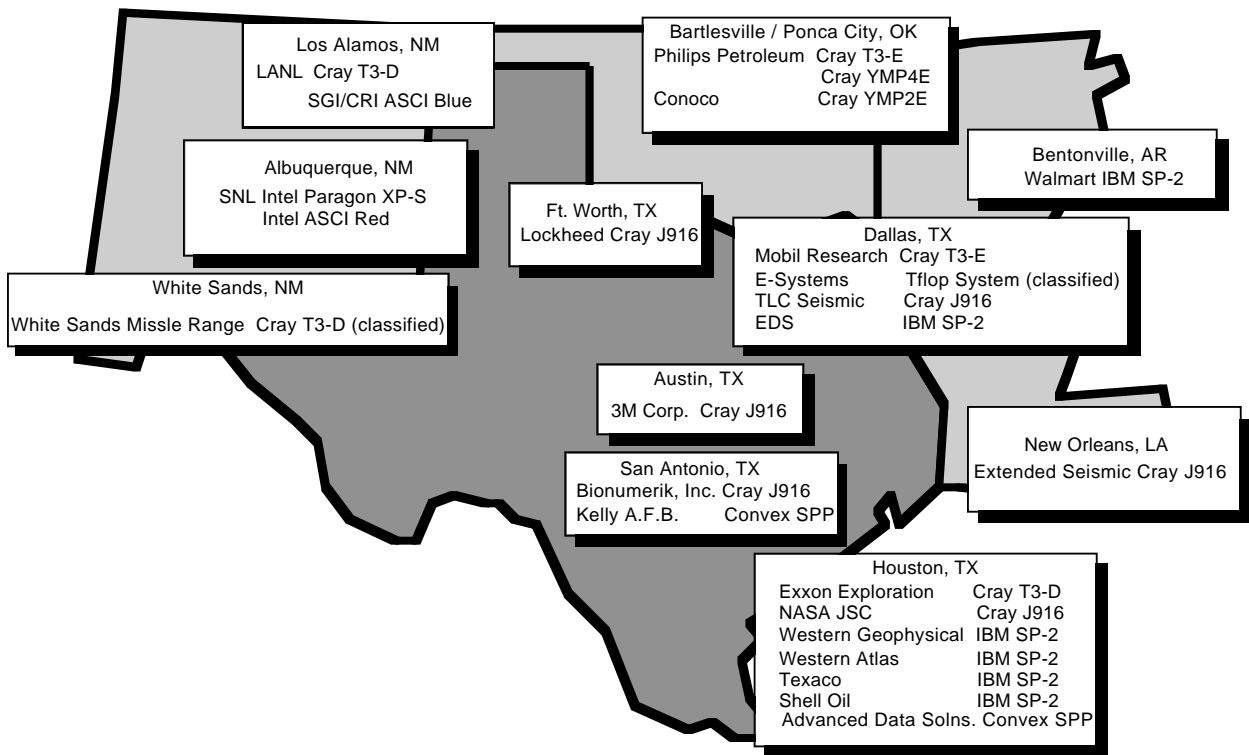


Figure 3. Southwest Industrial Activity in High Performance Computing and Communications.

It is important to the State that UT Austin maintain a strong leadership role in supporting high-end computing and information technologies, otherwise this leadership position could be easily lost to other institutions.

Finding 3: The role of high performance computing in research and instruction has changed in recent years, requiring a more flexible, dynamic infrastructure for the development and deployment of “Enabling Technologies”.

As evidenced in the recent NSF PACI competition, NSF Centers with aggressive, infrastructure-based research programs received continued support, while those Centers that were primarily service-oriented towards providing “cycles” to the Nation’s research community, were phased out. This trend represents a significant change in philosophy on behalf of the NSF, which established the Center’s program in 1985 as a means of providing access to state of the art computing systems by the nation’s academic research community. The advent of parallel, scalable computing, the potential for high-speed networking to the desktop, and the emergence of the web-based tools and collaborative environments are the primary factors affecting this trend.

4. Recommendations

Based upon the Findings, the Subcommittee recommends the following actions by the administration:

Recommendation 1: HPC Funding.

The HPC Subcommittee strongly recommends that approximately \$1.550 million be appropriated for FY98 for continued support of High Performance Computing and Visualization.

The Subcommittee recommends that these resources be provided by ACITS and that a Laboratory in High Performance Computing be a component of the ACITS budget. If additional resources are needed to fund this budget item, the Subcommittee recommends the creation of a Research Infrastructure Fee (RIF) to be paid by graduate students of the Colleges of Engineering and Natural Sciences. These resources will be used to offset the costs associated with providing a dynamic and evolving research infrastructure to support education and training in innovative applications of HPC, visualization, and related research computing technologies.

The Subcommittee emphasizes that there is presently no funding plan for HPC and related research infrastructure at U.T. Austin. The current budget commitment of \$900,000 per year for the next five years is inadequate to support a nationally competitive research program in computational science. The Subcommittee finds that \$1.5 million per year is the *minimum funding necessary* for a competitive research program and is comparable to funding levels for similar programs at peer institutions (See Appendix I). The additional funds (\$600K/yr.) would be used primarily for facilities enhancement and to insure that UT Austin maintains Second Tier facilities compared to other PACI-funded institutions. *It is imperative that The University take action to secure funding required to maintain competitive Second Tier facilities under the NSF PACI program.*

Recommendation 2: State of Texas Special Legislative Request.

The HPC Subcommittee recommends that appropriate action be taken to pursue a Legislative Appropriation Request (LAR) to provide State of Texas matching funds for PACI and related HPC programs.

Many of the PACI-supported Centers receive a direct state subsidy or utilize state funds as cost-sharing in the PACI program. Currently, there is no State of Texas matching funds which can be used as leverage to obtain additional funding from the NSF. Other states contribute directly towards high performance computing as a leverage for external funding, for example California (\$3 million/yr.), Minnesota (\$7 million/yr.) and Pennsylvania (\$2 million/yr.). The University of Texas should seek collaborations with other State institutions, notably Texas A&M, Texas Tech and other UT System institutions, in seeking this special appropriation.

Recommendation 3: HPC Management.

The HPC Subcommittee recommends that a Director of HPC be appointed to oversee facilities operation and ensure that the objectives of the PACI program are fulfilled.

Historically, management of the HPC program at UT Austin has been fragmented between UT Austin and UT System with policies driven by issues internal to UT Austin. In contrast, the PACI program will be driven predominantly by external issues which arise across the partnership. Success of the PACI program will require strong leadership to integrate UT Austin into the distributed infrastructure envisioned by the NSF. The University must have a full-time Director of High Performance Computing to oversee

facilities management and broaden the impact of HPC activities at UT Austin and regionally in the State of Texas. The Director will coordinate with the faculty in leveraging the University's HPC resources and associated infrastructure to create new research opportunities. The Director will work with the HPC Faculty Oversight Committee and document PACI-related activities for annual review by the NSF. The Director will also assist in the coordination of activities with the private sector, to assist in building further HPC partnerships for UT Austin. The Director will carry out these responsibilities within ACITS and will report to the Associate Vice-President for Information Technology.

Recommendation 4: HPC Oversight Committee.

The HPC Subcommittee recommends the establishment of a permanent Faculty Oversight Committee to provide usage policy and guidance in the provision of HPC and Visualization services.

The Faculty Oversight Committee will provide review and guidance to all activities related to the funding and policy guidelines for HPC. The committee will be chaired by the Associate Vice President for Information Technology. The Committee will be responsible for policy and budget oversight for High Performance Computing and Visualization at UT Austin. The Committee members will also be responsible for allocation of UT computing resources based on meritorious proposals for use of computer time. The UT allocation will be determined on a quarterly basis in accordance with the policy model proposed for PACI. Committee members will be selected by the Associate Vice-President for Information Technology and the Vice-President for Research. At least one member of the Oversight Committee should be appointed external to the University.

Recommendation 5: Periodic External Review.

The HPC Subcommittee recommends periodic review by an external review panel of High Performance Computing, Visualization, and related research infrastructure.

Based on the Findings of the Subcommittee, other institutions often employ an external review panel, to review their institution's activities and funding level to insure the quality and future viability of their High Performance Computing Program. The Subcommittee recommends the creation of an Industrial Review Panel to periodically review the high performance computing program at UT Austin. Their findings should be reported to the Associate Vice-President for Information Technology and the Vice-President for Research.

Recommendation 6: Broader Role for HPC.

The HPC Subcommittee clearly recognizes the broader mission of HPC under the NSF partnership and recommends changing the name of the High Performance Computing Facility (HPCF) to The Texas Advanced Computing Center (TACC).

High Performance Computing will have a major impact at the University due to the broad scope of activities which will be carried out under the PACI program. The facilities supporting this program will have a new mission and the Subcommittee recommends the change of name to more adequately reflect the depth and breadth of these activities in the development and deployment of advanced computational technologies.

