The Financial Mythology of Information Technology: Developing a New Game Plan

Can Small Colleges Be Technology Leaders?

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Reengineering Beyond the Illusion of Control

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50 E-Mail Etiquette: When and How to Communicate Effectively
by Joseph M. Saul, University of Michigan
At its spring meeting, the CAUSE Board of Directors identified an emerging challenge for the information resources management profession: now that our campus communities have discovered and embraced the enabling capabilities of networked information technology, how can we meet the escalating demand for related support services?

Crisis in support

This challenge is directly reflected in two of the nine issues articulated by the CAUSE Current Issues Committee for pursuit in the coming year—support for distributed computing and expectations rising faster than budgets. The latter issue, in particular, is prompting an examination of the prevailing institutional strategies for managing investments in information resources—especially information technology. In an article published in the Spring CAUSE/EFFECT, author John O'berlin laid the groundwork for challenging what he calls the “financial mythology of information technology.” In this journal issue, he proposes an entirely new game plan—reforming conventional wisdom, abandoning legacy-based technical and economic assumptions, doing the right financial analysis, and developing new financial strategies.

But small colleges can’t possibly afford the levels of investments in technology that O’berlin suggests are becoming common in top research universities, can they? Does this mean they can’t be technology leaders? David Smallen and Martin Ringle, from liberal arts colleges known for their effective management of information resources, examine numerous areas in which small colleges can and do provide technology leadership. In some of these—such as curricular applications, institutional efficiency, organizational innovation, and holistic planning—their small size and structural simplicity are great advantages, and in these areas they often can provide effective models for their colleagues at larger institutions.

At Central Michigan University, the crisis precipitated by rapid technological growth and consequent support demands was addressed through significant changes in the central technology organization. Through a strategic planning effort, CMU has implemented a matrix governance structure that authors Keith Nelson and Richard Davenport say “acknowledges the value of both distributed support and a strong central organization.” The resulting Technology Planning Board is working toward establishing technology priorities and achieving the best return on technology investments, while the matrix organization is providing improved support services by coordinating the efforts of local and central service providers.

New roles for CIOs

A recurrent theme running through articles in this issue is the need for strategic leadership for information resources at the institutional level to ensure that investments in information, technology, and services are aligned with the institution’s plans, creating “value chains” where they are most needed. Partnering with appropriate campus administrators and advisory bodies, chief information officers will also need to ensure that information policies are established and necessary support structures are in place to achieve widespread integration of technology in teaching and learning. The agenda for the CAUSE CIO constituent group meeting at CAUSE96 in San Francisco should be very full!

Business process change

Even as colleges and universities are searching for ways to afford perpetual investments in information resources, they continue to look for ways that technology can help them achieve efficiencies, especially in supporting restructured business processes. Two articles in this issue bear witness to the enabling capability of network technologies to streamline such processes.

Elazar Harel and Greg Partipilo share their experience in implementing an innovative system at UCLA that has eliminated all pre-approval processes and decentralized access controls. Their article (based on a paper that was a winner in the 1995 Society for Information Management Paper Award Competition) describes the “significant cost savings, faster turnarounds, dramatic cultural changes, and improved employee productivity” that have resulted from their reengineered post-audit process.

Similarly, according to author George Pipkin, a strategy at the University of Virginia to use electronic forms to downsize its data entry operation has led to the development of a prototype of an electronic forms system based on World Wide Web technology. Especially attractive about the system is its use of client software that is rapidly becoming a standard presence on every networked desktop computer.

As information systems and services continue to migrate to a network-centric environment, we can expect security issues to gain in prominence. See this issue’s Readers Respond department to find out what some of your colleagues are already doing today to authenticate access.

Julia A. Rudy, Editor
Process of Renewal

by Richard P. West

CNI observed its sixth birthday in March at the Spring 1996 CNI Task Force Meeting. Much has been accomplished in those six years, and we have seen a transformation in the way people perceive, consider, and use the Internet and the resources contained on it. Six years ago the popular press did not know of the Internet, and one of CNI’s premises was that now that the existence of an Internet was assured, an organization devoted to the scholarly uses of networked information was timely. Little did we realize—“timely” was an understatement! Our initial business plan called for sixty Task Force members, and before the year was out we had over 150 members paying $5,000 each. We now enjoy the support of over 200 CNI Task Force members, most of which are higher education institutions, private market information content providers, and software and hardware companies.

From the beginning, CNI has been viewed as a project under the joint sponsorship of the Association of Research Libraries, CAUSE, and Educom. Funding of the program comes from Task Force member dues, and the program development responsibilities rest with the very able CNI Executive Director, Paul Peters, advised by a nine-member steering committee. The steering committee is appointed, with three members named by each of the three chief executive officers of the sponsors—Duane Webster (ARL), Jane Ryland (CAUSE), and Robert Heterick (Educom).

Consistent with CNI’s charter, a review of mission and program occurs every three years. The first review three years ago caused the CNI steering committee and the sponsor’s chief executives to reorient several programs and initiate some new ones, as well as a healthy questioning of the purposes of the CNI effort. I would expect the same to occur with this three-year review. ARL’s and Educom’s boards have already endorsed a three-year renewal of CNI. The CAUSE Board has agreed to a one-year extension of CNI, and appointed a CAUSE Board committee to determine what would be needed to extend the renewal to three years.

Although CNI will continue, all three Boards are preparing their review of CNI to provide input to Coalition programs and projects. The CNI Task Force members have been polled for comments, and the members of ARL, CAUSE, and Educom are encouraged to send any comments they may have about CNI’s performance or next steps to me or to Paul Peters (paul@cni.org). The steering committee will be determining CNI’s program activity for next year in late July.

Enough about process—what about accomplishments?

In the first few years of CNI the working hypothesis was that there weren’t enough network resources available on the Internet and, if there were, how would one find them? Information search tools were rudimentary if they existed at all. Soon projects were identified that would assist these efforts. To provide better search mechanisms, Z39.50 demonstration projects on peer-to-peer database searching were encouraged, described, and monitored through CNI working group meetings. Creating experiments to develop new electronic-based information resources was a constant second theme in the CNI program. Examples include encouraging participation in the Elsevier TULIP Project for electronic journals (all participants were members of the CNI Task Force), and forming alliances with traditional content providers such as the American Association of University Presses. A third effort along the theme of creating networked resources was CNI’s incubation effort in helping the National Initiative for a Networked Cultural Heritage get started, thereby providing a focus for the efforts of the arts and humanities communities.

At the heart of CNI, however, is a theme of collaboration. The sponsorship and makeup of the Task Force membership reflect this theme, as does the way the Task Force meetings have been structured. Traditional scholarly information managers (librarians) and technology managers cannot make networked information work by themselves. CNI’s semi-annual Task Force meetings have created a forum for the intersection of technology and information in the networked world. Perhaps our most important contribution has been creating ways in which the best thinking regarding the creation and use of networked information can be shared.
Each Task Force meeting has a specific theme, and each provides opportunities to showcase and discuss projects that are not only related to that theme but also deal with innovations in creating networked resources, how to find and search these information resources electronically, and methods by which our existing campus organizations try to manage these new content-delivery mechanisms. Several years ago, an entire task force meeting was devoted to methods of finding and retrieving networked information. Such startling innovations as Gopher (you do remember Gopher?) and Archie, as well as other then-state-of-the-art search strategies (including the relatively unknown World Wide Web and NCSA Mosaic) were demonstrated by the developers.

As we conduct our three-year program review, I hear that the CNI program is no longer needed. Others comment that we have lost our strategic view. Others say we never had one! Yet, most commentators conclude that there is need to keep monitoring what is going on in the networked resources world. Although now we have many more networked information resources, the issues of how to find them on the network, how to pay for them, and how to foster still more innovation press heavily upon us. There is a new generation of challenges, many of which appear to have the same names as those on CNI’s 1990 agenda.

What are the issues on the horizon?

Networked resources and search techniques will continue to be paramount issues for CNI. New emphasis in the CNI program will be placed on projects that examine how users and institutions use the network and its associated resources. Where are the costs in this new environment for content and technology? Are we changing our local organizational behavior to benefit from the cost-saving potential of the network? Also among CNI priorities will be continuing to bring together librarians, technology managers, and others to assist in creating projects and forums about how we need to change our local behavior to benefit from the global Internet resource.

If there is a single most important theme for the next twelve-to-eighteen-month program effort for CNI, it would be planning and operating networked information resources and services in an enterprise-wide context. Projects will be identified to explore these efforts, but returning to my earlier observation that CNI is about collaboration and forming new partnerships, there will be a number of forums that bring together professionals to identify and work on solutions at the enterprise (campus) level. In addition to the Fall Task Force Meeting, which will have the enterprise-wide networking effort as its theme, there will be at least four regional conferences co-sponsored with CAUSE that will invite campus technology managers and librarians to explore how to work together better to exploit the networked information world.

When CNI started, I believed that an understanding was imperative of how networked information could transform scholarly communications and, therefore, our instruction and research missions in higher education. I believed further that librarians and technologists together could provide leadership in attaining this understanding. If there is any area in which CNI has been less successful than envisioned it has been in attracting these two constituencies in a balanced way to CNI projects and forums. The forums co-sponsored by CAUSE and CNI are one way that we are trying to remedy this situation.

Paul and I would particularly welcome your thoughts on creating an agenda that will attract technologists as well as librarians. This is a vexing challenge. Please send us your thoughts on how we can create a common agenda for developing and improving upon an enterprise-wide networked information strategy.

CNI offers a wealth of information on topics related to the challenges of the networked information environment. The CNI World Wide Web server, in particular, now offers an alphabetical index to the Coalition’s archives, including most of the reports and white papers generated by CNI Working Groups, as well as summaries of the Coalition’s Spring and Fall Task Force Meetings for the past several years.

Take advantage of this excellent set of resources by visiting the CNI homepage (http://www.cni.org/CNI.homepage.html).
Current Issues for Higher Education Information Resources Management

The CAUSE Current Issues Committee is responsible for proposing a list of current or developing issues and trends that are important to the future of information resources management and use in higher education. The following topics have been identified by the committee as key emerging or ongoing issues. We encourage articles for CAUSE/EFFECT on these and related topics.

Information Policy in a Networked Environment

Our institutions are learning to deal with the explosive growth of networking, connecting every part of the campus community and linking to colleagues and information resources across the country and around the world. Many of the issues colleges and universities are facing today relate to this proliferation of campuswide networks and Internet connectivity—free speech, censorship, student information privacy, ethical standards, and other information environment issues. Many institutions are moving toward establishing policies to deal with these issues. Such policies must be appropriately balanced between competing interests; to meet the needs of students and faculty who are participating in learning and discovery processes using network-based interactions, policies must promote the development of a community that is as rich, satisfying, and effective as the traditional academic community. Some issues that need to be addressed include:

- How do you know a policy is needed?
- Must information policy be comprehensive, or can it be developed in response to specific needs?
- What should an information policy contain?
- What is the best mechanism for creating policy, and who should be involved?
- Is an “acceptable-use” policy needed?
- How should institutional values impact policy (for example, open access versus privacy)?
- How can information policy be effectively communicated to the academic community?
- Should access to electronic directories be limited to on-campus only?
- Can the use of institutional computers be limited to certain activities or purposes?
- What do you do when the FBI arrives?

Support for Distributed Computing

As we make the transition from the classical model of mainframe computing with dumb-terminal access to a distributed model where greater intelligence is moved to the desktop, we are greatly increasing the complexity of the computing environment and pushing a significant portion of the costs of computing to the customer. This is happening at a time when, in most cases, central computing costs are not declining at a proportional rate, if at all. It is difficult to even define a “standard” client configuration for the desktop, and as a result, the complexity of the desktop usually exceeds the capability of the customer when problems occur. Departments, both academic and non-academic, typically have not had increased operational funding to cover the required technology support costs, yet they continue to purchase more and more hardware and software, making the need for technology support even more critical.

It is very difficult for the central information technology organization to provide all of the support needed by campus customers. Instead, technology support needs to be a partnership between the central support unit and the unit closest to the customer. If local units do not share in the solution to the technology support problem, the probability of a successful solution is low. Many implementation questions exist, among them:

- Should some central support staff be housed in departments or should individual departments provide their own support?
- Since central organizations cannot provide all of the support needed, should they outsource some of that support? If so, who should pay for it, the central organization or user department? Which services can successfully be outsourced?
- Are new budget paradigms needed to address the ramifications of distributed computing?
What is the role of information resources leaders on campus? Should we lead, follow, facilitate, and/or partner?

Integrating Planning for Information Resources with Institutional Planning

In theory, it is a basic; it is what we all say we will do. But in implementation, we find it often doesn’t happen. Both planning and information resources professionals grapple with the issue. However, there seems to be a model emerging from the small and community college sector where institutions have successfully incorporated planning for information resources—information, technology, and services—into their overall institutional plan. The common threads among these cases are that: the overall institutional plan guides all planning-related activity at the institution; information resources are an important priority for the institution (and noted as such in the plan); the president or chancellor actively leads the planning effort; the plan has explicit goals, activities, timelines, and benchmarks for assessing progress; and the plan is continually being refined. Given this, the issues become:

- What is the role of information resources leaders on campus? Should we lead, follow, facilitate, and/or partner?
- How do we assist our institutions in moving to a process model that works?
- If information resources aren’t identified as an important priority for our institution, how do we facilitate a change in thinking?
- What more do information resources professionals need to learn about the broader context of our institutions and the environment of higher education in order to shape our planning efforts?

Benchmarking Information Technology in Higher Education

Information resources organizations in institutions of higher education are showing a renewed interest in benchmarking. Benchmarking is a means for an institution to continually measure and compare against itself over time and against recognized leaders, the core processes and services critical to higher education in terms of costs, quality, and performance, with the goal of improving these. Through the HEIRAlliance (a collaboration of the Association of Research Libraries, CAUSE, and Educom), CAUSE is participating on a National Benchmarking Council for Higher Education established by the National Association of College and University Business Officers (NACUBO) to promote awareness and effectiveness of operational performance measurement. Benchmarking needs to include the following:

- Identify the key processes affecting performance
- Measure these processes
- Compare performance with “best in class” practices, then develop a strategy to equal or exceed these
- Focus on main opportunities for improvement that have the most impact

Issues for consideration include:

- How do we develop a benchmarking implementation and management strategy?
- How do we define appropriate performance measures for core processes and services, in terms of both results and how they affect other processes and services?
- What level of performance is our goal? What quality and costs of services do our customers want or need?
- How does benchmarking work with other approaches to performance improvement, such as total quality management (TQM) and business process reengineering (BPR)?

Development and Deployment of Integrated Digital Libraries

The digital library is much more than a highly automated traditional library. It is a library where much of the content is in digital format and is delivered to patrons electronically. As a purveyor not just of text, but of graphics, audio, and video, the digital library is face to face with some of current technology’s greatest challenges. Publishers of all kinds—on campus, at other institutions, and in the traditional publishing industry—are making scholarly resources available in digital formats that librarians must find appropriate ways to deliver. Librarians in the digital context adopt such tools as electronic full-text databases, LAN-based CD-ROM jukeboxes, and World Wide Web search engines in order to meet their patrons’ information needs. More than ever they must be familiar with non-traditional resources physically located outside the confines of the library stacks (but only milliseconds away in cyberspace).

- How can we apply methods from the library and information science disciplines to a broader array of institutional information resources, and help shape the evolution of library practices (organization, description, retrieval, delivery, and preservation) to a digital world?
- The credentials of the average reference librarian are very different from those of the average college or university “Webmaster.” What is the role of the college or university library in defining and managing the electronic information “face” the institution presents to the world through the Web?
• How do we extend the cataloguing, organizing, searching, and accessing standards and policies of the library to other campus information resources?
• What are the ideal relationships between practitioners of librarianship and information technology specialists?