5. Budget Justification

The recommended budget plan provides for the minimum funding necessary to maintain a nationally competitive research program in high performance computing and advanced visualization. The current UT budget funds HPC and related computational resources at \$900K per year. PACI resource funds provide additional leverage to this base funding, however all computing resources purchased with PACI funds are reserved by the NSF for allocation to the national research community. UT Austin will have little, if any, direct benefit from these resources. Within the current PACI plan, the next major system upgrade at UT will take place in mid to late 1999. *Unless additional funds are provided for cost-sharing this acquisition, UT Austin will only own 13 percent of the allocable resources, which is equivalent to 11 CPU's of the proposed 80 CPU system.* Even with PACI funds, an 80 CPU system is a third tier system when compared to the size and overall performance of systems available at other PACI-funded institutions. The budget recommended by the Subcommittee calls for an additional \$600K per year to be used primarily for modernization and periodic upgrades to University equipment and facilities. These funds will insure that UT Austin maintains competitive second-tier facilities through the duration of the PACI program. The NSF has planned a fourth-year review of the PACI program to consider an additional five year funding extension for existing partners or their possible replacement with new partners. *Without these funds, it may be difficult to justify UT's continued participation in the PACI program for lack of adequately funded computer facilities.*

A summary of the Subcommittee recommended budget as well as the current budget are provided below:

Recommended Budget Plan:

Budget Item	Required Funds
Operations	
Operational Expenses (Salaries, M,O&E, etc.)	\$ 631,145
Hardware Maintenance	129,257
Software License Costs	58,780
UT Capital Expenses	
Cray T3-E/J-90 Upgrades/Expansions	\$ 166,000
Visualization Upgrades/Expansions (I-Desk)	265,000
Carry Forward for 128 Gflop DSM System*	300,000
Total Funding for FY-98	\$1,550,812
*Note: 128 CPU DSM System	
Total Cost Estimate: \$5.2 million	
NPACI Funds: \$3.2 million	
UT Cost Share: \$2.0 million	
UT Cost-Share Summary:	
\$300K per yr. for 5 yr. duration of funding +	
\$500K previous Cost-Share Commitment	
UT's Share - 38 % of Allocated Resources	

**UT Allocation of DSM System:
128 Nodes * 0.38 = 50 Nodes of DSM**

Current Budget Plan:

Budget Item	Required Funds
Operations	
Operational Expenses (Salaries, M,O&E, etc.)	\$ 631,145
Hardware Maintenance	129,257
Software License Costs	58,780
UT Capital Expenses	
Cray T3-E/J-90 Upgrades/Expansions	0
Visualization Upgrades/Expansions (I-Desk)	0
Carry Forward for 128 Gflop DSM System*	0
Total Funding for FY-98	\$ 819,182
*Note: 80 CPU DSM System	
Total Cost Estimate: \$3.7 million	
NPACI Funds: \$3.2 million	
UT Cost Share: \$0.5 million	
UT Cost-Share Summary:	
\$0K per yr. for 5 yr. duration of funding + \$500K	
previous Cost-Share Commitment	
UT's Share - 13 % of Allocated Resources	
UT Allocation of DSM System:	
80 Nodes * 0.13 = 11 Nodes of DSM	

6. Conclusions

The University of Texas is positioned to play a leadership role in high performance computing through its participation in the NSF PACI program. This initiative will bring high visibility to the quality of the research programs at UT Austin and will provide tremendous educational experiences for UT students, both graduate and undergraduate, in the coming years. A short-sighted policy would view this opportunity as merely a substitute for University funding, rather than the strong leverage it provides for strengthening and broadening UT's research program in advanced computing. The visibility of this program is without precedent and the associated risks require strong leadership to insure its success. The findings of the HPC Subcommittee have clearly identified the importance of maintaining a nationally recognized program for High Performance Computing. High performance computing brings considerable resources to the University - both through the five-year duration of the PACI program, and also through additional research funds that are leveraged through sponsored research in the Colleges and Organized Research Units. The University of Texas must be successful with the PACI initiative if it is to secure a leadership role in advanced computing technologies for the State of Texas in the 21st century.

Appendix I Responses to University Survey Questions

1) How do faculty and researchers at your institution gain access to high performance and research-oriented computing services?

- a) Provision through institutional facilities.
- b) Provision through off-campus facilities.
- c) No provision for access is supported.

Univ. of Utah: Institutional resources (i.e. projects and equipment requiring large institutional matching funds are centrally operated and administered.

Univ. of Alaska: Both (a) and (b)

Univ. of Kentucky: Both (a) and (b), Kentucky is part of the National Computational Science Alliance (NCSA) and plan to use their facilities as well.

Univ. of Michigan: Both (a) and (b)

Univ. of Minnesota: The University of Minnesota contracts for supercomputing resources at the Minnesota Supercomputing Center (MSC), which houses a Cray C-90 and a 64 processor Cray T3-E. MSC is a privately held enterprise, located some two miles from the main campus and housed in University facilities.

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2) What organizational unit on your campus is responsible for providing shared access to high performance computing resources?

- a) Institutionally Supported?
- b) Department or College?
- c) Individual Groups or Research Institutions?

Univ. of Utah: Utah's Center for High Performance Computing reports to the VP for Research and operated and allocates the largest systems.

Univ. of Alaska: All of the above units and the Arctic Region Supercomputing Center.

Univ. of Kentucky: All the above - (a), (b), and (c).

Univ. of Michigan: Supported through College of Engineering.

Univ. of Minnesota: All of the above.

3) What type of facilities/services are currently offered?

- a) Access to Shared-Memory Multiprocessing Systems.
- b) Access to Parallel, Distributed Memory Systems.
- c) Access to Visualization Systems.
- d) Access to Special-Purpose Database and/or other Systems.
- e) Provision for Archival Storage Facilities for Data Management.

Univ. of Utah: All except (d)

Univ. of Alaska: All of the above.

Univ. of Kentucky: All of the above.

Univ. of Michigan: All except (d)

Univ. of Minnesota: All of the above. For shared memory Minnesota has access to a Cray C-90, and two 32 processor Origin 2000 systems by SGI. For parallel access, Minnesota provides access to an 896 CPU CM-5 (to be replaced), a 64 processor Cray T3-E, and a 14 processor IBM SP-2.

4) Of your institutions total academic computing budget, what fraction is spent in support of high-performance and research-oriented computing?

Univ. of Utah: Between 5-10%, but it is difficult to measure because there are large computer expenses hidden in departmental and college budgets.

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Univ. of Alaska: Less than 1% of State of Alaska funds support ARSC.

Univ. of Kentucky: Nobody has made an attempt to track this.

Univ. of Michigan: Difficult to say.

Univ. of Minnesota: Don't know.

5) Approximately, what is your institutions annual budget for both operation and capital expenditures in supporting high performance and research-oriented computing?

Univ of Utah: \$1.5 Million, including advanced networking.

Univ. of Alaska: Over \$10 Million. (Note: ARSC is primarily a DOD-funded facility)

Univ. of Kentucky: \$1.5 Million.

Univ. of Michigan: \$3.5 million (includes workstations in College of Engineering)

Univ. of Minnesota: Approximately \$7 million in direct state funding. Other facilities such as the Army's High Performance Computing Center at Minnesota have the largest funding and are funded with federal grants.

Chapter Nine:

Universal Student Computer Access

1. Introduction

One year ago, a task force concluded that universal student access to information technology services was “essential to ensure that our institution keeps pace with the Information Age Revolution and sustains its position as an institution of the first class, not only regionally, but nationally.” At that time, the goal of this task force was “to create an environment in which it will be practical for all students to use computers in their daily scholarly work.” The major obstacle to creating that environment was assumed to be ensuring that each student had direct use of a personal computer with basic software and an Internet connection for sufficient time each day to perform the tasks which are appropriate to work at the University. In fact the task force defined Universal Access to mean that “all students able to use a core set of information technology services on a daily basis, conveniently and routinely, in their academic program of study.”²

Today, the vast majority of the registered students at the University of Texas at Austin provide most of their own technology required to write papers, communicate with others, calculate numerical problems, analyze data, retrieve information from databases, and prepare presentations.³ Further, they accomplish these tasks by leveraging their own technology resources across an emerging highly distributed information technology system that includes an institutionally supported network, multipurpose servers and services, client machines in convenient locations, output devices, special-purpose labs, support, and digital content.

However, the differences in the configurations of these student-provided computing systems, including availability of modems and printers, in the computing skills and abilities of students, and in the patterns of usage of facilities and applications such as e-mail sharply illustrate how difficult “Universal Access” is to achieve. Nevertheless, at this point in time, the majority of students at the University of Texas at Austin are equipped to be active participants in an educational experience that takes advantage of information technology to enhance learning and better prepare them with the knowledge and skills necessary to succeed in an increasingly networked world.

Therefore the charge for this committee is to further the goal of providing students with access to the technology and services required for a first class education. Accomplishing this task requires that this committee (1) provide the University with adequate data about student computing for use in making recommendations for policy, programs and processes; (2) define a distributed computing environment that includes responsibilities

² Draft response to Strategic Question # 1, Southern Association Accreditation Report for The University of Texas at Austin, 1997.

³ Student Computer Survey, University of Texas at Austin, May, 1997.

related to student access for students, Colleges and the University; and (3) make recommendations that address key issues and responsibilities for each of those constituencies.

2. Methodology

A survey of University of Texas students was conducted in April and May of this year.⁴ In the beginning of the Results section, the bullet points describe the computer access of students at the University of Texas, highlight differences by ethnicity, gender and major, and identify differences between the students that provide their own access and those who do not, specifically in terms of use of campus labs.

Information about universal student access programs at three institutions was gathered through phone interviews and acquisition of documents. A brief description of the major features of these programs with demographic information about the schools is provided in the second section of results.

Additionally, several UT comparison schools were contacted by e-mail and information about computing use on their campuses was obtained through their participation on an interactive Web site⁵. The pertinent information is included in a comparison table in the third section of results. Finally, an interview with the director of the UT Student Financial Services office provides information about the possibility of providing funds to support student access to computing.

3. Results

3.1 UT Student Computing Survey

- **80% of the students provide their own private access to a computer.**
This access is primarily at their own residence, is most likely an Intel-based system (60%), includes a modem and a printer (70%). Most of these students use Microsoft Word, half of them use Microsoft Excel, most use a Web browser (83%) and many use e-mail (92%). What they do NOT do on their own machines is programming (<3%), statistics (1%), or graphics (<8%).
- **61% of the students rate their computing skills as good to excellent.**
- **60% connect to the campus network from off-campus and 40% connect at least once a day.**
- **90% have an e-mail account through UT and 68% use it at least once per day, with another 19% accessing it several times per week.**
Most of the students (79%) spend from 1-30 minutes on e-mail, using it primarily for personal communication (74%). 23% of the students, however, use it primarily for coursework.

⁴ The telephone survey, consisting of 1511 students was conducted the Office of Survey Research at the University of Texas at Austin. The survey included 71 questions that focused on the availability of computing technology, its usage for specific purposes, and the pattern of usage by time and location. Demographic information, such as gender, ethnicity and residency status allows for detailed cross-tabulations.

⁵ Insert inf. from Decker about how this operated

- Listservs, newsgroups, and ftp all used by about 25-30% of the students. Telnet is used by about 40% of the students, The Web is used by 63% of the students.
- 57% of the students reported accessing the on-line library catalog.
- 68% use a computer lab on campus. 36% report the SMF is their primary lab, with 13% citing the Business School facilities. The others were all less than 10%.
- Of the lab the students use most often, 28% use it on a daily basis while 48% use it weekly. 64% of the students use that lab on weekdays with the greatest percentage of usage occurring between 9 am and noon.
- Students use the campus lab on a frequent basis⁶ for the following: e-mail (.44), printing (.32), other Internet applications (.29), word processing (.29), programming (.12), games (.07), statistics (.07), graphics (.05), spreadsheets (.05), CAD (.03), presentations (.02).
- Overall, students are satisfied with the labs, (.82) with the lowest amount of satisfaction recorded for computer availability (.61).

The haves and have nots in terms of access do differ on this campus, but perhaps not in ways that were assumed. There is no significant difference in the GPA's or in the award of financial aid between the two groups. Nothing from the survey would indicate that access to a computer has an influence on academic performance as measured by the GPA, nor that access to a computer was correlated in any way with receipt of financial aid.

- Generalizing from the survey, approximately 6% of UT students that do not have access to their own computer have received financial aid. Approximately 15% of the UT students that do not have access to a computer have not received financial aid. Or put another way, of the students that have received financial aid, 76% of them have access to a computer that is not provided by the University.

If the receipt of financial aid is taken as an indicator of an inability to afford or find private access to a computer, fewer UT students fall in this area than those who presumably could afford to purchase or find private access, but have not done so. These students may also be at the margin, unable to qualify for financial aid and also unable to afford a computer.

No Private Access

In comparing the responses of those who do have access with those who do not, there were no significant differences in their assessment of the quality of services or the availability of computers from the campus labs. These students also did not differ in terms of their agreement with a statement about student responsibility for providing access to computers.⁷ Other differences between these two groups do exist however. The remaining statements highlight those differences, all of which are statistically

⁶ Frequent is defined as activity characterized as the sum of the responses under "several times per week", "daily" and "several times per day".

⁷ The statement reads: Students should be responsible for arranging for their primary access to a computer capable of word processing, spreadsheets, and connection to the campus network for e-mail and Internet services.

significant. The percentages given are for those without access first followed by those with access with the exception of the first item.

- Students without access are more likely to live on campus (30% vs. 20%) and to use campus computing labs (86% to 64%).
- Students without access are more likely to use general purpose computing labs (63% vs. 42%) and less likely to use specialized labs (23% vs. 42%)⁸.
- Students without access are far more likely to use a campus lab several times a day to several times a week than students with access (76% vs. 54%).
- Students without access use campus labs at different times than students with access, most significantly from 3 PM to 3 AM, with the greatest difference occurring between 6 and 9 p.m. (47% vs. 24%).
- Students without access are more likely to use campus labs for word processing (56% vs. 38%), for e-mail (81% vs. 49%), other Internet applications (56% vs. 38%) and printing (65% vs. 43%), but are less likely to use the lab for games (11% vs. 18%). In other uses of campus labs, such as spreadsheets, presentations, programming, simulations, CAD, and graphics, there was no significant difference between the two groups of students.

Students without access to their own computers need campus labs for both general purpose and specialized applications, while students with their own computers have far less need for general access, except to play games. In examining the time patterns of lab usage by both groups, students without access are more likely to use the labs after class hours, while students with access use the labs while they are on campus attending classes. So the labs, particularly the SMF appear to serve both as a safety net for students without any other access to computers and as a convenience for those with access.

Ethnicity, Gender and Major

Beyond the aggregate information about those who have access to computers and those who don't lies compelling statistically significant differences by ethnicity, by gender, and by major. The greatest number of differences are apparent with gender. Yet all of the differences speak to the need for multiple strategies to create and maintain an environment supportive of Universal Access by students.

Ethnicity

- Black and Asian students are less likely to have access to their own computers than Hispanic or White students (64% and 67% vs. 75% and 84%)
- Blacks and Hispanics are more likely than Asians or Whites to identify general purpose computing facilities as their primary computing lab.
- Asians and Hispanics with access to computers are less likely than Blacks or Whites with computer access to have access to a printer.
- Black students with access to a computer are far less likely than other students with computers to have a modem (24% vs. 11%)
- Asian students are more likely than others to have e-mail accounts supplied by UT (98% vs. 86%), while Blacks are less likely to use e-mail (11% vs. 1-7%).

⁸ General purpose labs include the SMF, CMA and dormitory labs. Specialized labs include Painter, CS, RLM, Business, Engineering and the Law School.

Gender

- Students without access to a computer are more likely to be female (56% vs. 46%). Female students are more likely than males to access a computer at a friend's residence (08% vs. 04%).
- Female students are less likely than males to use their computer to access the Web (80% vs. 90%) but only slightly less likely to use one for playing games (62% vs. 67%).
- More female students rank their computer skills as poor to fair (27% vs. 19%), while fewer rank themselves as very good to excellent (32% vs. 49%).
- Female students are far more likely to rely on family, rather than friends or institutional support for help with computer problems (23% vs. 09%).
- Female students are far less likely to connect to the campus network several times per day (24% vs. 36%), but more likely to connect several times per week (22% vs. 16%).
- Female students are more likely to connect to the network between 6 and 9 p.m. (79% vs. 73%), but far less likely to connect between midnight and 3 am (31% vs. 46%).
- Female students are less likely to use their e-mail accounts (07% vs. 04%) and far less likely to access it several times per day (22% vs. 32%).
- The vast majority of female students do not subscribe to Listservs (75%), while the percentage of males who do not subscribe is lower (59%). A more striking difference appears with the use of ftp servers, with 66% of the females never using them, and only 33% of the males answering the same way. Non-use of the Web is virtually identical for both genders.
- A greater percentage of female students have never used a computer lab on campus than male students (34% vs. 29%). Of those who have used a lab, a greater percentage of females use the SMF (44% vs. 29%).
- Female students are more likely to name a general purpose computing facility (57% vs. 38%) as their primary lab and less likely to name a specialized facility (25% vs. 48%).

Major

- Fine Arts and Pharmacy⁹ majors have the greatest percentage of students without access to a computer. Graduate Business, Law, Business Administration and the Graduate School have the most students with access to a computer.
- Fine Arts, Education and Liberal Arts have the greatest percentages of students rated themselves as poor to fair in terms of computer skills. Graduate Business, Engineering, Graduate School and Business Administration have the greatest percentages of students rating themselves very good to excellent in terms of computing skills.

3.2 Other Institutions

The institutions of higher education often noted in the press for their early adoption of comprehensive Universal Student Computer Access programs differ from the University of Texas in significant ways. These schools are either private institutions, state colleges

⁹ The Pharmacy numbers are small and this conclusion may be influenced by too small a sample.

or branch campuses of a larger University, and all are much smaller. Nevertheless, their programs provide valuable information to be used as UT seeks to provide an environment that supports universal access.

Wake Forest: private liberal arts college: Winston -Salem NC: undergraduate enrollment: 3,620; full-time faculty: 327.

- Began planning in 1993 to reform the academic mission to emphasize small classes, individualized instruction and faculty-student interaction. The technology part calls for every member of the Class of 2000 to be issued an IBM Thinkpad (laptop) which will be upgraded in two years and become the property of the student upon graduation.
- Ethernet connections are available in every faculty office and in each dorm room. Wireless network connections are available in 25 location across the campus with adapters available for student checkout from the library. Remote access is provided through IBM Global Network at a charge of \$17 per month which includes e-mail.
- Printers are available in all residence halls and in various locations across campus. Each student is allotted a print quota of 200 copies per year, with each additional costing \$.08 per page. Students are encouraged to use duplex printing whenever possible.
- Numerous file servers are available arranged in “neighborhoods” to simplify network traffic. Students are encouraged to post work for sharing with faculty and other students.
- Students pay \$22.50 per year for mandatory insurance that does not cover theft.
- Technical support is available through Computer Based training modules, Resident Technical Advisors in the dorms and a support center open for phone or walk-ins 7 days a week with the following hours: M-Th: 8:30 - midnight; F: 8:30 - 5; Sa: noon-5; Su: noon - midnight.

Sonoma State University; California State University system; Rohnert Park, CA: enrollment, undergraduate and master’s programs: 7,400

- Since 1995, students at Sonoma State have been required to have “assured access” to a networked personal computer. The University has made configuration recommendations, but the students have acquired the systems on their own.
- Students unable to afford a computer after seeking financial aid, loans or campus jobs that directly finance a computer purchase rather than provide cash are offered a year-long loan of a system from a University-supplied loan pool. The students have the option of purchasing the machine at the end of the year for 75% of the cost, dropping to 50% at the end of the second and 25% at the end of the third. Less than 5% of the students receive a loan computer.
- Network connections are available in all of the residence halls, faculty offices and docking ports are available in some classroom buildings.
- As part of the CSU system, the campus is now part of a larger universal access project across the system as described by Chancellor Barry Munitz:

“By the year 2005, every student, every faculty member, every staff member of the CSU will have access to information technology in her or his CSU environment. From cables and telecommunication facilities to Internet classes and live video conferencing, the CSU will be wired for the best the 21st century has to offer in the way of new resources that offer broad access to our programs and services. This is the future, and the CSU is preparing Californians to thrive in it.”