Achieving Widespread Integration of Technology in Teaching and Learning
The transformation of teaching and learning with technology promises to accelerate over the next five years. As the necessary technology and support become more readily available, faculty will integrate World Wide Web, multimedia, desktop video, and other new technologies into the teaching and learning process to serve students on campus, within commuting distance, and at great distances from the institution. Other providers will enter and compete for educational services business.

Issues that need to be addressed include:
• What is the role of information technology in the transition from teacher-centered to learner-centered instruction?
• What is the information resources organization’s role in this transformation—leader, supporter, participant in the creative process?
• How do we help our institutions to approach this in a way that effectively plans for and leverages the investments that will be necessary in technology, process, and pedagogy?
• Is there a model for effectively supporting faculty in using technology in their teaching and incorporating it into the learning experience of their students?
• How do we address the policy issues and challenges raised by distance education?

Expectations Rising Faster than Budgets
As demand for information resources escalates, it becomes imperative that colleges and universities address the need to increase budgets to meet demand. What is the best way to do this?

Most institutions have a tough time with this issue because of the flat budget approach they take, which means that if the institution feels compelled to invest more in information resources, then something else must be curtailed. Dealing with priority setting is essential, and generally this is something that must happen outside the information resources organization.

Information resources managers need to demonstrate that demand for information technology and services is rising, using measures that will be meaningful to executive and/or budget officers: growth in the number of courses (with enrollment) using electronic information resources; number of faculty with hardware and software that need to be supported; number of students arriving with computers; number of data connections, rate of increase, size of backlog; number of packets of information transmitted over the network; number of computing cycles being used centrally; number of electronic mail accounts; and so forth. In addition, we need to demonstrate value for money. How has the institution benefitted from resources invested? Specific success stories may be more compelling than general data of the type listed above, and relating dollars spent to specific categories that executives can readily understand may be more meaningful.

A second component of this issue is managing expectations. How can information resources managers balance the services we promise against the resources allocated—and make it clear that we cannot take on more than those resources permit? Information resources managers must decide, in conjunction with the budgeting and planning process, what customer expectations can be met, addressing specific service levels and budget allocations. This level of service must then be communicated officially to the campus community (through official reports, plans, strategy documents, newsletters) and unofficially (through staff interactions with users).

Diversity in Information Resources Management
The issue of “diversity” encompasses more than looking at the ethnic origin or sex of personnel in our information resources organizations. We also need to consider diversity among our customers (students, faculty, staff, and the broader community), with respect to how we package and market our products and services in a way that best meets different technology adoption styles and paces. Diversity can include different learning styles, different types of interaction in teams, different levels of willingness to cope with change, and so forth.

Acknowledging and leveraging different viewpoints to enrich our work environment and better meet the needs of the institution can be good. Not managing the diverse work environment toward common aims can be detrimental.

• Why do we care? Different perspectives brought together constructively can lead to better outputs—we don’t end up doing the same old thing the same old way. Our workforce is a reflection of society (though not necessarily statistically equivalent—which can be a diversity issue of under-representation of minorities in information technology).


CAUSE’s CIO Constituent Group: Sharing Experience and Expertise

by Barbara Horgan

When the CAUSE constituent group for CIO’s meets—whether at the association’s annual conference or online throughout the year—the interaction is always stimulating. This article reports the results of discussions of this group that took place through an expanded meeting format at CAUSE95.

What do campus information resources leaders lose sleep over at night? What successes can they share with their peers? What are the greatest challenges in higher education information resources management? What is the role and future of the chief information officer (CIO)?

When the CAUSE constituent group for CIO’s meets—whether at the association’s annual conference or online throughout the year—the interaction is always stimulating. This article reports the results of discussions of this group that took place through an expanded meeting format at CAUSE95.

1 The term “chief information officer” in higher education does not have a clear functional definition. For some, a CIO is a senior-level administrator who participates in the institution’s executive council and who is responsible for institution-wide information resources management (including central computing and networking, the library, telecommunications, multimedia, printing, and so forth). For others, a CIO is a senior information technology officer who provides high-level oversight for information technology-related operations and who works in partnership with the college or university library head and advisory groups in planning for institution-wide investment in information resources—technology, services, and information.

Great challenges

Participants in the CIO constituent group meeting in New Orleans agreed that their greatest challenge comes from having their dream come true: the dream that technology would be accepted by colleges and universities as a powerful tool for instruction, learning, research, and administrative operations. It is no longer necessary to sell the benefits of information technology; now the issue is how to keep up with demands and with the rapid pace of change. It is both an exciting and a difficult time.

One solution to managing change and rising expectations proposed at the meeting is the formation of internal and external partnerships for financing new technology, providing support for its use, and collaborating on projects. Partnerships today are more broadly conceived than in the past. They consist of new relationships within the institution, such as departmental liaisons; outsourcing relationships with corporate partners (for Internet access, for example); and collaborations with other institutions for distance learning and application development. Many of these partnership topics, initiated at the CIO meeting, have continued to be addressed in the online discussion in more detail.

Excitement about new technological developments—such as the rapid adoption of the World Wide Web—has been tempered by frustration over meeting escalating demands for support with limited resources. Strong leadership, from the chief executive officer and senior information technology officer to faculty, staff, and students, will have to meet these challenges with new ways of doing business and a greater focus on collaboration. Obstacles to effective leadership and management of change, however, were seen in the conservative fiscal and decision-making climate of the academy, where traditional budget cycles, lengthy purchasing processes, and cumbersome committee structures conflict with the speed of technological change.

The role of the CIO

Within the context of a rapidly changing environment, the role and future of the CIO is in flux as well. What the title means and whether the position will persist were both debated. All participants agreed, however, that the CIO must take the enterprise view and maintain an institutional focus rather than a narrower technology perspective. Managing the information resources strategy is different from managing the information technology infrastructure, although in practice many CIO’s do both. Some emphasized that CIO’s must be influential; that is, their advice must be sought, and they, in turn, must seek opportunities for strategic planning involvement.

Conversation about the CIO’s future was less sanguine and reflects the pressure that many feel.
While CIOs can come from any background, many are technology-literate former faculty. Where they move after the CIO position is unclear. Some mentioned the corporate sector; others reflected on the rapid turnover of CIOs and the failure to move upward in the institution. Finally, there was a brief discussion about the future of CIOs managing the library as part of the information resources infrastructure. Even if the library is not in the CIO’s line organization, there is a converging boundary with information technology that needs attention.

Strategies that have been effective

Of all the topic discussion groups in New Orleans, the one that addressed effective strategies had the fewest number of participants. Our online discussions, in contrast, have focused a great deal on sharing strategies, in such areas as networking computer labs, effective planning approaches, World Wide Web policies, and setting standards. Perhaps most participants came to the New Orleans meeting ready to learn rather than to rehash the past; perhaps few felt they had unqualified successes to share. Whatever the reason, most of the strategies mentioned were financial ones: student technology fees, resale of long distance phone services to students, moving to a semiannual capital budget, and broad use of lease/purchase agreements.

Another general success described at the meeting was residence hall networking, which can generate revenue, keep students happy, reduce demand on labs, and provide better access to technology. Other effective strategies mentioned were selective outsourcing; using surveys to assess priorities; having former instructors as technology specialists, trainers, and consultants; and using an open systems interface to administrative data for wider, easier access. Key success factors for these strategies are careful politicking and well-planned implementation.

Management issues

Answers to the question of how to manage an information technology organization most effectively revolved mainly around planning, staff development, organizational structure, and leadership. While there has been quite a bit of online discussion about difficult legal, ethical, and policy issues, there was not much discussion in this area in New Orleans. Two specific recommendations for information technology planning that surfaced were developing and sharing a vision, and thinking of planning simply in terms of fast-track initiatives or projects that change. On the issue of whether to have campus advisory committees focused on information technology, participants were divided. Some suggested that surveys and focus groups were more effective than standing committees, while others had success paring the number of committees down to one high-level advisory group.

On the subject of staff development, ideas included budgeting seed money in training for new staff and then ensuring an ongoing training budget; investing in staff training in new technology and having orientations which assigned new staff to each major unit of the information technology organization (or to customer areas) for a period of time; and encouraging lateral moves within the department to provide good cross-training and career-development opportunities.

The leadership role in information technology is changing, most agreed, to one of facilitation, both within the information technology department and within and outside the institution. Consortia with other colleges and universities, cross-campus partnerships (such as network and multimedia training with the library) and innovative private-sector partnerships were seen as the direction for the future. The consensus was that neither CIOs nor institutions of higher education can succeed alone any more.

Rethinking information technology

Everyone is reorganizing, reengineering, reinventing. Higher education is faced with decreasing budgets, greater pressure for accountability and lower tuition, and demand for quality services and new ways of teaching and learning. Where does information technology fit into this picture? Are we suffering from the same problems, or are we the solution to the problems? Many ideas came out of discussion groups on this topic, although few were radical.

Some participants described dividing services into baseline (free) versus extended (fee-based or outsourced). Another distinction made was the need to rethink the terminology of academic and administrative computing and look instead at content, delivery, and support. Others saw community colleges as models of customer-focused institutions and examined what it meant to treat students, faculty, and staff as customers. Another suggestion was for institutions to invest in innovation, just as businesses support research and development; for example, universities could conduct research on pedagogy to foster adoption of technology in teaching and learning.

This is not the end ...

Although the CIO constituent group has been meeting for several years at the CAUSE annual conference, the format of a four-hour...
The Financial Mythology of Information Technology: Developing a New Game Plan

by John L. Oberlin

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.

The fundamental economic factors underlying information technology are unlike those of more traditional assets. Technologists are finding the new economics to be a slippery slope from which to develop new financial strategies. The rate of technical advancement is accelerating, standards and architectures are changing daily, and prices are falling. Nevertheless, the legacy-based management practices and financial strategies of both technologists and financial officers have changed little in the face of these new realities. The jargon of the technical community is rich with sound bites of financial understanding, yet void of any holistic financial plan to deal with the fundamental economics of information technology. Developing rational and viable financial strategies to accommodate technological change is an institutional imperative for effective information technology management.

The new economics of information technology

The fundamental forces driving the economics of information technology are: (1) the value of information technology is steadily increasing; (2) the demand for technology by institutions, faculty, and students is growing dramatically; (3) the acquisition price per unit of computing power is rapidly declining; and (4) the total cost of owning and maintaining technology is constantly increasing. At the same time, there is a constant, if not accelerating, rate of change in the underlying technology that makes the economic life cycle of many technologies surprisingly short. These forces change the fundamental economic equations that determine the wisdom of investing in and managing these technology systems. The new economics are briefly summarized below; a more detailed discussion can be found in an article published in the Spring 1996 issue of CAUSE/EFFECT.¹

Life cycles

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. Comput-

ers rarely wear out. Instead, they become economically obsolete and are replaced. The record of academic institutions is littered with examples of technology at every level—desktop PCs, departmental servers, campus networks, and shared regional supercomputers—that have become functionally obsolete long before their hardware stopped working.

Asset management

The principles of asset management that apply to buying a computer are fundamentally unlike those of buying a truck. If the physical plant purchased a half-ton pickup truck for $25,000, with an expected life of five years, it would have a capital cost of $5,000 per year. At the end of five years, the truck could be replaced with another truck that would cost more, but still be more or less functionally identical. Computers, on the other hand, are quite different. If the physics department purchased a $25,000 computer and amortized the expense over five years, it would also cost $5,000 per year. However, the physics department will be able to spend significantly less on the replacement and still receive a new computer that is superior to the one it is replacing. In cases where this is true, the rule of thumb for making computer purchases is to adopt a life-cycle model, where you buy as little as possible and keep it for as short a time as possible.

Financial pressures

As long as institutions can expect a continual improvement in their return on investments in information technology, they will be compelled to spend an increased percentage of their budget on it. It is a simple economic reality. Any organization in a competitive environment will be forced over time to invest more of its money where the return is greatest. In the case of information technology, where it pays to invest today, it will pay even greater dividends to invest even more tomorrow. This does not imply that technology budgets will expand to 100 percent of the institutional budget. It does, however, mean that we are in an era where technology budgets should be expected to grow steadily over a relatively long period of time.

The business case

Traditional wisdom governing technology investment decisions views the investment decision primarily as an expense issue. In reality, it is a cost/benefit issue, where the investment is in the goals of the institution as well as the individuals charged with advancing them. No dean or department head would fill a faculty vacancy based solely on the fact that one applicant might be less expensive than another. It should be equally ridiculous to make investment decisions for technology based solely on cost.

Competitive economics

The biggest institutional downside of new information technologies is their potential impact on inter-institution competition. For example, if distance learning enabled by technology becomes viable, it could drastically change the competitive landscape. One result would be to break down the regional barriers to competition. If there is new competition, the one thing we can predict with certainty is that there will be winners and losers.

What can institutions do to effectively manage their technology investments in light of these economic forces? What are the fundamental tenets of a new financial game plan for managing those investments?

Reexamine the conventional wisdom

The first tenet of a financial game plan is to reform the conventional wisdom. Campus constituents need to embrace the evolutionary nature of technology and the subsequent need for institutional change, reengineering, and change management. The need for change should not be seen primarily as a threat; instead, it should be embraced as an opportunity for advancing the institution and empowering individuals. The conventional wisdom needs to accept the tremendous promise of information technology without underestimating the total cost or overstating what it can currently deliver.

Plan for change

The paradox of planning for information technology is dealing with the rate of change. In times of rapid architectural and technical change, when the need for a viable plan is greatest, the tendency is to abandon planning because of the belief that the changing environment makes planning impossible.

While planning in this environment is difficult, it is not impossible. If the one thing known with certainty is that technology will change, then the one thing that must be planned for is change. Any financial strategy that impedes change is likely to suboptimize or even undermine the investments that rely on it. Moreover, in a competitive environment where information technology can be key, staying ahead of the technology curve may actually be a critical success factor for institutions.
Adapt strategies to the rate of change

The rate of change inherent in information technology systems and the computing industry shows no signs of slowing; if anything, it will continue to accelerate for the foreseeable future. The scholarly record is teeming with false predictions that technological evolution is coming to an inevitable end. Instead, it is becoming increasingly clear that we are not at the end of technology history. Financial strategies will need to support technological evolution so that technologists can optimize campus investments over time. Business models that require long amortization periods, ad hoc purchasing decisions, or monolithic architectures, will almost certainly drive poor purchasing decisions.

Create financial, political, and social infrastructure

Part of the mythology dominating information technology management is that it is all about technical issues. It can be argued instead that it’s actually all about managing change—technical, social, pedagogical, political, and financial. From this perspective, the notion of building technology infrastructure is inconsistent with the notion of constant and rapid change and should be approached with caution. A foundation to build on is one thing; long-term hardware and system investments that are inflexible or static are another. If the phrase “technology infrastructure” means stable hardware, software, or wires in the walls, it borders on being classified as an oxymoron. If it means “long-term” hardware or software, it is definitely an oxymoron.

This doesn’t mean there isn’t a need for technology infrastructure. However, it does imply that hardware and software may not be the most important aspect of technology infrastructure. The changing nature of technology suggests that standards, architectures, and resource allocation systems that allow us to manage changing hardware effectively may be the real infrastructure needed. More exactly, it’s not actually the standards or architectures that are needed. The real infrastructure imperative is to create the underlying processes that can produce the standards, architectures, and governance mechanisms to manage the changing technology.

In other words, the infrastructure most needed to support the information era is financial, social, and political, not technical.

Tell the whole truth

Information technology promises to deliver big benefits down the road, but there will also be big expenses. The cost issue is likely the most misunderstood and misrepresented aspect about the future of information technology. The reluctance of chief information officers (CIOs) and technology leaders at all levels to identify the total costs may amount to “the big lie” for information technology. Their reluctance to document these costs is often justified in the short run, as campus executives, presidents, and trustees cringe at the thought of such large numbers and threaten to shoot the messengers. However, CIOs and other technology leaders may be jeopardizing their long-term credibility and casting technology in a negative light by implying that many of the increased costs are unexpected.