University of Minnesota: Crookston; Crookston MN: an applied technical education institution offering both 2 and 4-year degrees; 1,650 full and part-time students; 95 faculty

- In 1993, UMC provided each of its full-time students, faculty and staff, current and incoming, with an IBM Thinkpad computer for their use while enrolled or employed. The computers remain the property of UMC which acquires them through a lease program.
- The full-time students pay a quarterly access fee of \$300 that covers the cost of providing the computer, the pre-installed software, an extended warranty and insurance. Part-time students pay \$170 per quarter which allows them to check-out computers for class assignments. If they choose to pay the \$300 fee, part-time students will be issued a computer.
- Network connections are available in all residence hall rooms and docking ports are available in some campus buildings.
- Students have unlimited access to printing on networked laser printers located in residence halls, the library, some classrooms, and in public spaces.
- All students are required to take an introductory course that teaches them how to care for notebook computers and introduces the use of various application software package.
- The technology access fee is included in determination of student financial aid.
- The University provides lockers across the campus for storage of the computers.

3.3 Peer Institution Comparison Table

As the University continues to enhance its network capabilities, measuring its progress against a set of peer institutions provides valuable calibrations. These network criteria are all part of providing the institutional component of a universal access environment for students.

Institution	Enrollment	Access with Own Computer	Use Dial-up Access	Dorm rooms wired	Classrooms w/network connections	Docking ports	% of IT budget from fees
Indiana Univ.	33,000	40%	35%	100%	75%	No	20%
UC-Berkeley	29,000	75%	80%	100%	6%	Yes	0%
UCLA	37,000	50%	40%	100%	10%	Yes	0%
UNC-Chapel Hill Univ.	24,000	40%	20%	10%	25%	No	5%
Illinois-UC	35,000	50%	50%	100%	15%	No	5%
Univ. of Washington	35,000	60%	80%	75%	50%	No	0%
Univ. of Wisconsin		65%	60%	100%	100%	No	3%
Univ. of Texas	47,000	80%	60%	?	?	No	?

3.4 Financial Aid

The Office of Student Financial Services operates under Federal regulations that mandate that the estimated budget for assistance be equal for all students. Therefore, without a requirement of student ownership of a computer by a College or the University can additional funds be included. At this time, the MBA program through the Graduate School of Business is the only campus academic program with such a requirement and the cost of a computer is added to the student's financial aid package.

- If the University enacted a policy **requiring all incoming students (freshman, transfers, graduates) to own a laptop or desktop computer**, Student Financial Services would need to expand its staff and internal operation and find alternate ways to help students and parents find the money for the computer. The current cap of \$2,625 for a 12-month Stafford loan and the rising costs of education would suggest that a loan to parents would be the probable solution to finding additional funding.

4. Findings and Recommendations

Perhaps the strongest finding that emerges from an analysis of student computing data is a unarguable requirement for comprehensive information technology management at the University, a significant step beyond the current technology coordination efforts. Comprehensive information technology management, in terms of policies, clearly delineated responsibilities, and ongoing planning towards specific goals, is mandated

when the responsibility of providing resources and services is distributed across multiple constituencies, in this case, students, Colleges and departments, and the University administration.

Recommendation: Specifically, if the University of Texas at Austin is to achieve and maintain an environment that supports a concept of Universal Student Access to academic resources and services, significant steps should be taken by the Fall, 1997 to formalize the planning, acquisition, support and delivery of those resources and services.

1. This formalization process begins with the work of the Long Range Planning Committee, but should move rapidly from producing recommendations to implementation under the direction of the Associate Vice President for Academic Computing.
2. One aspects of formalized planning should include regular data gathering required to support information technology planning. This data should be reported not only to the University community, but also as part of the information exchange with peer institutions managed by the Office of Institutional Studies.

The rest of the findings are concentrated in four major areas: (4.1) Universal Student Client Machines; (4.2) Network and Other Technology Resources; (4.3) Support Availability; (4.4)Content and Services Availability.

4.1 Universal Student Client Machines

Finding: While students are increasingly assuming the responsibility for providing their own access to the University through privately-available equipment, some students are unable or unwilling to do so. These students without private access may lack the funds, skills or perceived need that would make acquiring such access easier. Further, these students are not concentrated in any one identifiable group, as might be identified by economic status, ethnicity, gender, or major.

Recommendation: ACITS should continue to operate a public access computing facility (the Student Microcomputer Facility) as a safety net for students unable to provide their own access to a client computer system.

1. Such a safety net would require that the majority of computers be capable of general computing tasks, rather than specialized applications, consistent with the usage patterns from the survey.
2. Upgrades to the facility should be made based on demonstrated need driven by annual assessments of student computing.

Recommendation: A loan pool of computers purchased with ITAC fees should be established that would make machines available for students wanting to acquire their own systems, but unable to find or qualify for resources.

1. A faculty and staff committee reporting to ACITS with representatives from Student Financial Services should develop a process for establishing and maintaining the loan pool.
2. The committee should establish a number of systems to be available on an annual basis, investigate and establish when possible a purchase program similar to Sonoma State, and devise an application and review system for evaluating student requests for loan equipment.

Finding: With the vast majority of students already owning or having access to a computer, requirements by the University or its academic units for acquiring a particular type of computer are problematic. This is particularly an issue in terms of requiring students to own a laptop computer. In many cases, such a requirement might require the student to acquire an additional computer. Further, issues of insurance, network access through docking ports, and use throughout the campus involve every aspect of the information technology infrastructure.

Recommendation: All current and prospective students, beginning with spring, 1998 semester, should receive annually a description of suggested client machine configurations recommended for academic work at the University.

1. The Faculty Computer Committee, working with representatives from ACITS and Administrative Computing, should take the responsibility for recommending these configurations to the Associate Vice President for Academic Computing. The FCC would base the recommendation on data from student computing surveys, information about network capacities and capabilities and an assessment of the computing requirements, including the availability of content in digital forms, of the academic programs.

Recommendation: Colleges or programs wanting to implement unique requirements for computers provided by students must submit plans to the FCC for approval at least one year before such requirements go into effect.

1. The FCC should evaluate all plans that require students to purchase or lease a particular type of computer as part of their academic program and submit a recommendation for approval or non-approval to the Provost. Particular attention should be paid to the burden of such ownership upon the student, particularly if it represents the acquisition of an additional computer; the solution for students unable to afford the required computer; the burden, if any, on the existing campus network and plans for addressing it; and the academic need to be addressed by the requirement.

4.2 Network and Other Technology Resources

Finding: If students assume the primary responsibility for the client part of a distributed universal computing system, then the University needs to provide the network, its infrastructure and other technology resources.

For students to use their computers effectively and efficiently in this environment, they need access to the University on a “borderless–timeless” or anytime, anyplace basis and convenient access to shared resources, including a variety of servers, special-purpose computing systems, printers, and software.

Recommendation: The campus network must provide for adequate access, defined in terms of bandwidth, ports and telephone connection required to support current usage patterns, for students, faculty and staff from locations both on-campus and remote, including those beyond the normally assumed geographic boundaries.

1. The Associate Vice President for Academic Computing should, in consultation with ACITS and Administrative Computing, develop a policy for supporting the telecommunications and network access needs of students, faculty and staff whether or not they are residing within a normally-defined geographic proximity to campus.
2. Supporting this policy should be a network and telecommunications plan that specifies a standardized general level of network service available to the entire University community, incorporates authentication processes, provides a growth projection for network capability and capacity, and includes a provision for “virtually -local” remote telephone access to the network.
3. The network plan should be reviewed and revised on an annual basis incorporating information about changes in usage patterns and demands based on survey data and advances in available technology.

Recommendation: While the University assumes the responsibility for funding and supporting the campus network for a specified level of service, the costs for additional services required by specific academic programs should be shared between the College and the University.

1. In a distributed system of student access, the needs of some academic units, particularly in terms of access to specialized equipment or performance of particular tasks may exceed the needs of the rest of the campus. Responsibility for providing the network infrastructure then must be distributed between the campus and the individual unit.
2. The FCC should, in their review of College Vision plans, make recommendations for cost sharing for projects that require a higher than general level of network services.

Recommendation: The University should standardize on a consistent and supported set of network access tools and client software, such as the UT Connect package, for use by faculty, staff and students with resources available on the campus network and Internet.

1. ACITS should continue to enhance and provide at a nominal cost the UT Connect suite of tools and applications for network access to provide distribution across the Web, especially for updates, and to include links to Web-based help for using the applications. Customization that can better achieve seamless integration across the various applications should also be a priority.

Recommendation: The University should provide networked printing facilities in residence halls including Married Student Housing, a majority of

academic buildings, and in public areas, such as the Union, with the cost of printing charged to individual or departmental accounts.

1. A committee should investigate and make recommendations to the Associate Vice President for Academic Computing for the implementation of highly-distributed printing resources across the campus. Some of the obvious issues arising from this recommendation include security, support, and maintenance. The committee should also recommend the number and type of printers to be made available across the network, including specialized output devices, such as those currently available through Central Duplicating.
2. Software support for these printing resources should be incorporated into the UT Connect package and detailed instructions made available over the Web.

Recommendation: Colleges, departments and academic units have the primary responsibility to provide student access to special-purpose equipment, software and resources required as part of a specific academic course of study.