If the biggest financial lie has to do with cost, the second has to do with the benefits of information technology. This is typically born from honest yet excessive enthusiasm. The case for technology is very compelling, but it is not a solution to all things, nor are all the promises deliverable yet. Overtelling the benefits may help obtain support or funding in the short term, but will almost certainly jeopardize long-term credibility. Financial planners and CIOs need to be careful to ensure that their business cases don’t inadvertently sow the seeds of skepticism as a result of overreaching.

Abandon legacy-based thinking

Considering the relatively short history of information technology, it is rich with legacies—legacy systems, legacy architectures, and legacy assumptions about the economics. Given the rapid change that is inherent in technology, planners need to be careful to constantly reexamine the assumptions on which financial strategies are based. Seven assumptions that bear on the financial case for information technology are briefly reviewed below. They include both legacy assumptions that are clearly no longer valid, and emerging assumptions that seem to be based more on wishful thinking than careful analysis.

Myth 1: Falling computer prices and commodity markets will reduce the total cost of campus technology expenditures. Like many of the myths, this is a seductive notion that is easy to buy into. The truth, however, is that falling acquisition prices do little to lower the total cost, and in truth may contribute to increases. As the acqui-

sition price falls, more users buy more technology. The growth in demand for more powerful computers and support is growing faster than prices are falling.

Myth 2: Cheap PCs with the power of mainframes are making distributed computing cheaper than central computing. Similar to the assumption above, this myth overlooks the increase in demand for computing power. More importantly, it fails to take into account the additional support costs associated with maintaining distributed computing systems. There are numerous studies by the Gartner Group that demonstrate the growing total cost of distributed computing.3

Myth 3: The marginal cost of supporting another software package, hardware platform, or standard is small. Much of the increased cost of distributed computing systems can be attributed to the decentralized and heterogeneous nature of the environment. The result is a highly complex web of computers and networks that is very difficult and expensive to support. Adding another brand of computer, software version, network protocol, or operating system causes the complexity to grow exponentially. The result is often a more heterogeneous environment and much higher total costs.

Myth 4: Information technology investments can be effectively managed through an ad hoc funding process. One problem with ad hoc funding is that it spawns ad hoc decision-making. This is fundamentally inconsistent with the need for information technology organizations to proactively manage change to ensure maximum effectiveness. A second problem is that individuals and organizations often have no faith that ad hoc funding will be there to replace their three-year-old computers. Therefore, they have strong incentives to purchase today the most expensive computer they can, a practice that leads to excessive spending as well as a loss of future benefits as a result of more timely upgrades.

Myth 5: Personal computers and distributed computing environments mean an end to central computing authority and enterprise-wide standards. PCs are highly valued because of the freedom of choice they give to individuals. Faculty, staff, and students can customize their computing systems to meet their personal preferences. The advent of PCs has clearly reduced the campus hegemony of central computing organizations. But this may be about to change. As stated previously, these environments are becoming increasingly complex and expensive to support, and campuses are under pressure to ensure that it all works together. Similarly, the need on many campuses for enterprise-wide solutions to networking, e-mail, and data storage problems is highlighting the necessity for a stronger central computing authority.

Myth 6: Emerging technologies and technology-based services will be cash cows for higher education institutions. There is a growing consensus that information technologies, and distance learning technologies in particular, will markedly contribute to the financial well-being of many institutions. This belief appears to have its roots in the notion that these new systems will truly disintermediate students from campus and faculty, thus allowing cost savings from reductions in faculty as well as bricks and mortar. There are problems with this assumption. First, the scenario implies that education would be transformed into a highly profitable enterprise. If true, it would spawn a whole new set of profit-motivated competitors that would either drive down prices (and thus profits) or force campuses as we know them today to change radically. In either case, there would clearly be very high costs. Second, even in the best-case scenario, the cost of acquiring and developing the new system will likely make the financial crisis worse before it makes it better.

Some Economic Myths about Information Technology

Myth 1: Falling computer prices and commodity markets will reduce the total cost of campus expenditures on IT.

Myth 2: Cheap PCs with the power of mainframes are making distributed computing cheaper than central computing.

Myth 3: The marginal cost of supporting another software package, hardware platform, or standard is small.

Myth 4: Information technology investments can be effectively managed through an ad hoc funding process.

Myth 5: Personal computers and distributed computing environments mean an end to central computing authority and enterprise-wide standards.

Myth 6: Emerging technologies and technology-based services will be cash cows for higher education institutions.

Myth 7: Higher education is leading the information technology industry in setting standards and functional requirements.

Myth 7: Higher education is leading the information technology industry in setting standards and functional requirements. Higher education has an important leadership role to play to ensure that emerging technologies deliver on the educational promise. However, the higher education community needs to be mindful that the educational marketplace is only 6 percent of the total technology marketplace, and that the large size of industry and household markets will continue to drive many of the important development decisions and directions.4

Do the right financial analysis

A frequent charge leveled at higher education is that it is falling behind the curve of what society is demanding of it. Investments in information technology are an opportunity to help close this gap. However, the decision to invest in educational technologies is often restrained by using either conventional methods of capital investment analysis, or no analysis at all, where the conventional wisdom tends toward ignoring hard-to-measure benefits. When a formal analysis is done, the value of technology is almost always underestimated because of a hesitancy to include anything but the most directly obvious benefits.

Adopt principles of strategic cost analysis

Technology leaders need to expand their level of sophistication when analyzing these decision points and begin adopting the principles of “strategic cost analysis” so their respective institutions can better understand the financial impact of these investments.5 Shank and Govindarajan argue that traditional methods of financial analysis of information technology investments need to be extended to a more holistic assessment that includes three strategic considerations: value chain analysis, cost driver analysis, and competitive advantage analysis.6 By doing so, organizations will be better prepared to judge the value of technology. Following the strategic cost management paradigm, institutions will be better prepared to: (1) identify technology’s impact on value-creating activities within the organization, (2) understand the cost structure that supports their strategic choices, and (3) realize the implications of how technology allows them to compete more effectively.

Understand cost/benefit and return on investment

The deciding criterion for investing in technology is not cost, it is cost/benefit. The financial game plan would be incomplete without an understanding of the appropriate scope for cost/benefit assessments. Analyzing investments in either central systems or distributed environments without considering the impact on the other, or on the larger institutional environment, will almost certainly produce poor results. As the demand for information technology grows, individual campus constituent groups will pressure administrators to place their respective technology needs ahead of others.

A challenge for central computing administrators in this environment will be to understand each of these perspectives and function as mediator in the funding equation to ensure that the sum of the parts continues to be greater than the individual pieces—a difficult prospect in a decentralized environment. The challenge will be to balance the demands of individual departments against the needs of the institution as a whole. Solving sub-problems does not solve the larger problem. It would not be unusual for a research university with 25,000 students to own 18,000 computers (not counting student-owned machines) with an asset value of $90 million dollars. Maximizing the return on these investments, department by department, may be much different from optimizing their return for the institution as a whole.

Take a life-cycle approach to budgeting

There is a great need to understand life cycles and to budget accordingly. Without this approach, colleges and universities will continue to make purchases that suboptimize their investments in information technology. If faculty, departments, and technologists continue to face an ad hoc funding equation when they plan for replacing their current technology, they will continue to make the worst possible investment decisions. Life-cycle budgeting can build confidence, promote coordination, and educate faculty, departments, and campus administrators. It shifts the emphasis away from the acquisition of technology and focuses the financial question on its replacement. The initial acquisition of information technology takes place only once; its life-cycle replacement should be considered a financial perpetuity.

Many skeptics of budgeting and planning for information technology view long-term planning for technology as an oxymoron. Although they may be right in some ways, life-cycle budgeting offers the best chance to prove them wrong. Learning this technique and using it is a critical first step toward overcoming the legacy-based planning biases of the past. Life-cycle planning can be used to: (1) avoid unplanned “expectation inflation,” where both planners and users continually underestimate the demand for future...

information systems; (2) combat unrealistic “life-
cycle optimism,” where planners are coerced by
their own false optimism or pressure from supe-
riors to adopt an overly optimistic estimation of
the true life-cycle of technology investments; and
(3) clarify the forces driving widespread, but
largely uncoordinated, “investment creep,”
where institutions, schools, and departments
continue to marginally expand their technology
budgets in an ad hoc fashion despite their best
efforts to hold them flat and deny the need.

Develop new financial strategies

The dominant financial strategies of the past
decade include: (1) positioning information tech-
nology as a vehicle for cost savings, typically
through simple automation applications; (2) sup-
porting distributed computing at any cost, with
the belief that personal computers would lower
the total cost of computing; (3) treating the fund-
ing gap as a problem to be solved by the tech-
nologists; and (4) posing acquisition decisions as
ad hoc funding considerations that are truly one-
time by nature. These strategies are inconsistent
with the new economics of information technol-
yogy, and if technologists continue to support
them, they will be their own worst enemies when
dealing with the economics. The strategic impor-
tance of information technology demands a reas-
essment of the financial strategies assembled to
support it, as well as the assumptions underpin-
ning them.

Plan on spending more

Institutions must plan to spend more money
on information technology if they expect to real-
ize the benefits. According to the Department
of Commerce, 1990 was the first year capital spend-
ing on the information economy (that is, on
computers and telecommunications equipment)
exceeded capital spending on all other parts of
the nation’s industrial infrastructure.7 The mes-
age for higher education is clear: the only cred-
ible financial strategy is to spend more or let the
technology wave pass by. Superior strategies will
focus on architectures and implementations that
support the enterprise, build synergy, and elimi-
nate redundancy. These strategies will offer op-
portunities for cost avoidance, but not cost re-
duction.

Articulate the business case

The case for information technology is that it
is a long-term investment in the competitive
standing and productivity of the institution. Infor-
mation technology expenditures do not directly
compete with personnel and are actually a nec-

should be considered an implicit part of the
college or university benefit package. It is not
unusual for a Research-I university with a student
body of 25,000 to spend $40 million a year on
information technology. Given the increasing
demand and the improving cost/benefit equa-
tion, pressure will mount to spend even more,
perhaps significantly more. In this environment it
will be critically important for senior officials and
chief information officers (CIOs) to have a good
grip of the numbers and strong financial con-
trols. Developing and maintaining the business
cases will rely on getting the numbers right. New
money will be hard to find without a fundamental
trust in the system that analyzes and manages
these investments.

Position the funding problem

Departments, schools, and central comput-
ing administrators will need to collaborate to
make the case for information technology, but
only financial officers, vice presidents, vice
chancellors, presidents, trustees, or even legisla-
tors will actually be able to solve the financial
problems. The funding problem needs to be
positioned within the bureaucracy at the ap-
propriate level to have it resolved. Telling a director
of academic or administrative computing that a
million-dollar funding gap is his or her problem
to solve is entirely unacceptable. Similarly, de-
partment chairs and deans with funding gaps will
have to pass some portion of them forward, as
they also can’t be solved solely in the academic
departments. However, the case of deans and
department heads is unique when compared to
central computing organizations. Part of the
funding gap must be resolved internally in these
departments as technology becomes a larger part
of their respective budgets. CIOs need to play the
lead role in bringing these individuals together
and outlining the cases to be made. Many institu-
tions will be looking at expenses of millions of
dollars a year (while larger universities will be
facing tens of millions of dollars) and will need
support and understanding at senior levels before
they can proceed.

Fund information technology as a perpetuity

The financial environment for evaluating
and managing information technology invest-
ments is very complex. These investment deci-
sions are rich with technical, architectural, and
management considerations. Moreover, they of-
ten involve questions of equity in how resources
are allocated, who benefits most, and how much
support will be available. These issues, com-
bined with the sheer number of decisions—
across central and decentralized units; among

7 Shoshana Zuboff, “The
Emperor’s New Workplace:
Information Technology Ev-
olves More Quickly than
Human Behavior,” Sci-
entific American, September
1995, 202-203.
faculty, staff, and students; and over academic and administrative units—perpetuate the belief that it is impossible to make rational holistic decisions about these investments. The natural tendency is thus to manage them as a series of ad hoc decisions.

There is, however, hope. The key is to separate the myriad of short-term technical considerations from the longer-term funding decisions. Consider faculty desktop computers. Life-cycle budgeting offers the opportunity to convert this chain of apparent one-time funding decisions into an annual expense. The basic life-cycle equation (*number of units x price/unit ÷ life-cycle years = annual cost*) converts the hardware expense of faculty desktops into a reasonably stable long-term perpetuity.\(^8\) The financial strategy is to identify the perpetuity and manage it over time. There will be many technical decisions that will vary over the years (what to buy, what standards, what architectures, what operating systems, and so forth), but the financial equation will be more permanent.

Even though the financial perpetuity is more stable than the technology, it will still vary and will need to be managed. The assumptions about quantity, price, and life cycle require continual review and updates. The financial management question is to determine whether the perpetuity is expected to decline, remain flat, or increase over time. The emphasis needs to be on the continuing cost over time, not the arbitrary cost of any particular year.

When this example of faculty computers is combined with other enterprise-wide technology service areas (e.g., networking, data storage, e-mail), a collection of perpetuities can be developed. The financial strategy thus expands to the notion of managing these expenses as a portfolio of perpetuities, where services will come and go, some will grow, and others will decline. The strategic imperative for the institution is to maximize the return on the portfolio.

Recycle old technology

Developing strategies to manage technology life cycles is a fundamental requirement of any new financial game plan. Technology rarely wears out, but it does become obsolete remarkably fast. The result is a clear need to recycle old technology on campus as well as off. Recycling old technology on campus has limited potential because it rests on two problematic options—one is to hand down computers from one department to another, the other is to hand down computers from faculty to staff. There are several problems with both of these cases, including: (1) the cost of physically redeploying the technology is high, (2) there are potential problems with equity between departments, (3) it assumes that the computers will be recycled before the end of their life, and (4) it assumes that there are campuswide network standards in place that will allow them to function at all. The greatest downside of recycling computers is the possibility of redeploying obsolete technology that would make the campus support problems worse, not better.

The challenge is thus to develop financial strategies that recycle old technology off campus. The best strategy to accomplish this may be leasing. Leasing has several advantages: (1) it sets a clear expectation that technology will be replaced on a regular life-cycle basis; (2) it shifts the burden of recycling to the vendor, who becomes responsible for disposition of the computers at the end of the lease; and (3) it offers the opportunity, depending on how the lease is structured, for the institution to recapture the salvage value of old technology before it goes to zero.

A leasing strategy that clearly commits an institution to a policy of life-cycling technology has tremendous potential. It represents an institutional commitment to managing change and is an example of the new type of infrastructure needed

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to manage technology evolution. It highlights the need to not just set campus standards, but to manage them over time. It also creates new urgency and opportunities to partner with vendors. In this scenario, lead vendors would be asked to play a greater support role, manage the transition from one generation of computer to the next, and participate in developing longer-term campus technology architectures.

Conclusions
The new economics of information technology demand new financial strategies to manage them. The tenets of a new financial game plan must include: (1) a commitment to change the conventional wisdom to recognize the new economic realities, (2) a clear resolution to abandon legacy-based technical and economic assumptions, (3) a shift toward better economic analysis of the investment decisions being made, and (4) an institutional resolution to develop new financial strategies that are consistent with the economic realities of the information era. Two of the most challenging strategies will be the commitment to spend a greater portion of the institutional pie on technology, and the need to manage technology life cycles proactively by focusing on replacement strategies and recycling.

While chief information officers, financial officers, and academic leaders will have to come together to develop and implement these strategies, it is the role of CIOs that is likely to change the most. When viewing information technology systems in aggregate, the CIO’s ability to bring information technology to bear on the organizational imperatives of his or her institution might be the single most important factor in determining how technology is valued.