1. The focus of College and departmental computing expenditures should be to provide for those technology needs that are specific to the programs of study and are not also provided for by the University.
2. The FCC, in evaluating College Vision Plans, should make recommendations based upon the fit between proposed projects and their applicability to the unique and specialized needs of the academic program.

Recommendation: The University should assume primary responsibility for providing, supporting and encouraging the use of general and specialized services or servers for accessing, storing, sharing, and communicating information within the University community.

1. ACITS should provide and support the server technology needed for e-mail, Web pages, archiving of instructional materials, storage of student materials, and new services such as video and audio delivery and chat. Use of servers, particularly for storing and sharing information, should be encouraged through outreach efforts to students and faculty.
2. The FCC should develop recommended policies governing the acquisition and operation of servers by individual academic units that are intended to be used by large segments of the campus community.

4.3 Support Availability

Finding: While students currently look to friends for the majority of their computing support needs, their increasing use of networked resources will require institutional support services. These services must be available when and where students need them, at all hours of the night and day, in residence halls, classrooms, and remote locations. Such diverse needs demand that the University develop and implement approaches that use a variety of methods to provide such support.

Recommendation: The University must develop and implement a distributed support system that is consistent with student computing patterns and needs.

1. ACITS should develop and implement a support system that could include a combination of information resources available over the network, walk-in and dial-in services closely aligned with student computing times (at least until midnight M-Th and with weekend coverage as well), and technology assistants in the residence halls.
2. Each College should be required to have a local staff qualified to provide information technology support for academic computing needs that links with the ACITS support staff.

4.4 Content and Services Availability

Finding: The vision of Universal access assumes that students accomplish academic work through their digital connections to the University. For some time, the chicken and egg issue of making content available to students over the network has stalled or at the least presented obstacles to the serious development of Web-based or other network-based content and services. The percentage of students with access to network capable client machines puts the responsibility for creating the virtual university back at the institution's feet.

Recommendation: As the University enrolls students providing their own access to computers capable of accessing University resources and services over the network, it should concurrently commit, through policies and dollars, to increasing the availability of resources and services over the network.

1. The Provost's office should require that all course syllabi be available over the Web by Fall, 1998.
2. Awards to faculty for the development of computer-based instructional materials should be increased,
3. ACITS and Administrative Computing should collaborate to produce tools and services that let faculty move course materials onto servers for access over the network.
4. Administrative Computing should make moving all types of student services to a Web-based delivery system a high priority.

5. Priorities, Obstacles, Interdependencies

To be addressed by committee this week

6. Conclusions and Cost Summaries

The University is blessed with a student body where the vast majority are already in possession of technology that allows them to participate in the information revolution that is rapidly transforming the ways we learn, teach, and communicate. To ensure that these students can use this technology as a critical part of their education requires that the University move quickly and decisively to provide the additional necessary resources and

services. But just as importantly as providing funds for these resources is the challenge of developing a comprehensive information technology management structure that can exert leadership in creating and maintaining a distributed computing environment that effectively works for all of the stakeholders.

The increased use of information technology as an essential part of education at the University of Texas requires an increase in the amount of funding dedicated to this purpose. Students are already making this investment, evidenced by taking responsibility for providing for their own access to computers. In some cases, that investment may have been possible only through a reallocation of existing funds, rather than an additional amount of expended funds. The University will need to look to both strategies to support its information technology requirements.

Chapter Ten: Outreach

Introduction

Scope of chapter: working group area

This chapter focuses on recommendations for using information technology to increase the effectiveness and scope of outreach programs at the University of Texas at Austin.

Our major thrust is that we must reconceptualize outreach at the University. Institutionally if not individually, we too often regard outreach as academic *noblesse oblige*, a “gift” to the community motivated more by a sense of duty than by a sense of the intricate interdependencies that link us with people, organizations, school systems, and communities with which we have little direct or evident connection. Too many of us regard the K-12 community as something wholly separate from the University, rather than seeing elementary and secondary education as integral parts of the same educational system to which the University belongs. We must learn to think differently: we must begin talking about an educational continuum that extends from K-16 and even beyond. We might even go farther: the phrase “K through Gray,” used by participants in a successful collaboration among Phoenix College, Longview Elementary School, and Xerox PARC, implies a commitment to the lifelong learning increasingly recognized as crucial to the success of American society in the Information Age.

University-community relations

A report (1997) by Jane Moore and Alan Turley of the University’s Urban Issues Program describes several stages in the evolution of thinking about university-community relations. One model descends from the medieval monastery: the university is set in a remote location so as to promote scholarly concentration by isolating students from the distractions of urban life: thus, for example, the Michigan legislature in 1817 established the University of Michigan in Ann Arbor, a long 50-mile journey from Detroit. By contrast, the land-grant universities of the late nineteenth and twentieth centuries were established—again generally outside major urban centers—to serve the interests of Western, largely agricultural states by making higher education more accessible to the citizenry and by applying research findings directly to agricultural (and later industrial) problems facing the community. Another direct-service model, this time with a focus on the problems of the urban poor and the disenfranchised, springs from the work of Jane Adams and the University of Chicago’s Hull School of Social Work in the late nineteenth century.

In today’s world, Moore and Turley argue, the urban research university must combine basic and applied research with community service. The university must meanwhile define its service mission not just in relation to the local metropolitan area, but also in relation to the state, the nation, and even the globe.

The foregoing brief review may help to account for attitudes toward the University being expressed in the current legislative session: the Legislature’s apparent interest in establishing greater parity between funding for UT Austin and for other institutions and systems around the state evidently stems from a conviction that the interests of the state are better served by a distributed model involving multiple, substantially “equal” institutions organized along land-grant lines than by a “flagship” research institution fed by a system of

smaller tributaries. This belief has very complex roots, but is traceable in part to a widely shared perception that UT Austin has been too much an “ivory tower,” a place where individual faculty focus on their own research while the institution tends its own interests rather than those of the community at large.

We cannot afford this representation of the University as an independent island. The University must treat outreach as a *strategic* issue, involving its competitive position and standing *vis-a-vis* other institutions and systems of higher learning across the nation as well as community and industry relations, student recruitment and retention, faculty training, and curriculum development and implementation. All of this in turn has important implications for budgeting and planning—and of course for fundraising.

Importance of information technology

Contemporary information technology makes this extension possible. It also allows, perhaps even requires, a double expansion of the idea of *service*, first by making our research activities more widely accessible and second by situating academic outreach in relation to the delivery of other services.

Narrowing the gap between research and teaching

One consequence of integrating classroom teaching and advanced technology has been an unanticipated but highly fruitful blurring of traditional boundaries between teaching and scholarship, as instructors have used technology to bring their early findings to students’ attention (and, conversely, to bring students’ intelligence to bear on the questions raised by research activity). As contemporary information technologies like the World Wide Web and networked learning environments carry teaching and learning beyond the physical and temporal limits of the traditional classroom and class-hour, then, these technologies also have the potential to involve the state’s citizens in research as well, as both participants and beneficiaries. Here the traditional lines between elementary and secondary schooling on the one hand and university education on the other, begin to blur in a productive way that suggests the value of seeking “redistricting” in other areas as well.

Changing role of public schools

A 1993 report on University/K-12 collaborations by the University of Texas System notes that demographic, economic, and cultural changes in American society have created a situation in which today’s public schools are expected to address and provide services to meet a host of social needs not traditionally understood as belonging to the educational domain. We must therefore develop new ways to coordinate academic outreach programs with other service efforts.

Background: technology status, needs, and challenges

Technology status

The technological infrastructure to support a significantly expanded, strategic conception of outreach is to some extent already in place, thanks in part to the University’s commitment to existing systems such as THEnet and TENET, as well as to new organizations like ITAL. University outreach programs will expand along with the growing campus- and statewide infrastructure.

THEnet

The Texas Higher Education Network (THEnet), operated by the University of Texas System Office of Telecommunication Services (UT System OTS), provides Internet connectivity throughout Texas to accredited, degree-granting educational institutions (public and private K-12 schools, community and junior colleges, and four year

and graduate level colleges and universities), and to governmental agencies at all levels of government. Connectivity may also be provided to commercial and non-profit research and development entities in Texas where the connection is required for the support of an on-going research program conducted within an institution of higher education or federal agency, or where the connection is necessary to support the fulfillment of contracts with federal agencies. Generally such a requirement must be documented by the "sponsoring" educational institution or federal agency as part of the approval process. THEnet services include direct connections of organizational LANs to the Internet at speeds of 56 Kbps and 1.536 Mbps (T1).

THEnet acts as a network number registry for its members, and is the registration authority for several domains in use within Texas. THEnet currently lists over 300 member organizations.

GAATN

Completed in 1996, the Greater Austin Area Telecommunications Network is a 300-mile fiber optic network that joins approximately 300 sites in the Austin Independent School District, the State of Texas General Services Commission, Travis County, the City of Austin, the Lower Colorado River Authority, Austin Community College, and the University of Texas at Austin. GAATN was originally intended to serve the needs of Austin ISD; the other five partners joined the project in order to achieve economies of scale and to improve efficiency. Valued at approximately \$12,000,000 GAATN is unique in the nation in that it involves seven different governmental entities.

TENET

Established in 1991, the Texas Education Network operates under the auspices of the Charles A. Dana Center, with funding from the Texas Education Agency. Subscribers may access TENET services either from schools with direct Internet connections, or dial in from home through a statewide network of modem pools and 800 numbers; dialup service is due to be increased under a new agreement with Southwestern Bell Internet Service. TENET also maintains a network of master trainers around the state, provides a mini-grant program and other programs to encourage technological innovation among Texas teachers. TENET maintains an extensive Web site offering resources and information to teachers, educational administrators, and educational computing specialists around the state.