It is not surprising that chief information officers have a difficult job when it comes to delivering a set of services whose value is difficult to quantify and hard to measure directly. To make the information technology function a valuable asset to their respective institutions, CIOs should view their job as adding value to critical areas. They need to know the critical success factors inherent in their institution’s plans and be able to link information technology to these plans to create value chains where they are most needed.

As strategists, CIOs need to provide more than just the technology infrastructure. They need to be actively involved in developing the business plans and financial strategies that close the gap between today’s realities and tomorrow’s promises. It may prove to be more important to have a chief information technology strategist than it is to have a chief technologist.

Current Issues...
(continued from page 7)

- What can we do? There are several things we can do, including: (1) build an action plan for promoting understanding and support for a diverse environment, (2) train people in how to recognize diversity and how to work with the different perspectives brought together in a diverse work environment, (3) perform cultural audits to provide data on your organization and then use that data when managing the organization or hiring new personnel, and (4) seek ways to diversify the workforce where such change can better lead to achieving organizational goals.
- What are the risks? One risk is that with a broadened view of diversity we may lose some emphasis on the critical issues of under-represented groups. Another is that faced with other pressures (changes in affirmative action legislation, budgets, changes in technology, shake-ups in higher education), we may not give this issue the attention it needs.

Electronic Data Interchange (EDI)
Electronic data interchange is a set of transaction templates defined by the X.12 standard that occur in a secure environment and permit application-to-application transmission of information. While several hundred templates exist for business purposes, EDI for education has only recently become available. For example, EDI permits the transfer of grades from a junior college to a four-year college or university. To date, the use of EDI by education has lagged far behind the private sector, where some companies only accept electronic transactions; for example, Ford Motor Company will only do business with suppliers that can process transactions by EDI. Certain services, such as credit card purchases for business purposes, may only be available if EDI is used to process the billing and payment transactions.
- What issues must be addressed for EDI to be effectively used in education?
- Do we have an accepted definition of EDI?
- What are the most likely applications of EDI in higher education?
- How will security and privacy be addressed?
- What are the costs of doing EDI? What are the savings?
- Does EDI require a value-added network (VAN), or can the Internet be used in place of a VAN? If so, how?
- How will the secure World Wide Web protocols affect the use of EDI?

“As strategists, CIOs need to provide more than just the technology infrastructure.”

Can Small Colleges Be Information Technology Leaders?

by Martin D. Ringle and David L. Smallen

Small colleges appear poorly positioned to be technology leaders. However, in these difficult times they have opportunities to distinguish themselves through focused applications of information technology resources in support of their missions. Taking a leadership role in technology can have significant payoffs as well as substantial risks. This article examines both the costs and benefits of technology leadership for small colleges.

Colleges and universities, challenged by rising costs, increased competition for funding, and a need to operate more efficiently, must consider the possible benefits and risks of information technology leadership. Small colleges are particularly susceptible to pressures on resources because of their inability to take advantage of economies of scale.

A distinguishing characteristic of small colleges is the scarcity of resources they can apply to the pursuit of technology goals. While all institutions of higher education are challenged by the cost of technology, small colleges are especially hard-pressed to provide adequate staff support, network enhancements, software customization, and equipment replacement to maintain campuswide technological currency.

Of equal importance, however, is the fact that small colleges generally emphasize teaching and learning as central features of their institutional missions, while placing less importance on the role of faculty research. Even at selective liberal arts colleges, where the scholarly activities of the faculty are rewarded through tenure and promotion, support for new technology is rarely a top institutional priority. Research universities and other institutions, by contrast, take great pride in their applied research achievements and the creation, acquisition, or deployment of the latest technology.

In a climate of scarce resources and with technology a comparatively low institutional priority, it is not surprising that both the faculty and the administration of many colleges believe that this type of leadership must be found elsewhere. Indeed, when strategic questions about technology arise, small colleges commonly look to large universities for solutions.

The problem with university paradigms

The difficulty with seeking technology mod-
els elsewhere, however, is that solutions that are appropriate for institutions like Cornell University or the University of Washington do not easily scale to colleges such as Hamilton or Reed. This is true for almost every aspect of technology deployment and support, from methods of funding and equipment allocation to strategies for the development of administrative information systems. There are, of course, exceptions: a graphics workstation for undergraduate chemistry instruction may be equally suitable at Ohio State or Oberlin. In most cases, however, technological solutions at small colleges cannot be obtained by simply “shrinking” the approaches taken by large universities. The list of technical and organizational differences is a long one. Consider just a few examples.

In a large university, administrative data processing operations often support a multitude of fiscally autonomous and semi-autonomous organizations. The complexity inherent in these types of environments typically demands institution-specific financial management software and, not unexpectedly, a programming staff of considerable size. Small colleges, by contrast, tend to have unified, top-down financial organizations, which neither require nor can afford a large staff of programmers. As a result, small colleges tend to rely more on relatively low-cost, off-the-shelf, integrated packages that need little customization and (at worst) a modest-sized programming staff.

Likewise, consider the differences in networking. Computing organizations at large, multicampus universities often view networking primarily as the provision of backbone services to a hegemony of “LAN fiefdoms.” Promoting university-wide protocol standards and maintaining interfaces for e-mail packages and other intergroup software tools is a full-time challenge. Small colleges, on the other hand, are far more likely to be responsible for designing and maintaining networking for the entire institution. Much of the large-university complexity brought about by interoperability demands is simply absent. As a consequence, many of the hardware, software, and staffing solutions suitable for a large university network are irrelevant to small institutions.

Further, universities have a long history of using technology fees and chargeback mechanisms to fund computing services, and restricting computing access to students in particular courses. These practices are foreign to small institutions, which generally finance educational programs through tuition charges and institutional funds.

Thus in many cases small colleges must seek technology leadership within their own ranks, or look to collaborative relationships with universities or peer institutions for workable strategies.

Some opportunities for technology leadership

Technology leadership defies precise definition. The most obvious type of leadership, the creation of new software or hardware technologies, is beyond the scope of most small colleges. Rarely can these institutions devote significant professional staff or financial resources to such endeavors. The result is that the impact of software development is usually confined to a small number of courses and disciplines at a modest number of schools. Further, hardware and software incompatibilities have limited the portability of such software to other institutions. Traditionally, therefore, the development of new technology has not been an easy avenue of leadership for small colleges.

The World Wide Web

The recent incredible growth of activities on the World Wide Web augurs a significant new opportunity for small colleges. Unlike earlier generations of software, preparation of Web materials may be accomplished without requiring a major investment in a large professional staff. The Web allows faculty at different institutions to build upon the work of others, often collaboratively, to enhance the learning environments for their students. This is a particular opportunity for small colleges because of their emphasis on teaching and learning. Further, the relative hardware and software independence of Web activities makes this collaborative process feasible for virtually any college. During the next two or three years, development of Web materials is likely to provide unprecedented opportunities for small colleges to exercise technology leadership, individually and in collaboration with others.

Curricular applications of technology

While large universities excel in many ways, most education professionals agree that the highest quality undergraduate instruction is found in small colleges. Using this as a foundation, small colleges can play a leadership role by finding ways to innovatively apply available technologies to enhance teaching and learning. A technology leader in this regard uses technological resources in new ways to address different learning styles, illuminate difficult concepts, accelerate the acquisition of knowledge, and prepare students for a lifetime of learning. For example, the Reed College chemistry department has redesigned large parts of its curriculum to incorporate

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4 Additional opportunities for leadership are implied in the Evaluation Guidelines for Institutional Information Resources (HEIRAlliance, 1995). This publication is available at http://cause- www.colorado.edu/collab/heirpapers/hei2000.html

5 In spite of these hurdles, however, faculty at several small colleges have created instructional software of distinction that has won national awards and enjoyed broad dissemination.
“Colleges are recognizing that all technologies and information resources need to be tightly coordinated in order to achieve optimal institutional strategies.”

Institutional efficiency

Operating in an efficient manner helps to reduce the costs of achieving the institutional mission. The use of technology has become almost mundane in the daily operations of higher education institutions—we can’t imagine how we could do business otherwise. However, truly innovative applications of technology, which redefine, in some sense, the way business is done, are still rare and characteristic of strong leadership. Technologies that enable us to do more effective student recruiting, to track prospective donors with more precision, or to analyze financial aid requirements more reliably, without adding staff, help colleges operate more cost-effectively.

At Hamilton, for example, Career Services has been substantially transformed by using Web technology. All recruiting opportunities for students are published on the Web. One average day, more than thirty changes are made in contact persons, telephone numbers, deadline dates, etc. Over the course of the semester, using the Web allows career services personnel to reinvest hundreds of hours of staff and student time while making information about recruiting available to students any time of the day or night. But perhaps the most exciting change is Hamilton’s involvement in a cooperative venture to share the expertise of career services personnel—nationwide—through a Web effort called the Catapult. These activities not only promote efficiency, but improve the quality of services provided.

Institutions can also demonstrate technology leadership in the way they provide services that address important needs in the campus community. Thus, for example, Occidental College has provided students with a graphical utility for remote registration which is friendly, efficient, and radically superior to the traditional methods of registration. Other colleges that have reviewed the Occidental approach view it as a valuable model for the design of their own registration systems.

Access to electronic resources

While some traditional metrics, such as the total number of computers on a campus, may be little more than public relations fodder, the ability to provide students, faculty, and other members of the college community with excellent access to electronic resources presents a genuine opportunity for leadership. Institutions can achieve a good deal of recognition for providing high-speed, reliable, and secure network access from anywhere on campus, including offices, classrooms, labs, dormitory rooms, the library, and so forth. Increasingly, colleges are also providing friendly means of off-campus access to faculty, alumni, parents, donors, and others associated with the college. Swarthmore and Trinity University (Texas) have both received national attention for their innovative approaches involving electronic services for alumni. Hamilton’s collaboration with Cornell University’s Institute for Social and Economic Research (CISER) has provided faculty and students with access to vast social science databases and the expertise to use them—access and skills that would otherwise be unavailable in a small college setting.

Organizational innovation

In an era characterized by so many changes and challenges, colleges need to have information technology organizations that are nimble, fluid, and maximally responsive to users’ needs. The days of isolated departmental units for academic computing, administrative computing, telecommunications, multimedia, library resources, and the like are gradually disappearing. Colleges are recognizing that all technologies and information resources need to be tightly coordinated in order to achieve optimal institutional strategies. Gettysburg College, for example, has taken a bold step in creating an organization where all library and technology resources report to a vice president for strategic information resources. While this may not be appropriate for all small colleges, it does demonstrate technology leadership in the realm of organization.
Creating and maintaining a modern technical infrastructure is a resource-intensive activity, often beyond the means of small institutions. Even among institutions with considerable financial resources, the expectations for the quality of the hardware, software, and networking environment often exceed the institution’s capacity to fund these investments. However, there are a number of strategies that small colleges can use to enhance the likelihood of distinction in the creation of an excellent infrastructure, and to maximize the institutional investment in it.

Controlling the diversity of hardware and software will minimize support costs, particularly the staff resources necessary to answer questions, provide training, and assist with upgrades. Adhering to established standards and mainstream products across the entire institution make it more likely that the infrastructure can be efficiently managed. These are particular opportunities for small colleges that are often unavailable to large universities.

A less complicated physical plant, coupled with adherence to standards, provides small colleges with opportunities to create a network infrastructure that can be managed in a cost-effective manner. At both Hamilton and Reed, for example, recently completed campus networks extend to every classroom, office, public space, and residence hall room, with high-speed connections for each student. All network wiring and electronics are standardized, and the network is centrally administered using modern network management software. Another good example is Cedarville College in Ohio, where every residence hall room contains a college-provided computer of a standard configuration connected to the campus network.

Fiscal strategies for technology
As any college financial officer knows, the cost of technology is one of the major “black holes” of the institutional budget. Colleges that establish creative ways of dealing with technology funding clearly have an opportunity to exercise significant leadership. For example, Hollins College provides a model of how to reduce the cost of campus networking by forming a partnership with a local cable TV provider. Institutions like Reed, that have managed to increase the availability of computer resources while maintaining a constant technology operating budget level, also play a leadership role.

Holistic planning
Institutional planning processes at small colleges tend to be more highly centralized, and less complicated. As such there is an opportunity to integrate strategic planning for information technology with overall institutional planning. At Hamilton, for example, the director of Information Technology Services is part of the Campus Planning Committee, and at Reed the director of Computing and Information Services is a member of the president’s staff. Another good model is that of Hartwick College, where a chief information and planning officer oversees both institutional planning and information technology. The person who holds this cabinet-level appointment is responsible for integrating computing and other information technology initiatives with the operational and strategic planning activities of the college. As Reed, Hamilton, and Hartwick have discovered, closely linking goals for information technology to institutional goals enables an institution to maximize its use of available resources.

Benefits of technology leadership
Pursuing a technology leadership position has both rewards and risks. Many small colleges pointedly avoid being in the technological vanguard and prefer instead to be “early followers” or simply to remain “near the median.” However, pursuing technological leadership can result in a number of potential benefits.

Enhanced learning environment
Without question, the most compelling benefit of being a technology leader is providing students with the best possible opportunities for learning. This is clearly the primary motivation behind Reed’s innovative use of technology in biology and chemistry instruction, of Mills College’s use of advanced technology for music composition and synthesis, and of Hartwick’s practice of providing every entering student with a personal computer. If the overriding goal of a small college is to offer students the best possible environment for learning, then being a pioneer in instructional uses of technology can help to achieve that goal and thus to underscore an institution’s curricular strengths.

In the coming years, as enrollment and financial pressures on small colleges mount, it will become increasingly critical for these institutions to distinguish themselves from one another by more than geography, architecture, or cost; successful institutions will be those that are perceived as having unique—or at least highly competitive—programs in specific curricular areas. Some in higher education believe that in addition to having the best faculty, colleges will also need to have the best information resources and technology to justify claims about disciplinary
Attracting outside funding

During the 1980s, individuals, private foundations, and government agencies provided substantial funds to allow colleges to take advantage of new technologies. While the availability of such funding has declined, and competition for it has increased, there are still many opportunities to obtain sizable grants. Many technology grant decisions, however, are based on the likelihood that the recipient will be capable of doing something truly innovative and that other colleges will be interested in the results. Establishing a reputation as a technology leader, in almost any of the categories mentioned above, can help an institution to attract external funding. Reed, for example, by serving as a model of technology innovation among liberal arts colleges, has received millions of dollars in grants in the past ten years to underwrite substantial portions of its network, microcomputer labs, advanced workstation facilities, software acquisition, library automation system, and other electronic resources. Likewise, Hamilton (in conjunction with Colgate University) recently received a Mellon Foundation grant for infusion of information technology into modern language instruction. The award was based partly on each institution’s commitment to work collaboratively as a way to maximize the use of electronic resources.

Developing favorable relationships with technology vendors

A similar benefit applies to vendors of software, hardware, and services. While the prolific equipment grants of the 1980s, like foundation funds, are no longer abundant, there remain numerous opportunities for a college to acquire new technology at little or no cost by having a reputation as a technology leader. Recognizing the ongoing importance of “reference sites” among different sectors in higher education, vendors continue to be willing to make special allowances for schools that are perceived to be leaders in one area of technology or another. In addition to grants and deep discounts, technology leaders also benefit from favorable vendor relationships by learning of new products early in the development cycle and, in some cases, by having input into both product and marketing strategies. Technology leaders that are invited to participate in focus groups or educational advisory boards, or that serve as beta or early-support sites, may play a small but nonetheless important role in shaping the direction of future educational technologies.

Recruiting

Using technology to improve the learning environment, the quality of campus life, extramural funding, and so forth may contribute to the ability of a college to attract and retain outstanding students and faculty. Several years ago, the claim that a decision of whether or not to attend or work at a particular college was based on the availability of electronic resources was most likely the product of a chief information officer’s overworked imagination. Today this is no longer true. At Reed, for example, prospective students (and their parents) frequently inquire about dormitory networking, electronic library resources, and access to the Internet during the application process or a campus visit. Likewise, prospective faculty members often raise detailed questions about electronic resources they may require for instruction or research purposes. While a variety of other factors are undoubtedly critical to the decision of whether to attend or work at a particular college, the lack of sufficient technological resources may be instrumental in a decision not to affiliate with an institution.

Technology staff development

A technology leadership position for a small college means that technology staff will likely have greater opportunities for professional growth and exposure to advances in technology. Because of small staff sizes, the ability to acquire management skills at small colleges may be lacking, but a great variety of technical challenges exist, and staff can develop a broad range of expertise. These challenges, coupled with the opportunity to be part of a collegial environment, are especially attractive to recent college graduates. Enjoying a leadership position will help to attract staff who see problems as challenges to be overcome, as well as help existing technical staff to develop professionally.

Service to peers

Finally, we must recognize that when a small college investigates a new technology, organizational structure, or fiscal strategy, it enables other colleges to evaluate the results without putting themselves at risk. In the words of a familiar truism, “it’s a dirty job ... but somebody’s got to do it.” By taking the lead in a particular area of technology, small colleges help one another to define collective technical strategies.
Risks and barriers

Along with the opportunities and possible benefits of technology leadership come barriers and risks. Small colleges, in choosing an information technology leadership strategy, must do so with a full assessment of the possible risks—that is, with their eyes wide open. Given the constrained financial environments these institutions face, resources must be invested wisely, and technological applications are but one investment opportunity. Further, leadership is not an all-or-nothing concept; colleges have the choice to lead in some areas and not others.

Underestimating support requirements

The most fundamental barrier to technology leadership is the lack of adequate support staff. A robust infrastructure (e.g., hardware, software, networks), often a central part of a leadership environment, must be supported by substantial staff resources. These are usually difficult to provide when institutional staffing levels are constrained and institutions are trying to find ways to reduce operating costs. Institutions commonly focus on the creation rather than the maintenance and support of a campus infrastructure, since this is generally what foundations and vendors will fund. Seeking “soft” funding for leadership activities can encourage institutions to think of technology acquisitions as “one-time” expenditures. Vendors, unfortunately, encourage this thinking, since they are generally interested in the short-term promotion of their most recent products by the institution. The immediate result is often large infusions of hardware and software to campuses, with only short-term support from vendor personnel. The end result can be disappointment when continuing staffing needs become apparent.

Infrastructure needs are also driven by factors outside of the institution’s control. For example, the release of a new version of an operating system may create broad incompatibilities in the computing environments of colleges and universities. While ultimately these changes may be beneficial to the institution, short-term problems can result. Since much of the new hardware (and related software) is ordered by colleges during the summer months, support staffs are forced to scramble to prepare for the arrival of machines that will not work with existing software applications and network operating systems. In many cases, institutions that standardize on a particular operating system to reduce costs have to deal with major problems just when an academic year is about to begin. The result is serious, sometimes overwhelming stress on support staff.

Finally, corporate mergers and takeovers, which have accelerated in recent years, can cause further instability in support costs. Institutions that make major investments in leading-edge hardware and software can find a company upon which they rely taken over by another company or out of business entirely. The result can be a significant degradation or elimination of support.

The cost of staff technological currency

Technology leaders must invest in the continuing professional development of their staff. Investments of $2,000 to $3,000 dollars per staff member annually are required to allow staff to remain technologically current through attendance at seminars, workshops, and conferences. Failure to allocate these resources on a continuing basis can lead to increased stress, discouragement, and ultimately burnout. This, in turn, can lead to costly staff turnover and a lack of stability in both technical and user support.

Haves and have-nots

Targeted and substantial investments in technology leadership in one area of the college can create internal tensions if other areas do not feel well served. For example, technology leadership in the modern languages can create campus problems if other areas, such as the humanities, do not have adequate support for basic operations such as Web browsing or electronic mail.

Automation and cultural change

A common risk of using information technologies to improve efficiency is that the focus will be on automation rather than redesign. That is, instead of analyzing administrative processes to make them simpler, more efficient, or more cost effective, emphasis is placed on using technology merely to speed up existing procedures without considering their real usefulness.

Further, any effort to improve efficiency will result in cultural change. For example, using electronic mail and bulletin boards to enhance and simplify communication on campus requires participation by the entire community if full benefits are to be achieved. Some individuals will see this kind of change as undesirable, resulting in a less “personal” approach to providing educational services. Change is a disorienting process for many, and cultural change, especially at small institutions with long academic traditions, is particularly difficult. Managing that change carefully must be a primary consideration for institutions attempting to be technology leaders. If handled badly, such changes can
Small liberal arts colleges are facing a variety of challenges that may affect the very nature of their existence in the twenty-first century. Dramatic increases in financial aid, rising personnel costs, and extensive deferred maintenance are but a few of the pressures driving colleges to look more closely at the way they allocate their resources. Information technology plays a dual role in this already complicated picture. On one hand, it has the potential to enrich the undergraduate learning environment, promote new forms of scholarship, and render college administration more efficient and cost-effective. At the same time, however, it adds a substantial burden to budgets that are already severely strained. The question that colleges are now asking is how they can achieve the greatest possible benefits of technology without plunging into a financial black hole.

With this question in mind, representatives from nearly eighty colleges in the United States, Canada, and Japan gathered at an Educom workshop in Portland, Oregon, hosted by Reed College in November 1995. The two-day workshop focused on the impact that new technologies, such as the World Wide Web, will have on curriculum, community, and financial priorities of liberal arts and other small colleges.

Provided below is a checklist of ten critical issues for technology planning that emerged from the workshop. How is your institution dealing with these issues?

1. **Do you evaluate technology investments by how well they serve the institutional mission?** Many colleges and universities are caught up in the rapid growth of technology investments without giving careful consideration to the specific outcomes they hope to achieve. Is your institutional investment in technology fully known, and has it been weighed carefully against other institutional priorities?

2. **Are you using the World Wide Web to its full potential for teaching, student recruitment, campus information, public relations and other purposes?** Small liberal arts colleges, challenged by budgetary limitations and sometimes geographically isolated, can gain enormous benefits from the Web. There are, however, substantial costs for hardware, software, networking, and technical expertise associated with the development and use of the Web. Additionally, there are policy concerns regarding censorship, fair use, and liability of Web service. Has your institution identified and addressed the practical and policy issues related to the Web?

3. **Has your institution made provisions to enable easy electronic communication on campus as well as with alumni, parents, prospective students, and scholars at other institutions?** Campus networks and the Internet are playing an increasingly important role in on-campus and off-campus communication. Do your electronic facilities promote or inhibit communication and collaboration among members of your college community and others?

4. **Are your faculty prepared to take advantage of curricular opportunities provided by the World Wide Web, multimedia, and other new technologies?** Are there incentives (or obstacles) for faculty who wish to integrate technology into their courses? The greatest challenge to effective use of technology is the amount of support provided for faculty who wish to use computers. Such support includes everything from training and technical assistance to free time for curricular development. Does your institution encourage and enable faculty to take full advantage of existing electronic resources or does it place obstacles in their path? Are your technology funds devoted primarily to equipment and technical staff, or is a portion set aside for faculty development activities?

5. **Has your institution explored consortial or collaborative relationships with other colleges to provide technology and information resources in the most cost-effective ways?** For small colleges, “going it alone” with respect to technology innovation is both costly and risky. Have special alliances with technology vendors been pursued? What alliances has your institution pursued?

6. **Is there a campus-wide policy that provides ethical and legal guidelines for the use of facilities such as the Internet, electronic mail, and the World Wide Web?** New telecommunications legislation may affect your institution’s liability for use of electronic resources, and there are a growing number of cases where campus electronic resources are being misused. How well is your institution prepared to deal with such cases?

7. **How is your institution dealing with copyright and licensing issues as it broadens electronic access to library materials?** Many colleges are discovering that technical and staffing problems are small in comparison to some of the legal issues related to electronic resources. Are your faculty, library staff, technology staff, and college counsel keeping track of the national discussion about these issues?

8. **Do you have a policy that covers ownership and/or royalties for electronic materials produced by faculty or other members of the college community?** Faculty and staff at virtually all research universities sign such agreements, but their counterparts at small liberal arts colleges rarely do so. Changing technology is now making it easier, however, for faculty and staff at small colleges to develop databases and other electronic resources that can be sold or licensed via the Internet.
result in a backlash that could seriously impede future technology innovations.

Marginal investments

Small colleges already have many of the characteristics of the ideal learning environment for students. In particular, these institutions provide small classes, opportunities for frequent and substantive interactions between faculty and students, opportunities for all students to be involved in co-curricular activities that complement classroom learning, and a variety of support services to assist student learning. These are among the most important reasons why students and their parents are attracted to these institutions. Applications of technology can provide opportunities to enhance these characteristics. However, equating instructional excellence with information technology leadership is risky. The fundamental decision an institution must make is which areas of technology leadership are likely to improve the campus learning environment.

Some final thoughts

The competition for students among higher education institutions is fierce, and institutions have to balance their investments between technology and competing interests. Among these interests are: financial aid for attracting a diverse student body; improving salaries to attract the most gifted teachers, scholars, and support staff; creating an attractive social environment; and renovation or replacement of physical plant facilities to provide modern learning environments. While it is true that technology investments, at some level, are necessary to provide the tools necessary for students to be prepared for life beyond college, decisions about which college to attend are far more idiosyncratic than analytical. A focus on technology leadership beyond a certain point may not be as important as other investments. It is well known, for example, that the quality of a student tour guide, interactions with faculty while visiting a campus, the social climate on a campus, and the sense of whether the student “fits” at the institution play major roles in the student’s selection of a college. While a certain level of institutional technological sophistication is expected, and perhaps even sought, it is not the ultimate determining factor.

Major investments in becoming a technology leader must therefore be weighed carefully against the backdrop of other institutional priorities. Not every small college can or should be a technology leader and those that strive for technology leadership should bear in mind that being a leader is best pursued by excelling in a particular area (or areas), not by attempting to conquer every possible technological frontier. In the end, however, small colleges must seek leadership from within their ranks if they are to help one another find solutions to technological problems.

An electronic copy of this checklist is available at http://www.reed.edu/pcw

9. Do you have an institution-wide policy for allocating, upgrading, and replacing computer equipment? Colleges that have provided faculty and staff (and student facilities) with computers are finding that aging equipment prevents members of the community from taking advantage of new electronic resources. Replacing computers on a periodic schedule, however, is extremely expensive. Although most colleges agree that five years or fewer is the optimum cycle for microcomputer replacement, fewer than 20 percent have set aside operating funds to cover the costs. Has your institution discussed this issue and determined whether or not a replacement policy is feasible? Do you have sufficient budgetary resources to carry out such a policy? If not, how will you deal with equipment obsolescence?

10. Are planning and budgeting for information technology and information resources done in a cohesive manner? In order to achieve coherent, cost-effective strategies for information technology and resources, it is imperative for colleges to promote the highest degree of interaction and coordination among all information technology and information resource organizations, including instructional computing, research computing, administrative computing, libraries, media services, telecommunications, etc. How well coordinated are information technology and information resources services at your institution? Do those in charge of computing and library resources play a direct role in strategic planning for the institution?
A Planning Process Addresses an Organizational and Support Crisis in Information Technology

by Keith R. Nelson and Richard W. Davenport

In the last several years, Central Michigan University (CMU) reached a level of technological growth, excitement, and frustration that required rapid and significant changes in its information technology infrastructure. This article describes an institution-wide strategic planning effort at CMU, resulting in a matrix governance structure for information technology that acknowledges the value of both distributed support and a strong central organization.

Many papers and conference presentations have reported on restructuring information technology organizations in higher education. Factors that differentiate institutions and influence their information technology capabilities and organizations include size, status, funding level, and mission. Central Michigan University (CMU) is a public comprehensive institution with approximately 17,000 students, located in the center of Michigan. It is one of fifteen public universities in Michigan, and one of 105 higher education institutions in the state. CMU has a large, nationally recognized teacher education program and one of the largest colleges of extended learning in the country, serving more than 12,000 additional off-campus students. The University has most recently become known nationally for its guaranteed four-year degree program and its leadership in the charter school movement.

Recent changes to CMU’s information technology governance structure were prompted by increased user demands for technology throughout the University over the last few years. The institution was not prepared for such a ground-swell of interest and demand, nor was it prepared for the shockingly high costs involved in meeting the demands. In solving the crisis, CMU involved a combination of external consultants, an internal technology task force, and electronic town meetings to recommend and discuss new organizational approaches for achieving and supporting a technology plan. A strategy emerged for an...
expanded campus network, computing system upgrades, new uses of distance learning technologies, increased coordination of user services, and a long-range financial plan. A new matrix organizational governance structure for information technology emerged that recognizes the value of both distributed support and strong central coordination.

Historical antecedents to organizational change

A number of factors contributed to CMU’s need to restructure for technology planning, coordination, and support.

Rapid and uncoordinated growth of microcomputing

Demand for computers had reached epic proportions during the last few years. Every unit at the University was frantically involved in providing hardware and software, with little assistance and coordination. It was estimated that purchases from the various units totaled more than $3 million per year, with little attention paid to coordinating efforts. The campus mainframe was overtaxed, resulting in long and frustrating response times. Students, faculty, and staff were dissatisfied with the mainframe and for the most part resorted to innovative ways of accomplishing their needs without the assistance of a central computer. Most people had a good understanding of the power of PCs, even if they were not proficient with their operating systems, applications, or operational features and practices. Many correctly perceived a sharp contrast between the usability of a PC and a mainframe, but were not very computer literate with either one. A serious situation was building and about to explode unless something was done quickly to resolve the unmanaged growth in distributed computing.

Development of the campus network

Significant progress had been made in recent years to create a campus backbone network that consisted of 1,500 nodes and connected thirteen buildings (although only a few of those were completely internally wired). While the network was well planned, piecemeal funding from faculty grants, departmental or college computer upgrade projects, and state-funded building projects was sporadic. As use of the network developed, further expansion, management, maintenance, and longer-range planning became a pressing need. In short, the incomplete campus backbone severely limited the University’s ability to address its constituents’ needs.

Decentralization of technology funding and support

As end-user computing became more important, decentralized technologies and support became an increasing proportion of total information technology expenditures at CMU, with approximately 35–40 percent of its technology dollars being spent on personal computing and associated support. The issues for decentralized computing became a combination of basic needs (such as training, maintenance, support, and upgrades) and production opportunities (such as instructional application development and distance learning) that required an advanced information technology infrastructure.

Technology outside the walls of the University

The developing uses of wide area networks and telecommunications technologies had already had some impact on the University’s historical involvement in distance education. Until recently, the program was effectively distributed via traditional teaching methods to off-campus students at regional centers located primarily in Michigan, but also at other national and international locations. CMU was using interactive television and the Internet to improve educational content and further reduce the constraints of geography on distance learners. Unfortunately, campus expertise was lacking in the art of teaching and production for distance learning. CMU did not have a program for developing distance learning faculties and technologies.

Technology change, cultural change

For CMU, like most institutions, rapid technology-driven change and the realities of finite resources challenged many elements of our institutional infrastructures. Organizations need to change to adapt to this growth, but the trouble is that organizations often change more slowly than technology. An appropriate funding model is a very critical part of the challenge. When funds are plentiful, it is much easier to achieve cross-organizational collaboration, and priorities are relatively easy to negotiate on an informal level. Very few institutions, especially public institutions, are beyond the point where funding and costs are not under tremendous scrutiny. Information technology is characterized by high visibility, high cost, and merging functions of voice, video, and data. There is also a history of decentralized user constituencies that want control over resource decisions, including technology, that affect them greatly. There is usually no impetus to change a technology organization if most users are satisfied with the status quo; that is,

(continued on page 32)
Founded in 1868 by Andrew Dickson White and Ezra Cornell as an institution where “any person can find instruction in any study,” Cornell University today encompasses thirteen undergraduate, graduate, and professional colleges and schools. Eleven of these are located on the Ithaca, New York, campus, while two medical units are in New York City.