TENET is currently in transition to a new client/server architecture which will permit the Texas Education Agency to provide one basic TENET Plus account, free of charge, per public school educator. (There are approximately 230,000 public school educators in Texas). The TENET Plus account will include the following services:

- Electronic mail
- Customer support provided by other educators
- Access to training and other professional development opportunities
- Curriculum resources correlated to the Learning Standards for Texas students (TEKS)
- Web resources, including access to lesson plans
- TENET newsgroups
- Databases (such as Project Unite and TESS)
- Planned Forums

ITAL

The Institute for Technology and Learning was established in 1996 as an Organized Research Unit, with funding from the Texas Education Agency and the University. ITAL's mission is to improve education by using technology to make the University's resources—faculty expertise, student talent, technological experience, library and museum

holdings—available to the K-12 community in Texas, thereby bridging gaps between the University and public schools, academic research and K-12 classrooms, technological innovation and pedagogical techniques. ITAL maintains a World Wide Web server and a listserv for teachers and other interested parties, and collaborates in the development of a text-based virtual environment maintained by the Computer Writing and Research Lab in the Division of Rhetoric and Composition.

ITAL is in the process of developing and testing a comprehensive approach to large-scale implementation of technology-based curriculum. ITAL is currently developing Web resources for a statewide project, *TX2K: The Texas 2000 Time Capsule*, which will begin in Fall 1997, and is providing support for *Utopian Visions '97*, a worldwide project that involves schools in eight countries on four continents. Other projects (and concomitant fundraising efforts) are in the planning stages.

Other UT resources

The University maintains a major Web presence. Information about key UT agencies and services, including course descriptions and syllabi as well as technical information prepared by Academic Computing and Information Technology Services (ACITS) and information from the General Libraries, is available around the clock to anyone with World Wide Web access.

The University offers electronic mail service to retired faculty. The Internet Task Force has recently recommended that the University offer electronic mail service to UT alumni as well.

Technology in the schools (TIF Master Plan stats)

Technological resources are very unevenly distributed across more than 6,900 Texas public schools enrolling 3.6 million children in 1,044 Independent School Districts. Almost half of Texas school children are classified as economically disadvantaged. The population of Texas is expected to reach 22 million by 2025; projected enrollment in Texas public schools in that year is estimated at over 4 million.

The Telecommunications Infrastructure Fund Board (TIF), Texas NetResults, and other federal, state, and local programs and private-sector initiatives are directed at connecting Texas schools, public libraries, not-for-profit healthcare facilities, two- and four-year colleges, and universities to the Internet. The TIFB is expected to distribute approximately \$1.5 billion over the next eight years. The Federal Communications Commission has recently issued a requirement that makes Internet service available to public schools at a sharp discount; the nationwide value of these discounts is estimated at approximately \$2.25 billion.

Technology needs

- Fast, reliable Internet connections for Texas schools, community service organizations, and UT community members (including alumni) involved in outreach activities
- Multiple Internet connections for each classroom in Texas schools
- In-home Internet service for families of at-risk children
- “Traveling” Internet access for school-age children of migrant and homeless families
- Up-to-date, centralized database with detailed information about all outreach activities at UT Austin and other component institutions.
- Transition to very high-speed, high-bandwidth network linking UT with schools statewide

Other needs

- Staff support for outreach efforts, including technical support
- Teacher training and development, over time and at times and places convenient for teachers
- Administrative training and development concerning management of 21st-century schools as information- and technology-driven organizations
- Appropriate educational and service models

Challenges

We face enormous challenges in the years to come. Some have to do with curriculum; others are demographic. Together, they exert enormous pressure on educational systems that were not designed to withstand such stresses.

The curricular challenge is most clearly evident in science and mathematics. Scientific knowledge doubles approximately every five years. This puts immense pressure on both university and K-12 instructors, who must learn continually. In order for K-12 teachers to prepare their students to do university-level work in science, universities must do a far better job of making new knowledge available and usable in K-12 education, for example by making research data more readily available and, where feasible, enlisting K-12 students in collecting or analyzing data needed by University researchers. We must also do a better job of recruiting and training outstanding teachers, and provide ongoing support after they leave UT for positions in the schools. The magnitude of the problem is suggested by the following statistic: only 28% of more than 226,000 Texas schoolchildren passed the newly mandated Algebra I exit test in 1996 (only 7% of students in grades 10-12 passed, while 67% of eighth-graders passed) (Associated Press, “New Algebra Test Tough on Texas Students,” Sept. 12, 1996: <http://texnews.com/news/algebra091296.html>). Again, the University must help K-12 mathematics teachers prepare students, not just for admission to the University, but for success in the workplace as well.

Demographic projections show a significant expansion in total population, as well as both the proportion of school-age children *and* elderly persons in Texas. Total population is expected to increase by 30%, to 22 million, by the year 2025; 20% of the population will be under the age of 14, while 23% will be over 60. Hispanics will become majority ethnic group in Texas. In the wake of the *Hopwood* decision, both the number of minority applicants and the percentage of minority admissions have declined sharply.

Meanwhile, the social function of the schools has changed significantly. Besides providing traditional academic instruction, the public schools are increasingly important providers of social services (e.g., health and community service delivery; see '93 UT System Report) to students, their family members, and other members of the community; this trend seems likely to increase as a result of changes in federal and state welfare laws. Such developments place new demands on school facilities which they are ill-prepared to meet. Education funding seems to be holding stable at best, and at worst is heading downward. As a consequence, the existing physical plant of our schools is often dangerously dilapidated, and in many communities funds for new school construction are difficult to come by.

The challenge seems clear: how to provide high quality educational materials and support to a growing, aging, and highly mobile population (many schools report a transiency rate over 20%) which is economically and culturally diverse, whose members will pursue multiple careers during their working lives. How can we develop programs to help teachers prepare students to qualify for admission and to succeed once they reach UT?

It seems equally clear that this mission cannot succeed without taking advantage of contemporary information technologies. The reservoir of technological expertise at the University is a great resource, as are the networks and organizations described earlier in this document (THEnet, etc.). We must develop administrative systems that maximize use of these resources.

Key issues and goals (objectives)

- Develop new educational cooperatives involving the University, public schools, and industry to ensure appropriate balance between private-sector needs and the long-term needs of society at large
- Create scaleable, sustainable projects through voluntarism, community involvement, and outreach to and from professional organizations, businesses, and others
- Seek contributions from private sponsors
- Maximize effective use of UT Austin and UT System technological resources (e.g., THEnet, TENET, component institution networks, modem pools, Texas Telecommunications Policy Institute, High Performance Computing Facility, special vendor relationships, etc.)
- Maximize effective use of UT's human resources, e.g., faculty, students, and staff, alumni
- Target particular areas of need that are not being addressed effectively elsewhere, and develop programs to address them extremely well.
- Make electronic information resources and appropriate training available to a growing, geographically distributed, highly mobile, and increasingly diverse population.

Benchmarks: Outreach at Other Institutions

The University of Michigan's Academic Outreach Program (AOP) is housed within the Office of Information Technology, and the Dean of Academic Outreach also holds an appointment as Vice Provost for Information Technology at the University. Michigan's \$8,000,000 outreach operation is responsible for an extensive array of college preparatory programs, K-12 collaborations, digital library projects, and other services including partnerships with the automobile industry. The University of Michigan On-Line (UMOL) makes University services and facilities available on a subscription basis to U of M alumni and their spouses, as well as families of currently enrolled students, and current and retired faculty. For more information, see <http://www.outreach.umich.edu>. (Web pages attached.)

Among the most impressive outreach projects at Michigan is a \$3.5 million program involving faculty and students in the University's English Composition Board, who act as mentors and writing tutors for students and teachers at Murray-Wright High School in Detroit, in one of the city's poorest and educationally least successful neighborhoods. This project has sparked considerable interest around the state, and has served as the lynchpin for an \$8 million effort involving corporate and community partners as well as the University and the public schools.

The National Center for Supercomputing Applications at the University of Illinois at Urbana-Champaign also conducts an extensive K-12 outreach program (Web pages attached); services include training workshops, curriculum design, and other activities. Beyond this, the University also supports a wide variety of local and statewide programs.

Chapter 10 – Outreach

Methodology, data pertinent to UT-Austin

We have relied on information gathered by the University of Texas System (<http://www.utsystem.edu/ns-search/k-12/home/pstoc.htm>), TENET, the Institute for Technology and Learning, the report *UT Links: Community Service and Outreach 1997* published by the Urban Issues Program, and other sources, including the Telecommunications Infrastructure Fund Board.

Findings

Pertaining to UT Austin

There is no single office responsible for overseeing UT outreach efforts, and no specific budget.

A 1995 report prepared by the University of Texas System estimates the total cost of all University/K-12 collaborations at University of Texas System component institutions at approximately \$50 million; this figure includes the value of cost-sharing and in-kind services as well as direct outlays. Total *listed* cost of outreach projects at UT Austin was \$10,541,465, with most of this funding derived from non-UT sources including the National Science Foundation, the Department of Education, the National Endowment for the Humanities, the Texas Education Agency, and a number of private foundations and donors. UT Austin has no specific budget for outreach.

There is little coordination and planning among University outreach programs.

Outreach efforts at UT Austin generally spring from the energy, good will, and expertise of individual faculty members. These projects, though often successful in their own terms, nonetheless lack coordination and integration; most academic units do not consider it part of their mandate to develop instructional materials that may be adapted to the needs of K-12 students and teachers. Many worthwhile projects fall short of achieving their potential impact through lack of follow-up, or because the technological infrastructure available at the time did not support efficient, cost-effective migration to a larger scale.

Further evidence of this lack of coordination appears in the fact that several different organizations on campus, such as the Institute for Technology and Learning and the Urban Issues Program, have conducted independent surveys of outreach activities—without being aware of one another’s efforts, or even of one another’s existence.