Cornell is a unique combination of public and private divisions, being both a private, nonsectarian university and the land-grant institution of New York State. The first university in the eastern United States to admit women, Cornell currently enrolls 13,300 undergraduates and 6,200 graduate and professional students, served by a faculty of 2,300 teachers and researchers.

Creating a vision for the future

In 1994, Cornell published a University-wide strategic plan that focused on four themes: educating the leaders of tomorrow, generating and applying knowledge, exercising effective stewardship, and creating the faculty of the future. That plan’s ways and means section specifically recognized the importance of developing communication and information technologies “to promote more effective learning, extend interactions within and beyond Cornell, and enhance the quality and effectiveness of academic programs and support services.”

Prior to the University’s strategic planning effort, a visionary report, Cornell in 10 Years: The Influence of Technology, had been issued late in 1992 by the 2001 Committee. This committee had been charged by the president with identifying and assessing trends in electronic technologies that could affect the University, describing a feasible vision for the next century, and suggesting how that vision might be achieved. The report drew heavily on a vision document that had been created by the Cornell Information Technologies organization, under the leadership of M. Stuart Lynn, then vice president for information technologies. A Vision for the Nineties: At Any Time, from Any Place—Collaboration through Technology formed the basis for the strategy that is still in place at Cornell today.

Major recommendations of the report of the 2001 Committee included:

- transition the technology structure to a distributed model,
- provide universal access to a campus network that integrates voice, video, and data,
- establish programmatically oriented support teams in the colleges,
- develop a strategic plan to further the goal of an electronic library,
- disseminate information electronically as much as possible, and
- provide easy access to data to support student and administrative services.

A second planning document related to technology, Planning for Learning Technologies Services, was issued in January of 1995 by the Faculty Advisory Board on Information Technologies (FABIT), a high-level faculty body that advises the vice president for information technologies and the provost. The FABIT report identified three areas that needed to be addressed: (1) faculty support, (2) student access to information resources, and (3) “teaching spaces.”

Taken together, these various planning documents have provided a clear blueprint for Cornell’s information resources directions and investments over the past few years.

Ensuring a strong advisory structure

Cornell’s information technologies are managed through a combination of advisory and operational structures. The advisory structure consists primarily of two University-level groups: the faculty advisory board mentioned above and the Cornell University Board of Information Technologies (CUBIT). The latter is a high-level administrative coordinating body whose members include the senior vice president, vice presidents for aca-
demic affairs and research, the university librarian, two deans, and the chair of the faculty advisory board.

Clearly information technologies support not only Cornell’s educational, research, and outreach mission, but also its effective administration. With the vice president for information technologies reporting to the provost, to ensure balance in policy guidance, CUBIT is chaired by the University’s senior vice president.

According to David Lambert, vice president for information technologies, this structure works to ensure that information technologies are applied to the effectiveness of both education and administration at Cornell. Thus he sees his job as facilitating the effectiveness of both the provost and the senior vice president, and leading institution-wide technology initiatives that call for mobilizing the broad campus community, including faculty within the colleges. Lambert refers to this as his CIO (chief information officer) role as head of the Office of Information Technologies, as compared to his chief operating officer role as head of the centralized information technologies divisions. While he provides leadership and seeks resources for central technology operations, he has a responsibility to work to get resources for distributed investments, as well.

Cornell has been described as a “federation of strong disciplinary units, linked together through centers and other structures that allow innovations and advances to be shared across units.” In this highly decentralized environment, FABIT provides strong faculty input to the information resources planning process and is broadly representative of the kinds of diverse intellectual interests at work on campus.

Lambert sees FABIT as not only an advisory body, but also a working group, charged with making decisions that impact information technology investments. For example, $2 million in funding in the provost’s budget has been earmarked for classroom upgrades, and a FABIT subcommittee has been created to set priorities for how the funds will be spent, including recommending site licenses. The subcommittee will review proposals from colleges concerning classroom upgrades and its recommendations will be presented to broader University bodies dealing with financial allocations. Professor Ronnie Coffman, chair of FABIT, says, “This is not a centralized place, but there’s a great appreciation that we have to hang together in the area of information technology or we’ll hang separately—or invest a lot of dollars needlessly.”

Changing the organizational structure

As technologies have changed dramatically over the past decade, so has Cornell’s central information technologies organization. One of the first Research-I institutions to bring academic and administrative computing and networking into the same line organization in the mid-eighties, Cornell continues to reinvent its approach to supporting technology. A recent reorganization has established three primary line management divisions, each of which has two charters, one oriented toward the missions of the University and the other oriented toward technology.

◆ Administrative Systems and Distributed Technologies deploys applications and builds client/server infrastructure to support Cornell’s administrative and stewardship missions.

◆ Academic Technology Services works with academic units to enable faculty and staff to use information technologies in pursuit of the University’s academic mission.

◆ Network and Computing Systems is responsible for infrastructure services such as networks (voice and data), servers, and integrated communications technologies in support of all of the University’s missions, with particular attention to outreach.

Lambert believes that having strong directors in these three divisions will allow him to concentrate on his CIO facilitation and coordination role, leaving operations to the divisions.

A major focus of the FABIT report was on finding a way to rationalize the relationship between central technology divisions and the related efforts that occur at the college and school level. According to Lambert, “We have done a good job of distributing technology, but we have not done as good a job of distributing the support infrastructure. Central staff and faculty work well together, but we haven’t achieved a level of organization that is efficient; too often we practice in the same area, sometimes creating duplication while leaving other areas unaddressed. A major challenge for us to address is, How can the faculty get the support they need where they work?”

Lambert hopes to effect a formalization of responsibility for information technologies in each college where it does not already exist, beginning with identifying a chief information officer within the college and then bringing all of those individuals together in a kind of CIO Council to promote communication and collaboration.

Lambert also believes that “virtual organizations”—temporary support structures built quickly to serve immediate needs—are the way of the future. Such organizations are more project oriented, serving as homes for major initiatives. This approach does not limit the responsibility of the information technologies divisions, but spreads accountability and ownership. Project 2000, the University’s plan to become a “best-managed university,” is a good example of this approach. While the administrative systems division is a major player in the core administrative systems project, it does not own the project; rather, the University has established a separate accountability structure through which an institution-wide effort is under way to reevaluate business processes and achieve a unified vision (see below).

Exercising effective stewardship

A major recommendation of the stewardship section of Cornell’s strategic plan was to implement standard administrative data systems and develop greatly enhanced campuswide access to
and usability of centralized information databases and electronic services.

Activities resulting from this directive are articulated in a report released last fall, Project 2000: Creating a Best Managed University. Senior Vice President Frederick Rogers, who spearheaded both the strategic planning task force and the executive group that studied the issues the task force raised, says Cornell considered several possible models for replacing its core administrative systems and opted for the strategy of partnering with one vendor to jointly develop all core systems. This will likely be in partnership with other institutions who have selected the same vendor (PeopleSoft, Inc.). These conclusions were drawn only after a great deal of work had taken place to establish a vision and set of goals and objectives that the campus could buy into, work that Rogers orchestrated through Cornell’s Administrative Data Systems Policy Advisory Committee.

Rogers and Lambert co-chair the Project2000 Council, which functions as a forum for the difficult policy issues that arise in a major systems project, while a project steering committee is responsible for managing the project. The President’s Council has taken ownership of the project, and President Hunter Rawlings has gone on record as strongly supporting its goal of making Cornell’s administrative processes more effective and efficient, and thus attaining financial equilibrium for the University.

To facilitate communications on this and other administrative systems matters, the director of Administrative Systems and Distributed Technologies, Helen Mohrmann, reports not only to Lambert but also to Rogers, a relationship she thinks makes sense: “To me, this indicates that both are interested in this agenda, so the dual reporting lines will only make my job easier.”

According to Mohrmann, Project 2000 encompasses other activities besides reengineering the core business systems and replacing the core information systems—human resources/payroll, student information, sponsored programs, finance, and alumni/development—with client/server systems. These include developing a data warehouse, adopting departmental good practices at the University level, and fostering more shared or cooperative systems and fewer shadow systems, including defining a common data model. In all, the project is expected to take five years to complete.

Educatng the leaders of tomorrow

Cornell, like many other institutions, has witnessed a groundswell in the past eighteen months of faculty interest in using technology in the teaching and learning process. Lambert says, “It’s difficult for us as technologists to predict what will happen with the technology once it is in the hands of the users. We tried to provide cost/benefit analyses in advance of implementing the full network, but the actual outcomes have been amazing. Removing the barriers engaged the creativity of the University community in ways that we simply could not have predicted.”

Provost Don M. Randel comments in this same vein: “The aim of engaging the technology is not to make music historians into technologists, but to make them into better music historians. What we have done quite well is to take that kind of burden off people—provide them with tools to liberate them to think about what they need to think about; not worry about the tools themselves.”

According to Ann Stundon, director of the Academic Technology Services (ATS) division, all of the recommendations of the FABIT report, except in one area, have been implemented. There is more permanent funding for computer labs, the proposed student orientation program to educate students about information access was launched last fall, and a major effort is under way to outfit classrooms across the campus with the most appropriate and best of new technologies. The missing piece is how to most effectively provide faculty support, but Stundon’s division will be working closely with FABIT on this challenge in the coming months.

What about current uses of technology by faculty for teaching? Carrie Regenstein, who heads the Academic Technology unit of ATS and works closely with Cornell faculty, says many faculty are reaching out to students in new and innovative ways: teaching with the World Wide Web, collaborating with listservs, teaching across universities, and using digital libraries. An appendix of the FABIT report lists many special projects that creatively use technology—for example, the computer-driven “dry laboratory” at the College of Veterinary Medicine and the “virtual design studio” in which architecture professor Kent Hubbell has participated for several years—as well as the many projects that have been recognized beyond Cornell by national publications and awards programs.

An excellent example of using the Web effectively is found in the work of Andrée Grandjean-Levy. This modern languages senior lecturer has created a Web page that provides many links to resources she has found of value in several levels of teaching. “At the more advanced level,” she says, “I use the page to send the students to France to look at online French newspapers and to
look for information on French politics. From the cultural point of view, it brings them right smack into contact with what’s over there; the culture and the language all of a sudden are brought to life much more. It’s extremely enriching; I am almost ready to do a course simply using the Web.”

Enabling information access and enhanced service
Cornell has become renowned for its excellence in providing information access and enhanced service to its campus community, beginning more than a decade ago with the development of CUinfo, the first campuswide information system (CWIS) in the U.S.; through the development of Project Mandarin tools and user-friendly applications such as Bear Access; and most recently in being selected for the 1995 CAUSE Award for Excellence in Campus Networking (see photo).

Today, the formerly mainframe-based CUinfo resides on a World Wide Web server and is one of many information resources available through Cornell’s Web site.

Perhaps one of the best known of Cornell’s technological innovations, Project Mandarin has created a set of tools to build applications that use networks and point-and-click interfaces to move information from databases into the hands of students, faculty, staff, and administrators. The project has become a consortium of more than two dozen colleges and universities. Mark Mara, who leads the Project Mandarin team, says the consortium has been excellent in keeping the goals of the project realistic and the technology from becoming provincial. Many of the consortium members have built applications with the Mandarin tools similar to the Bear Access application in use at Cornell.

Bear Access is a simplified interface application—a menu of Cornell-supported network services—that allows users to easily access those services using their individual network ID and password. The application makes it easy for people to connect to information resources such as the Cornell Library Online Catalog, Just the Facts, and CUinfo. Graham Hall, Bear Access project manager, says this was the first project emanating from the central information technologies organization that actually reached out and touched “true” end users in a significant way.

Registrar David Yeh agrees: “Students love it. We are one of the few universities that allow students full access—from seeing grades and financial aid information, to actually having the ability to change their addresses, to now enrolling for courses online. We are continually asking, ‘How can we reduce lines and production of paper, and provide information to students when they need it, wherever they are?’”

The University Library is also being transformed by the networked environment. Over 100 Macintosh-based kiosks in library buildings use Bear Access and other gateway software to make a vast collection of bibliographic information available.

Collaborative projects include a pioneering effort to both preserve and electronically distribute books across the Internet; the CUPID project, aimed at using the Internet to create a distributed printing environment for high-quality documents; and the Making of America project, the purpose of which is to digitize and electronically distribute primary source material on nineteenth century American history. The latter project is in cooperation with the University of Michigan, but eventually this project will engage additional campuses and be a good case study for what it will take for institutions to participate in a consortially developed digital library.

The library is also using the World Wide Web to deliver undergraduate library instruction, having developed a tutorial that is available on the Web, and library staff provide instruction in the use of the Web, teach classes on HTML, and work with faculty who use the Web in their classes. All divisions of the library are engaged in the effort to build electronic libraries and will be part of a strategic planning effort that will begin after the appointment of a new University Librarian.

Currently using the NOTIS automated library system, the library is in the process of evaluating vendors who have or are developing distributed systems products, in concurrence with Cornell’s move toward client/server systems.

Creating network-related policy
With such an intensive networked information environment, it is not surprising that Cornell is addressing the need for policies in this area. Last year the position of policy adviser was established in the Office of Information Technologies and filled by Marjorie Hodges, who reports directly to Lambert. Hodges works closely not only with the information technologies divisions, but also with the University Counsel, Judicial Administrator (a position she held formerly), Cornell Law School, and various other Cornell entities. While she holds a law degree, Hodges does not function as an attorney; rather, she is responsible for encouraging campus dialogue about the legal and ethical issues surrounding the use of network-based resources, sponsoring seminars and workshops, and participating in campus policy development efforts, such as the one that resulted in the Responsible Use of Electronic Communications policy published last fall.

In response to tremendous interest shown by other institutions in Cornell’s work in this area, the policy-development process and experience will be shared in a program called “Computer Policy and Law,” to be held August 6-8, 1996, on the Cornell campus.

From effective organizational strategies, to creative use of technology in instruction, to use of the network for easy information access and dissemination, to innovative technological developments—Cornell University has received much well-deserved recognition from its peers as well as several higher education associations and agencies. Its approach to information resources management and use has surely contributed to its being referred to by the Middle States Association Commission on Higher Education as a “world treasure.”

Most of the documents described in this article are available from the CAUSE Information Resources Library (orders@cause.colorado.edu, 303-939-0310). An online version of this article with many hypertext links to these documents as well as projects mentioned will be available on the CAUSE Web server at http://cause-www.colorado.edu/cause-effect/cem96/cem962.html
Planning Process ...
(continued from page 27)
typically, conditions need to reach a crisis proportion to facilitate rapid change. Such was the case at CMU.

Approaches to organizational planning
Several options for organizational planning were open to CMU. The University considered addressing the most immediate needs by stepping up the networking process and supplementing support for the mainframe. Investment in client/server technology was another option that would help alleviate but probably not solve all of the University’s needs. Additional monies could be channeled into several areas simultaneously until funding was exhausted, but this seemed like a meaningless approach to planning. Alternatively, CMU could start by examining its mission statement and vision to determine how information technology fit into institutional goals. The institution needed to step back and assess its current situation. Several steps were followed to begin the intensive planning process.

Influence of technology on the University mission statement
One of the first steps taken was the revision in 1994 of our academic mission statement to include goals related to the use of technology. This increased technology emphasis reflected a broad-based understanding of how technology can improve academic outcomes. There is widespread belief that technology is escalating the limits of information access and capacity, and creating new opportunities for communication and collaboration. The revised mission statement speaks directly about the role of technology and underscores the faculty commitment to reengineering instructional processes and expanding their vision of the campus and student market.

Assessment and recommendations of outside consultants
A shadowy future of converging multimedia telecommunications and computing requires difficult decisions about technology, people, budgets, and organizations. In 1994, the University sought the advice of a technology consulting firm to assess the current environment and make recommendations about technology change and organizational strategies for how to accomplish these changes. The consultant recommended an aggressive transition into a client/server application environment and suggested either reorganizing and refocusing internal technology support, or outsourcing. Either of these recommendations would impact significantly on the personnel and systems that were already in place. Which technologies were necessary? How would technology affect both technical and non-technical jobs? What was the appropriate balance between cost and benefit? What types of organizational changes were needed to maximize return on investment and provide a competitive advantage?

Assessment and recommendations of an internal task force
In January 1995, CMU’s president appointed a task force on technology that comprised representatives from many campus constituencies. The task force worked on an extremely ambitious timetable, committing a large part of their weekends for several months to discuss and plan technology from an internal perspective. An electronic mail list was used to solicit ideas and opinions from the entire campus. The final report of the task force delineated a set of goals and key activities for technology (see Table 1).

The task force recommended an organization and governance structure (shown in Figure 1) that combined features of the distributed and centralized models with local service providers in colleges and administrative offices. The proposed matrix model included a formal Technology Planning Board chaired by a technology administrator reporting directly to the provost. The planning board would include deans (or designees) and vice presidents (or designees) from all the major divisions of the University. The technology administrator would be responsible for the various technology support services, and would promote technology on campus. The planning board would be responsible for strategic planning for technology at the University, including proposals for funding and the schedule for completion of key activities. A second layer of the proposed matrix was the role of technology coordinator. As envisioned by the task force, technology coordinators from each division would have more of a technical management relationship with the directors of the centralized service “centers”—for computing, telecommunications, and instructional support. This matrix of directors and coordinators would form collaborative operational-level teams of local and centralized service providers.

The resulting organizational structure
In the fall of 1995, the president presented his Technology Initiative Plan, which endorsed the general recommendations of the technology task force. According to the plan, the objective of
technology was to “support and improve teaching, learning, research, and service and to enhance the productivity of students, faculty, and staff.” The resulting organizational changes followed the recommendations of the technology task force, with some changes. The president created a new position of assistant vice provost for information technology, reporting directly to the provost and serving as the technology coordinator for computer services, telecommunications, and instructional support services. Most of the academic deans appointed their associate deans to serve on the Technology Planning Board. The planning board also included the directors of computer services and telecommunications. The resulting structure was less hierarchical than the model in Figure 1 because the deans’ technology coordinators usually became the planning board representatives. Initially the Technology Planning Board, chaired by the assistant vice provost, received the following charges:

- Develop a plan to complete the campus computer network
- Develop a comprehensive plan for a technology training center to be integrated with the library instructional resource center and the new technological library expansion plan
- Develop a job description for a new coordinator of distance learning
- Consider a comprehensive plan to provide every CMU student with a personal computer to assist the student with his or her University studies
- Develop a plan that would ensure that all faculty members would have appropriate computer access

These charges addressed some of the most pressing technology-related issues that have been reported by many higher education institutions. However, it is difficult to look very far ahead when there are often more basic and immediate technology needs to resolve. While there is great potential for client/server computing to support instructional and business process reengineering, client/server solutions require a ubiquitous campus network, hardware and software upgrades, and considerable training. There are many conflicting sources of information about the cost and timetable to move from a mainframe-centered environment to a network-centered, distributed computing environment. Many analysts agree that migrating to distributed computing environments will (1) shift cost structures from being capital-intensive to labor-intensive; (2) at least for the short-term, result in high capital costs due to acquisition of more networking, new clients, and new servers; and (3) occur over a period of years rather than months.

### Table 1

**President’s Technology Task Force**

**Key Goals**

- Encourage students, faculty, and staff to learn and use basic technologies needed in contemporary society, as well as specialized technologies appropriate to their disciplines and roles
- Provide and encourage the use of technology to improve teaching and learning, research, and service
- Use technology to facilitate and improve communication and instructional delivery between and among on- and off-campus constituencies
- Establish a process for ongoing planning and evaluation of technology initiatives
- Establish funding mechanisms to acquire, support, maintain, and upgrade basic and specialized technology resources
- Promote the development of user-friendly applications of technology

**Key Activities**

- Establish a technology planning and organization structure
- Upgrade student computer labs
- Acquire faculty and staff computers
- Establish a technology training center
- Integrate instructional development and multimedia functions into the training center
- Implement a student technology fee
- Complete the campus network
- Improve remote computing capability (Internet access, modem pool, off-campus lines)
- Upgrade the mainframe
- Upgrade residence hall technology
- Expand and upgrade library facility
- Provide additional technology-based classrooms
- Provide an adequate number of sites with access to on-campus cable television and satellite downlinks. Increase the number of sites on demand
- Obtain servers and migrate applications from the mainframe
- Upgrade the telecommunications switch as needed
- Modify the university budget to allow for repair and replacement of equipment and software
- Institute incentives for using technology
- Ensure the implementation of technology in all building and remodelling plans
- Upgrade library technologies
- Pursue cooperative links with other education agencies and institutions
- Evaluate the technology plan and the success of key activities
- Support the development of distance learning

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Balancing long-range planning with strategic action

“As it is, we are right on the edge of what works.”
(Bill Gates, 1995)

“If you come to a fork in the road, take it.”
(Attributed to Yogi Berra)

The first quote, from Bill Gates, aptly describes the challenge of technology-driven change. The second quote characterizes the urgency of decisions that face CMU and other institutions. It was important to move forward rapidly with technology planning while taking immediate action, and some risks, on very fundamental issues and problems that simply could not be postponed.

One of the first challenges addressed was determining the intermediate to long-term value of a mainframe computer as a server in a client/server network. The central mainframe had become heavily overloaded, and usage of its existing applications was still increasing at a rapid rate. There are many opinions, both pro and con, about mainframe versus client/server technology. On the pro side, mainframes have provided security and stability, rapidly improving price/performance ratios, and operating systems that are evolving into client/server-compliant systems. These attributes offer assurances that an upgraded “legacy” system can serve a substantial future role in a distributed computing network environment. The mainframe can be smoothly migrated from its traditional role as an exclusive server to its new role as a network server and data warehouse repository. On the con side, there are concerns that mainframe hardware has a higher price/performance ratio than smaller servers, is less scalable and less flexible, and doesn’t fit the client/server architecture.

An initial strategic action was to replace the old mainframe with an upgraded model. A key assumption was that the mainframe would continue to provide valuable service for at least five years, long enough to justify its initial cost. The new model is about 90 percent smaller, uses about 93 percent less power, has lower software and maintenance costs, and is about three times more powerful than the old mainframe. The new system also provides a rapid, seamless solution to a problem that was affecting the productivity of most administrators, faculty, and students. The physical replacement of the old system was accomplished within four hours. The only initial difference noticed by thousands of users was vastly improved performance.

A second challenge was deciding how to move forward with other important technology
projects while the planning board was producing a strategic plan to address the more comprehensive, future-oriented charges. These projects included (1) critical systems, such as a telephone registration system that was close to becoming unserviceable, (2) network access issues and demands that were beginning to affect academic programs and individual productivity, and (3) even more basic infrastructure problems—such as a lack of sufficient electrical power—in many campus buildings. Before creation of the Technology Planning Board, the administration was responding to these needs on an ad hoc basis, without a comprehensive strategic technology plan. There was an understandable reluctance to spend limited funds without knowing all of the technology needs.

The solution was to prepare a presentation to the Board of Trustees, describing the process that led up to the University plan for technology, and the major components of the plan. The proposal suggested that the institution proceed cautiously with projects that were crucial, but to make certain they were consistent with the long-range goals. For example, several buildings had been connected to the campus backbone network, but many departments or individuals within the buildings had never been connected. Therefore, one project was to complete hookups within partially networked buildings, adding over 400 more users to the network. The Trustees supported the recommendations and encouraged continued planning for information technology.

A third challenge, which was already being addressed, focused on providing an appropriate level and quality of technology for students. The Technology Planning Board assessed student technology needs and devised a life-cycle student technology model that addressed shared student computers, student access to networks, classroom technology, maintenance, upgrades, and support. A similar assessment and model are currently being completed for faculty and administrative computing needs. The goal is that every faculty, staff member, and student will be included in the plan. The life-cycle student technology model yielded a proposed student technology fee that would provide a sustained and specified quality of technology and support for all students.

The remaining steps in the solution are to obtain funding and align the student technology model, which is to some extent theoretical, with a more costly list of real student technology requests from the various campus constituencies represented on the planning board. For example, the model provides for a ratio of 15:1 shared student computers that are fully maintained, up-
graded, and replaced every four years (about 1,100). However, with the growth of departmental computer facilities, there are already more than 1,100 student computers. One challenge for the planning board is to figure out how to provide such services more efficiently while maintaining quality and effectiveness.

Further issues to be addressed and challenges to be met

Nearly two years after CMU began the technology initiative, there remain a number of issues and challenges still to be met, from funding to training to determining the best way to provide ongoing technology support in a distributed environment.

Technology funding

Achieving adequate funding is partly a function of management and coordination of resources. Other funding issues include the high, but perhaps temporary, levels of expertise and funding needed to migrate into client/server computing and other new technologies. There is little doubt that the cost of technology initiatives is high. One obvious way to finance new technology is to discover ways that technology can reduce costs elsewhere. There are many examples of cost reductions: lower support costs with centrally managed network-accessible data; reduced use of paper; and, as distance learning and other new technologies grow, travel costs can be lowered and physical space can be reduced. Technology can also result in lower personnel costs through reengineering and streamlining people-intensive processes. This last point is especially important, since the most significant cost of higher education involves personnel.

For most institutions, the complexity of technology growth has required very serious consideration of an appropriate balance between in-house information technology staff and external subcontractors. In our systematic approach, we have learned that external contractors can serve as consultants or project partners, or an entire information technology operation can be outsourced. Such contracts, however, are often finite-term relationships. The transitory nature of most contractual relationships and the importance of mission-critical information systems is a serious concern that should cause most institutions to be wary about dependence on outside contractors, who do not necessarily have a long-term interest in the success of an individual institution. Nevertheless, use of subcontractors is still a viable option to consider, but should be acted upon only after carefully considering all the short and long-term implications.

Technology standards and trends

One obvious way to reduce technology costs is to standardize hardware and software as much as possible. In most higher education environments, it is virtually impossible to standardize on one platform or configuration. However, arbitrary heterogeneity may result in higher support costs and thus be a false economy. No matter how efficient technology investments are, they will not produce satisfactory returns without anticipating medium- and long-term pedagogical, economic, cultural, organizational, market, and technology trends.

One example of where many of these issues surface is in the area of distance education. There are many potential delivery systems available for distance learning, including interactive television, satellite links, and the Internet. Each of these systems can deliver instructional materials. However, it is important to analyze how comparable outcomes could be achieved with conventional or more cost-effective solutions. The ultimate evaluation of any technology or trend is that whoever can provide the best product for the best price will be the most successful. Every technology purchase is a strategic decision that must balance price versus performance and obsolescence, and current versus projected markets and priorities.

Completing and upgrading the campus network

The current, partially completed FDDI campus network at CMU provides some users shared Ethernet to the desktop. There is great impetus to make the network accessible for all faculty, staff, and students. A network planning team created by the Technology Planning Board recently participated in a network design workshop to create a network plan. The plan will accommodate current and future multimedia application needs, preserve the investment in the existing network, and meet application needs in several years that include advanced technologies for a new music building and a technological library addition. The network team comprised campus network experts and key user constituencies. The design workshop also was done in consultation with an external network consultant.

Instructional development, training, and incentives

Technology upgrades will accomplish very little if not used effectively to improve instructional and business practices. A 1993 federal government report identified user training and organizational learning as the two most critical technology issues confronting higher educa-

technology support. An approach used at Brigham Young University, points of view. The most important aspects of this user support function are (1) effective communications between the central and local service providers, (2) efficient support from the central service providers to reduce unnecessary load on the local service providers, and (3) access to technical information, documentation, problem histories, frequently asked questions, and deeper levels of support for the local service providers at their remote points of service.

Conclusions

The various planning processes employed at Central Michigan University yielded similar conclusions about the strategic importance of technology growth, broad goals, and an organizational structure for achieving those goals. Details of this organizational change will need further and probably continuing refinements. Some activities, such as expanding the campus network, are already under way and are prerequisite to proceeding with both instructional and business process reengineering. The newly created Technology Planning Board will have an opportunity to establish technology priorities, increase efficiency, and achieve the best return on investments. The matrix organization will also have a very exciting opportunity to provide improved user services by coordinating the efforts of local and central service providers.

Experiences in the first six months of the new organization have been encouraging. Progress and planning are occurring simultaneously. The matrix organization is beginning to function as a technology roundtable that is consensus building in nature and greater than the sum of its parts. CMU has committed to its technology initiative and realizes that this commitment will also require continuing and increasing investment.

“The University is now in the process of hiring its first University-wide director of distance learning to provide leadership to all segments of the institution and to cultivate strategic corporate and academic distance-learning partners.”


Reengineering Beyond the Illusion of Control
by Elazar Harel and Greg Partipilo

UCLA has recently implemented an innovative computing system based on radical post-audit and distributed security concepts. Rather than automating standard manual processes, the University decided to eliminate all pre-approval processes and decentralize access controls. The implementation has resulted in significant cost savings, faster turnarounds, dramatic cultural changes, and improved employee productivity.

The administrative processes of the University of California, Los Angeles, have recently been transformed through the implementation of innovative computing systems based on radical, new post-audit and distributed security concepts. Like many other large public universities, UCLA has a long history of relying on bureaucratic and inefficient administrative processes. The recent State of California and University of California budget crises provided University administrators with an incentive and a mandate to reengineer, automate, and dramatically reduce costs.

Rather than implementing the standard industry method of automating/replicating manual processes, UCLA decided to take a risky leap toward eliminating all pre-approval processes and distributing access controls to the operating department level. We have found that valuable time and a significant amount of money were consumed by manual, or even electronic, approval processes that were historically justified by administrators for control reasons. These reasons have turned out to be an “illusion of control,” costing the University much more than the savings they were supposed to produce. For example, due to the large volume of transactions it has become impossible to verify or check paper signatures. Similarly, traditional automated approval processes turned out to be almost as clumsy and time consuming as the old manual methods.

In this new process, people who key in transactions, such as purchase orders or personnel actions, are now empowered to fully perform their duties and are accountable for the quality and correctness of the data. Electronic mail messages containing a comprehensive view of the completed transactions are automatically sent out to the people assigned the responsibility for reviewing those actions. The key difference is that these reviews are done after the fact; with the

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reviewers assuming the responsibility for taking appropriate actions when and if necessary. Electronic logs of the accountability structure and of all actions are kept online in a relational database and are available to authorized users through a variety of search engines. These logs have proven to be an electronic paradise for auditors and other administrators who have always longed for access to such useful information.

Background: The culture

Over the past few years, the University of California has been facing difficult challenges, which have seriously threatened its financial, social, and economical stability. Financial support from the State of California to the University has continuously declined, while competition among higher education institutions (for students, private gifts, contracts, and grants) has become fiercer. The successful unprecedented growth period of the ‘70s and ‘80s has finally come to an end, and UCLA, being one of the largest UC campuses, was not spared the consequences.

UCLA is a large enterprise measured by any economical terms. Its annual budget is about $1.8 billion, with over 20,000 employees, 35,000 students, a large teaching hospital, and numerous colleges and professional schools. This Los Angeles campus is located in Westwood Village, spreading across 411 acres with over 150 buildings and structures.

Like many other universities, UCLA has developed over the years an “impressive” cumbersome bureaucracy. Many rules and regulations were piled on, based on complicated University, government, and state regulations. The number of paper forms increased exponentially over time; that necessitated, of course, a larger number of paper shufflers, more rules, and more forms. Eventually, many University faculty and administrators became involved in a spiraling paper-signing and -chasing ritual that complicated basic processes and increased the cost of doing business. It was not uncommon to see paper forms with fifteen (or more) signatures, and business transactions that took several weeks to complete.