Most existing outreach efforts are limited in scale and scope.

With a few notable exceptions, most of the 67 projects identified in 1995 as collaborations between UT Austin and one or more K-12 schools or districts were not technology-based, and did not rely on information technology in significant ways. Most were limited to a few schools within a single district. A few projects (e.g., Reading Cohort Program, Geography Institute, Art Enrichment) involved an entire district; some of these placed student interns in Austin-area classrooms, while others focused on teacher training and staff development. A few (e.g., Marine Education Services, McDonald Observatory) reached thousands of students and hundreds of teachers from multiple districts. Projects in this category focused on bringing K-12 students or teachers to UT facilities for summer camps, institutes, and workshops. Only the Dana Center’s State Systemic Initiatives and AmeriCorps programs were designed to extend statewide.

New models have recently begun to emerge.

New models and processes for large-scale, systemic change are beginning to emerge, thanks in part to the World Wide Web. Examples include TxServe, the State Systemic Initiative, and the Texas Accelerated Schools Program, all in the Dana Center. In addition, four Area Studies programs within the College of Liberal Arts (Asian Studies, Latin American Studies, Middle Eastern Studies, and Post-Soviet Studies) perform national outreach work (e.g., Outreach Asia, UT-LANIC, etc.) with support from the U.S. Department of Education.

Few outreach projects take active advantage of alumni and other community members.

UT faculty rarely develop course materials with a view toward possible adaptation to K-12.

Pertaining to K-12

K-12 teachers need high quality, conveniently available professional development and training.

K-12 teachers frequently lack access to up-to-date information about research discoveries.

Strategies

Approach outreach as a strategic issue for the University.

Specific actions

Establish and fund an Office of Outreach Programs reporting to Associate Vice Provost for Information Technology

Develop a comprehensive approach to outreach

Institute and support coordinated planning for University outreach

Provide financial support to projects with statewide impact

Responsible group(s)

Executive Vice President and Provost

Resources available

Unclear

Resources needed

\$500,000-\$2,000,000/year

Timeline (years 1, 2, and 3)

Provide more effective training for K-12 teachers.

Specific actions

Pre-service training

Colleges and schools should develop effective programs to recruit outstanding teachers and train them in the use of instructional technology.

Such programs are already under discussion in two colleges. These should be high-profile initiatives.

Inservice support and training

Develop and implement technological infrastructure to support ongoing, two-way (or rather multi-channel) communication between UT faculty and classroom teachers throughout the state

Chapter 10 – Outreach

Design and implement virtual environments and tools to support cooperative and collaborative work

Develop educational technology practicums and courses to be offered via distance/distributed learning techniques

Responsible group(s)

Colleges and Schools; academic departments; ITAL; Dana Center/TENET

Resources available

Resources needed

Timeline (years 1, 2, and 3)

Year 1: Natural Sciences, Pharmacy

Year 2: Liberal Arts, Engineering, Communications

Year 3: Business, Nursing, GSLIS

Make up-to-date information about University and other advanced research available to K-12 classroom teachers.

Specific actions

Provide K-12 teachers and schools with free or low-cost access to online databases and other fee-based or restricted materials.

Develop information infrastructure to facilitate interaction between University-based research and student activities;

Responsible group(s)

General Libraries, ACITS, TENET, ITAL, academic units

Resources available

Resources needed

Timeline (years 1, 2, and 3)

Coordinate alumni and other volunteer participation in outreach activities.

Specific actions

Responsible group(s)

TxServe (Dana Center), project organizers

Resources available

Resources needed

Timeline (years 1, 2, and 3)

Priorities, obstacles, crosscuts (i.e., interdependencies)

Priorities

It seems to us that the highest priority should go to establishing an Office of Outreach Programs, to be charged with coordinating and planning large-scale outreach efforts at UT Austin. This office must be funded at a level sufficient to make a statement about the importance of outreach as a strategic tool that helps the University attract outstanding faculty, develop and maintain a pool of highly qualified applicants, and extend its impact throughout the state, during a period of increasingly intense competition.

Obstacles

There are two major barriers to making the University's outreach efforts maximally effective. One of these is lack of coordination. The Urban Issues Program report, *UT Links* (1997), notes that, historically, outreach projects have been allowed to grow more or less according to the will of the individual faculty members and academic units involved. This has produced many fruitful and exciting projects, but has also meant that the impact of those projects has necessarily been limited. It is now time for the University to recognize that new, highly flexible, and often information-based structures have emerged. We should ratify and institutionalize these structures, both in order to avoid unnecessary duplication and to permit concentration of resources on projects important to the University as a whole.

The second barrier has to do with money, and an understandable reluctance to cut valuable existing programs in order to support new, unproven initiatives. We must therefore seek ways to “expand the pie,” that is, to increase the pool of available resources so that new programs can be supported with new monies. At the same time, however, we must look for economical ways to use limited resources for multiple purposes.

Crosscuts

Much of the work outlined here is closely related to actions proposed by the Multimedia Instruction Committee, especially to those sections of the MIC report concerned with curriculum, integrated networked learning environments, and access to digital instructional resources. Wherever possible, we should develop and store digital instructional resources in such a way that the same resources may be easily used in multiple contexts for multiple purposes, e.g., in developing curricular materials for the K-12 community and in advanced courses at the University. By the same token, we should design our integrated, networked, multi-sensory learning environments from the outset so that they serve the needs of both the local campus and the statewide K-12 communities—not least by supporting collaborative interaction among faculty and students in both communities.

Conclusions and cost summary

Appendices

Web pages describing outreach programs at UT and at the Universities of Michigan and Illinois.

Chapter Eleven:

Business/Funding Models and Partnership with the Private Sector

In areas of the economy in which the underlying technology is moving rapidly organizations must struggle to be informed about current developments, especially as they affect the organization's mission. In the area of information technology (IT) no one organization can hope to remain informed by relying solely on in-house resources. Firms in the IT industries have found that one very good way to be on top of IT developments is to form strategic alliances with other firms in the IT industry. These alliances have become a fact of life in the IT industries and have been accepted as a standard way of doing business.

Strategic alliances represent more than just hand-shake agreements between or among organizations. Because they typically involve mission-critical aspects of an organization's activities, they are negotiated and maintained at the highest organizational level. Important alliances almost always involve the direct involvement of the chief executives of the organizations involved. They also involve more than just arms-length transactions. Frequently they involve the sharing of previously developed intellectual property and the joint development of new intellectual property; usually they involve the exchange of personnel—sometimes in the form of joint ventures established by the partners.

Historically, the University has not participated as an enterprise in alliance activities, and such activities at the level of organizational sub-units has been limited by organizational incentives and operating policies. In the IT area, limited alliance activity has occurred between colleges and private sector IT firms. More often such relationships have been characterized by the private sector firm acting as donor and the University unit acting as recipient—or the relationship has been of the contractor-contractee or grantor-grantee variety. Rarely have we seen full partnership activities or joint ventures in the IT area. It can be expected that increasingly IT firms will gravitate towards those educational institutions that can provide additional value from a relationship—value that very often will come best from an alliance.

The information technology providers on campus (General Libraries, Administrative Computing Services, and Academic Computing and Instructional Technology Services) can

also contribute to the these alliances. These organizations have a tradition of working to create strategic partnerships. There have been some notable successes. Recently, however, opportunities have existed that should have been useful in the developing of such alliances, but have not been exploited. The present campus-wide printing and micro-computer laboratory management system are examples of such. Unfortunately, these may be past the optimal time for industry to exploit. However, we should not fail to leverage such works in the future. A possible example is the public key authentication infrastructure and client software.

If the University is to survive and prosper in the digital era it is incumbent upon it to devise ways to partner as an enterprise with private sector IT organizations as a means of acquiring and developing mission-critical IT knowledge and competence. This means that this initiative must be a top-down effort and will require leadership at the topmost levels. Education of administrators and faculty in the development and nurturing of alliances should be a priority. (Fortunately this knowledge is resident in some of the IT firms that currently support the University). Current obstacles to alliance formation and operation must removed or limited through internal policy changes, through changes in state law (or interpretations of state law), and through the establishment of new organizational forms. The following are some suggested action items.

I. ALLIANCES

1- The senior executives of the University should articulate a vision for the University that promotes, in the area of information technology, alliances with leading private sector companies, government agencies, not-for-profit organizations and other educational institutions. This articulation should be framed to legitimize and motivate enterprise-wide relationships directed at enhancing the University's understanding and use of information technology in carrying out its mission.

2- The senior executives of the University should develop guidelines and procedures for alliance formation. These guidelines and procedures should be in accord with University policy (extant or revised) and should be designed to facilitate alliance formation on an enterprise-wide basis.

3- Appoint a task force to develop a program to educate faculty and administration about benefits and costs of alliance formation/maintenance. As an initial part of this effort a collection of articles and other educational materials on alliance formation and management should be established and the key materials should be summarized for distribution to the faculty and staff. As a second step the task force should establish speakers series on

alliance formation and management and invite both scholars and practitioners of alliances to share their knowledge and experience with the University community.

4- Working with resident expertise in schools and colleges such as the LBJ School, the Graduate School of Business, and in consultation with private sector information technology companies, the task force mentioned in (3) above should develop and offer a workshop on alliance formation and management.

5- The senior executives of the University should create a clearing house/coordination mechanism for initiating and managing alliances. This “Office of Alliances” should be responsible for identifying prospects for alliances, identifying areas in which alliances are needed, identifying University contacts for alliances, identifying and removing overlaps and inconsistencies in prospective and existing alliances, as well as providing the infrastructure for alliance management. This organization should report directly to the senior executives of the University.

6- The University administration should establish an annual pool of matching funds for IT donations/gifts in areas deemed mission-critical. There are areas for the application of information technology which are deemed critical to the mission of the University and for which the University is prepared to expend funds to provide the required information technology. Once these areas are identified, to attract IT alliance partners to meet the area needs, the University should have available matching funds that will defray the cost of the alliance to the non-University partner(s).

7- The Office of Alliances should encourage experimental forms of alliances, e.g., N-by-M-way alliances, joint ventures, work-study, faculty (staff)/executive exchange, and exchange of intellectual property by providing administrative support for such ventures. It is crucially important that the University learn how to establish and manage a variety of forms of alliances in order to provide a degree of flexibility with respect to this organizational form.

8- The Office of Alliances should be responsible for integrating alliances with placement of graduates via internship, for provision of research assistants, work/study and other cooperative programs involving students in the alliances. One of the key resources that the University brings to the table in forming and maintaining alliances is our excellent student body. Students represent not only a source of reasonably-priced, highly inventive labor but represent a pool of potential employees to the non-University partner. For the students, working with alliance partners is an excellent way of gaining experience and training.

9- The Office of Alliances should establish procedures/guidelines/facilitating mechanisms for cross-college or campus-wide alliances. There are numerous overlapping and

conflicting and sub-optimal alliances currently in existence at the University. Most of these are conducted on a college-by-college basis, and while they provide for a focused interaction they incur substantial overhead and ignore possible economies of both scale and scope.

II. IT FUND RAISING

1- Develop and articulate a vision for the funding of IT resources within the context of the broader fund-raising efforts. This vision should motivate and prioritize the raising of funds for IT as well as provide conceptual links between IT fund-raising efforts and efforts to raise funds for buildings, educational and research programs, and faculty endowments. In particular, the critical role of IT in the future of the University should be highlighted and brought to the attention of the University community.

2- The Development Office should participate in the development of a clearing-house/coordination mechanism for funding of IT as part of the Office of Alliances. In the past, the University has missed significant IT funding/gift opportunities due to lack of coordination among organizational units. These missed opportunities have included canceled IT gifts or discounts to one or more units because purchases by other units went to the potential gift-giver's competition, funding of duplicative facilities or services, lower than possible quantity discounts because University purchases were not aggregated, and non-realization of preferred relationships with IT vendors because relationships were formed at subsidiary levels.

3- As part of the preceding item, the Development Office should provide a mechanism for the identification and reporting of IT donations/gifts as a separate category of donations. This will enhance the coordinating and reporting functions of the Development Office with respect to IT and will emphasize the importance of IT resources to the University's future.

4- To mitigate the likelihood of IT resource acquisition taking place in a vacuum, the Development Office and senior University executives should, insofar as is possible, link IT resource acquisitions to educational/research programs. This will guard against IT resource acquisition that results in projects that consume more in the way of University resources than the commensurate value to the mission and goals of the University. In short, it will provide a mechanism for the University to say "No." to well-intentioned, but off-the-mark gifts or discounted purchases.

5- To enhance fund-raising for IT resources, the Development Office should, in collaboration with the DISC Committee and its various sub-committees, develop a

consistent set of promotional materials for IT alliances and IT funding. These materials should be both technically sound and should reflect the IT needs of the University.

6- Evaluate "the big picture" when dealing with corporations. The Development Office currently promoting partnerships with corporations which involve research, continuing education, recruiting, scholarships, internships, fellowships, chairs, curriculum, distance education, equipment, buildings and so on. It is extremely important for units of The University to work together in our search for technology resources. The Development Office is currently developing and implementing a prospect management system for individuals, foundations, and corporations which will improve communication and coordination. There are currently policies and procedures in place concerning fundraising and solicitation of corporations, thus education of faculty, staff, and administration is vital.

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Chapter Twelve: Developing Information Technology Policy

1? Introduction

- Scope

Generally, technology develops faster than our ability to understand its impact at a societal level. For an institution as large and complex as UT Austin, this means that we are absorbing and deploying technology without policy issues being clearly understood, let alone developed and articulated.

- Background

The key policy issues may be broadly categorized, for discussion purposes, as:

Access Policy. Access policy deals with technology resources that are available to faculty, students, and staff. Some issues around access are:
1) What is the policy of the institution with regard to providing access to what level of technology for faculty and staff? 2) What is responsibility of the institution for providing access to students?

Responsible Use. Responsible use deals with using University resources in a manner consistent with state and federal law as well as University policy and Regents Rules. How should responsible use policy be framed? Should it be a general policy regarding abiding by laws and university rules? Or, should it be a list of specific prohibitions?.

Records Retention and Management. Records retention and management deals with how the institution maintains information. Federal and state law as well as institutional rules affect this policy. For example, to whom does email belong? How does the institution deal with an Open Records request for the email sent to a student and existing on a backup tape for a central server?

Privacy. Privacy deals certainly with the traditional FERPA requirements. However, with decentralized decision making, a much larger number of faculty and staff handle information that is governed by FERPA. Further, since FERPA was passed in 1974, much more technology has been deployed. As an example, web servers log what user accessed which pages. If that information is personally identifiable, then privacy advocates consider it to be an education record

under FERPA that cannot be distributed without the written permission of the student. Can we even locate all such logs at UT Austin?

Copyright and Intellectual Property. Copyright and intellectual property deals with creation and use of information by faculty, students, and staff. Rapidly developing technology, that is easy to deploy, presents the institution with problems that were not possible in even the recent past. For example, anyone with an internet connection can setup an internet radio station (using streamed audio) to share his or her collection of recordings with the entire internet. How does the University deal with the copyright issues generated with these activities? How does the University communicate its policies so that the University community is well informed? As another example, two faculty members create a distance education course that can be used over and over again. Should they receive royalties for their creative work as they would have had they written a traditional textbook?

Ethics. All information technology policy should be based upon sound ethics. A forum should be developed for students, faculty, and staff to interact and debate the ethics upon which the policy is based.

- Vignette

The technology deployed across the campus is much better developed than policy regarding its use. While many conscientious faculty and staff work to protect student information, there are many that are unaware of requirements of federal law, let alone the more demanding requirements of ethical considerations such as: Is it appropriate to require students to post their pictures on the web for a class, department or college.

1. Methodology

A University committee on Computer and Information Technology Use Policy (CITUP) now exists. The CITUP committee, headed by Patricia C. Ohlendorf, counsel to the president and vice provost, is made up of representatives of the faculty, students, and staff. It is bringing together existing rules that apply to technology use and identifying areas with inadequate or inappropriate policy. If needed, the CITUP committee will make recommendations for additional policy. Under consideration are such issues as "Is advertising permitted on University web pages from University servers?"

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The CITUP committee's assignment is to produce a report or policy document that will likely contain:

- Assuring Responsible Use of Information Technology
- Authentication/Security
- Copyrighted Material and Trademarks
- E-Mail
- WWW Publishing Guidelines
- WWW Personal Pages
- WWW Personal Page Disclaimer
- WWW Advertising
- Political Activities
- Academic Advising/Student Records
- Access for Alumni
- File Retention/Backup

The CITUP committee discovered that it takes considerable time to provide a policy group with enough information so that the participants are equally knowledgeable.

The CITUP committee expects to use existing policy whenever possible.

For the purposes of campus information technology long range planning, the results of the efforts of the CITUP committee will be useful. However, there are issues regarding policy that CITUP has not yet addressed. For example, there is a need for an on-going group to deal with technology policy issues.

1. Finding XI.1 There is not an on-going body to address IT policy issues.
2. Strategy XI.1 A committee similar to CITUP should be established to deal with on-going policy issues, once CITUP completes its work. Its membership must include faculty, students, and staff. It should have two roles: 1) To consider new legislation, court decisions, and technology changes as they relate to institutional information technology policy, and 2) To act as an advisory board to those charged with implementing policy when issues arise that are not clearly covered by the policy or when the policy needs interpretation.

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The Administration, in the form of the Executive Officers, should constitute such a committee.

The resources needed consist of the committee and a staff person from ACITS and/or ACS.

The metrics are the number of policies created annually and the number of times the committee is consulted by those charged with implementing the policy. Barring some major event in law or otherwise, the number of policies created annually should decline over three years. Likewise the number of consultations with the committee needed by implementors should also decline over three years.

3. Finding XI.2 There is no educational program or public relations campaign to let the entire University community know of the policies and rules they are expected to observe.
4. Strategy XI.2 The Committee should promote awareness of the policies governing information technology use on campus.
5. For example, ACITS, ACS, and the General Libraries, could be charged with designing and implementing an educational program about campus information technology policies. Faculty, students and staff interests would shape the program.
6. Possible metrics are the number of complaints reported, which should decline over the three years. Other metrics could be number of advertisements regarding technology policy run, short courses taught, and the number of policy questions asked of help desks.
7. Priorities, obstacles, crosscuts with other chapters
8. Both of the strategies are essential. Clearly, the committee must be constituted first, but it must make the educational program its number one goal.

The major obstacle is getting the initial report from CITUP, given everyone's schedule.

Crosscuts with other chapters include administrative computing and the Intellectual Property Committee.

9. Conclusions and Cost summary

Without adequate policy and information about policy, students, faculty and staff make inconsistent decisions about the use technology resources. In such an environment, the University runs a substantial risk of alienating the public, if not incurring substantial liability for actions of members of the University community.

Strategy XI.1 has no incremental cost to the University because it uses only the time of the individuals involved.

Strategy XI.2 will have incremental costs for the educational campaign. This would most likely be for advertising and training, in the amount of \$10,000 annually.

The costs of developing and even implementing policy plus educating the University community are minor in comparison to the potential costs in liability suits and the impact on individuals' careers.