The culture that evolved as a result of these processes was quite interesting. From a traditional audit perspective this seemed to be a well-controlled and accountable process. After all, so many of the involved parties signed the forms.

From a personal perspective, there seemed to be almost no accountability or risk involved, since so many people signed the papers. One of the authors still recalls his first days as a University director, when one of the campus executives told him, “There’s nothing to worry about; someone will catch your mistakes or save you just in time.”

Such a culture is obviously very dangerous and expensive, and encourages mediocrity. It also promotes the public view of a bloated, inefficient, government-supported bureaucracy that keeps wasting taxpayer money. Based on our experience and on discussions with numerous colleagues, we believe that this kind of a culture was, and still is, quite common in many other large universities and even in large Fortune 500 companies.

As the financial belt started tightening, it became obvious that something had to be done. The University had to cut costs and streamline its processes. It also quickly became apparent that in order to be successful, information technology needed to be a key ingredient of the prescribed medication.

Concepts: How radical can we be?

Thus, a few years ago, UCLA embarked on a process aimed at a fundamental restructuring of its administrative processes. The University’s chancellor unveiled a campuswide blueprint titled, “Transforming Administration at UCLA,” which called for dramatic cultural and organizational campus changes. Key concepts included a shift to personal empowerment and accountability, elimination of bureaucracy, and creation of appropriate incentives to facilitate these changes.1

This was naturally easier said than done. Cultural transformation usually takes a long time and requires an extensive top executive commitment. The process, however, had begun, and first steps were taken to communicate the challenges and issues.

Meanwhile, several of us started thinking about the potential steps that could be initiated. Many of the issues at hand were quite obvious. However, it was not clear how to remedy the situation and how to truly transform the organization. As we started to review what other universities and companies were doing, we quickly found out that the term “computerizing” was far from synonymous with “streamlining.”

forts to allow distributed processing of transactions, they tended towards caution and conservatism when it came to proposing any significant modifications to the associated security access and transaction authorization controls. Basically, their design efforts tended to electronically replicate the long-standing manual processes.

As a result, those institutions that had implemented online transaction processing were not experiencing anticipated reductions in overall processing time. This appeared to be due to three primary factors:

1. System access needed to prepare online transactions, while being requested electronically, was still being reviewed and approved centrally.
2. The transaction authorization process remained basically the same, with electronic preapprovals replacing manual signatures.
3. Since it was now “easy” to add individuals, routing paths, and new approval criteria, the number of electronic signatures often increased, further prolonging the desired purchasing, hiring, or other financial outcome.

After reading Hammer’s now famous “Don’t Automate, Obliterate” article and capitalizing on the experiences gained by others, we decided that it was time to challenge these long-standing and well-accepted system access and transaction authorization policies and procedures. As a first step, the project team identified the core reasons behind the current internal control practices: the central offices reviewing and granting access to systems were only doing this because they alone had the system tools to do so. The resulting time delays were unfortunate, since requests were seldom denied as these central areas had no way of knowing the qualifications and capabilities of the departmental staff. This resulted in an “illusion of control” atmosphere, which had very little basis in reality.

The key reasons that the pre-authorization of transaction documents had been put in place were for department managers to (1) ensure that only authorized personnel were preparing transactions, (2) ensure the accuracy of recorded information, (3) confirm the adequacy of available funding, (4) verify compliance with special funding restrictions, and (5) monitor overall departmental activity. However, as the volume of transactions increased over time, this control became less and less effective. Better ways were needed to meet these objectives.

With these findings, the project team then determined that UCLA’s paperless processing scenario could shorten overall processing times and provide fully automated controls using a combination of new technical tools and revised processing flows supported by modified policies and procedures. The specific recommendations presented and adopted by UCLA management included:

- Developing ASAP (Application System Authorization Process), a post-audit mechanism to distribute electronic mail notifications of completed financial transactions to prescribed department administrators to perform their reviews after processing, rather than before
- Having ASAP provide an accessible and secure repository (audit file) of copies of all notifications forwarded to individuals performing the post-authorization reviews
- Publishing written policy that clearly outlines the qualifications and responsibilities of individuals entering online transactions and those performing the post-authorization reviews
- Developing DACSS (Distributed Access Control Security System), a new online tool that would allow departments the ability to grant system access to their staffs and designate transaction reviewers themselves
- Writing new interfacing programs so applications could interact with DACSS to ensure that only authorized personnel could prepare online transactions
- Building front-end edits (and exception reporting) into the application processes to help prevent department users from entering inaccurate information, expending money if budgetary funds are insufficient, and failing to comply with special funding restrictions

These concepts turned out to be truly revolutionary. The idea that purchase orders or person-
nel actions can be initiated and finalized at the same time and by the same person (see Figure 1) was very difficult for many people to digest. This meant that staff would need to be empowered, trained, and trusted to do their job, while those who used to sign the forms would have to become accustomed to acting or reacting after the fact. It also gave the word accountability a whole new and very real meaning. Figures 2a, 2b, and 2c respectively present a graphic comparison between the old manual process, its electronic replication (as implemented in many places), and the reengineered post-audit approach developed and implemented at UCLA.

Gaining acceptance: The consultation phase

It was in the consultation phase that we began the legitimization process of these concepts. First, we tried to make sure that we were not totally naive or irrational. The core project group, which comprised financial managers, internal auditors, and technologists, discussed the issues over and over again, assessing different alternatives and solutions to the potential problems.

When we were truly convinced that the ideas were good and feasible, we began the second and most difficult task—communicating the concepts to the campus community, conveying the risks and benefits, and ensuring proper support throughout the implementation.

Several key factors contributed to the success of this process:

• Having the most appropriate people right from the beginning of the conceptual stages, including the campus comptroller, budget officer, and key administrative computing staff. Especially critical was the presence and enthusiastic support of the campus internal auditors.

• Strong team spirit and cooperation among the various involved campus offices. The team members were genuinely convinced that the post-audit approach was “the right thing to do.” This was critical in order to stand up to pressure from fearful skeptics who viewed the concepts as “abandoning controls.”

• The creation and demonstration of prototypes of the proposed system to various University audiences. The ability to quickly build screens and present them to the users kept the momentum and enthusiasm going. The prototypes were continuously revised based on the feedback received.

• Flexibility in rolling out the post-audit concept. It was extremely important to listen to and to analyze many concerns that were brought up during the consultation phase.
Issues such as proper logging of all activities and technical certification of electronic mail systems, required proper attention and needed to be resolved promptly.

- Timely development of policies regarding the qualifications and responsibilities of transaction preparers, reviewers, and security administrators. The subsequent training of the involved parties regarding these policies was also a critical success factor.

System design
Both ASAP and DACSS were designed as core infrastructure systems. They underline and interface with all other administrative computing systems which are a combination of purchased and home-grown applications (e.g., purchasing, payroll, billing, and financial journals.) All system data are stored in a relational database (DB2) and are available online to authorized users through predefined screens or via ad hoc SQL queries.

The new paperless processing scenario at UCLA begins with local departments defining their accountability structure, which delineates the personnel responsible for processing and reviewing transactions. This step first involves selecting a Department Security Administrator (DSA). In conjunction with the chief administrative/financial officer, this person helps identify those who will be entering and updating data (preparers) and those responsible for reviewing these transactions (reviewers) for each specific online application. To ensure the integrity of the “check-and-balance” control mechanism, the preparer and reviewer must be different individuals. This accountability structure is then entered directly into DACSS by each DSA; it is the “glue” that holds the entire system together.

The post-audit process is performed through two main avenues:
- As transactions are finalized, electronic mail messages (a comprehensive view of each completed transaction) are generated by ASAP and are transmitted to the appropriate reviewers throughout the work day. At least one reviewer has to receive an electronic mail notification in order for a transaction to be completed. The campus policies state that the reviewer is accountable for reading the notification within two working days. The system, however, does not verify that the mail was actually read. The reviewers are identified automatically by the system based on the accountability structure stored in the DACSS database. This assures that notification messages are sent to the appropriate reviewers and that the transaction preparers cannot tamper with the process. The preparer has the option of copying additional people on the electronic mail messages (see Figure 3).

- An audit log of all transaction and electronic mail messages is maintained and is available online. Authorized users can search the log based on numerous criteria (e.g., date ranges, identity of the preparer, transaction amount, account number, etc.) and are provided with a list of all transactions that satisfy these parameters.

Benefits and lessons learned: It was worth it!

The implementation of the post-audit and distributed access controls at UCLA has been extremely successful. Almost all financial and payroll transactions are now executed under the new paradigm by several thousand users in almost 300 departments. A recent audit conducted by the University external auditors concluded: Our review found no major control weaknesses which would significantly impact either the University’s MIS general control or the DACSS/ASAP control environment. With respect to the DACSS and ASAP systems and the process for preparing and reviewing online financial transactions, we believe the University is well ahead of its peers in its use of information technology to automate this process.
Processes that in the past took two to six weeks (or more) to complete and that traversed numerous approval desks are now being completed in a matter of seconds. Transactions that previously required four or more signatures are now typically reviewed by only one or two people in a post-audit mode.

The number of transaction errors has been reduced dramatically, primarily due to the increased awareness of personal accountability and to the edit controls that were added to the various application systems (e.g., verification of account numbers, ensuring sufficient funds, etc.) For example, one of our departments reported a decrease of monthly errors from 500 to 5! This, of course, significantly reduced the manual labor required to detect, correct, and explain the mistakes. Needless to say, customer satisfaction was also positively affected.

The systems allow for the delegation of financial management from central authorities to operating units. Thus, instead of routing paper forms all over campus for approvals before a transaction can occur, teams of preparers and reviewers in the operating units can conduct transactions online. Because of online processing, paper filing for purchases, personnel, and financial transactions have been reduced by 80–90 percent, resulting in staff time savings and regained office space.

Without top management and auditors’ commitment to the concepts, it would have been practically impossible to challenge the longstanding (and traditional) security and approval practices. Also, the prototyping approach was mandatory to effectively show the skeptics how the new controls are much more effective than the old. Without such early demonstrative proof, it is likely that the fear of “loss of control” would have persevered, causing designers to “automate” in the old way. As can be seen from Figure 4, the number of transactions generated by the purchasing, payroll, and transfer of fund systems has significantly increased over the course of the implementation process (migration from the old to the new process), thus indicating the success and the users’ “faith” in the post-audit review philosophy.

Training of users and executives proved to be one of the most important factors affecting the success of the implementation. The internal audit department, in coordination with other units, developed a comprehensive training session that addressed critical issues such as the changes in responsibilities, the accountability structure, and the use of the systems.

Although it is quite difficult to estimate the total cost savings realized by the implementation of the post-audit methodology, it is clear that the savings were substantial. An unofficial quick and very conservative calculation shows that if a total of only five minutes of staff time were saved for each transaction, the campus has realized an ongoing annual saving of at least 30,000 staff hours or about $600,000 (number of transactions X the time saved per transaction X average salary) due to the post-audit process. These savings are realized in reduction of personnel or a shift of resources to other activities. Significant additional savings were also realized with the elimination of outside form data entry (more than $300,000 per year) and the decentralization of access controls (at least $100,000 per year).

It is important to acknowledge the benefits of selecting electronic mail as the mechanism for delivering the notifications to the reviewers. Our goal was to build a process that would facilitate a quick delivery of the notifications without inconveniencing the reviewers, who typically are busy managers. Electronic mail was found to be the obvious choice—most people were already using it and there was no need for system training on how to use it. Additionally, this practically assured that reviews are performed in a timely manner, since most people check their electronic mailboxes at least once a day. The use of electronic mail also involves some calculated risk, since it is not possible to verify that the review actually occurred (reviewer may not have read the message or message may have not been delivered). We addressed these issues by: (1) issuing a campus policy that requires reviewers to check their electronic mail within two working days of the transaction, and (2) implementing an automated process that alerts the help desk on the

“... the prototyping approach was mandatory to effectively show the skeptics how the new controls are much more effective than the old.”

![Figure 4](image-url)

The steady growth in number of online transactions shows that departments have moved away from the old manual process and have faith in the post-audit system.
An important shift in roles of central offices has resulted from the implementation of the post-audit process. These offices, which used to process transactions and play the “police” role, are now engaged in broader corporate activities that include policy setting, departmental support, training, and education.

Although it may be difficult to believe, there were only a few problems or disadvantages resulting from the implementation of these concepts and systems. The biggest challenge was addressing the skeptics who did not think that such an approach is workable. The other was accepting the risk (and the associated accountability issues) that some of the reviewers might not perform their duties as defined by the policies. Our experience so far, two years after the initial implementation, indicates that the process is working remarkably well and that the campus community (4,000 users in over 300 departments) has made no overtures to return to the classic pre-approval process.

The single, key factor that made this complex implementation successful is not the technology, but rather the unprecedented cooperative relationships between campus administrators, internal auditors, and the administrative computing department.

Implications

The issues presented in this article can have significant implications for other institutions that face similar problems. We believe that challenging the traditional approval and access control processes can be valuable for many organizations, not only throughout the higher education community, but also across a large range of private and public industries. Following are a few general guidelines that are based on our experience:

- Do not shy away from radical concepts if they are believed to have significant value to the organization. With the right approach and good teamwork, it is possible to implement systems that may be considered unthinkable by many people.
- Communicate the content and value of the new concepts throughout the organization. Radical concepts usually sound strange to people when first introduced. Continuous discussions and strong belief in the ideas are critical.
- Employ prototyping tools to allow for quick adaptation of the system. These prototypes also serve as excellent communication tools that give skeptics the opportunity to “see” what the system does and how the concepts are implemented.
- Be aware of the personal fears and political implications resulting from the recommended processes. It is very important to address those issues and identify acceptable alternatives without compromising the basic principles.
- Develop and deliver the best possible training program. User training is crucial to the successful implementation of any system, but it is even more critical when processes are altered and responsibilities change.

Summary and conclusions

The conceptualization and implementation of post-audit principles and new distributed security practices at UCLA can have far-reaching implications to institutions in numerous education and business sectors. This article describes a complicated process that resulted in a fundamental cultural change and significant cost savings using information technology tools.

To the best of our knowledge, UCLA was the pioneer in the implementation of the post-audit philosophy, and the University of California is probably still the only institution that has implemented this approach on a large-scale production environment. This concept has proven to be successful and has practically become a cultural “way of life” within just a few years.

We hope that the reader is able to identify with at least some of the cultural and transformation challenges presented here. We believe that comparable “illusion of control” situations can be found in practically every business. Post-audit and distributed access control solutions may be applicable to many of them.

Our journey toward a transformed University administration still has a long way to go. It is clear that information technology will play an even greater role in this challenging process. We hope to be able to continually introduce innovative and extraordinary solutions.
Implementing Electronic Forms with the World Wide Web

by George P. Pipkin

A strategy at the University of Virginia to use electronic forms to reduce the size of its data entry operation has led to the development of a prototype of an electronic forms system based on World Wide Web technology. This article describes the elements of the system, its structure, and its implementation to date.

Along with many other large institutions, the University of Virginia (U.Va.) is actively looking for ways to simplify its business processes and reduce the overhead associated with administration. One of the most important tools that we can use to work toward this goal is the University’s high-speed data network. A fundamental strategy we hope to employ is to convert much of the paper that people work with on a day-to-day basis to digital formats on the network, and in doing this nurture automation and process simplification while increasing the overall speed of information flow throughout the organization.

The University’s administrative sector still relies on paper-based objects of work that are moved around the institution through a manual messenger-mail system. The majority of these objects are forms and reports. More than 1,200 different types of printed forms are used institution-wide, and every month our administrative mainframe produces more than 700,000 sheets of paper reports.

In 1994, the University embarked on a plan to reduce the resources needed to run its administrative mainframe. A key strategy associated with this effort was to use electronic forms to reduce the size of its data entry operation. The University’s Information Technology and Communication (ITC) department examined several commercial electronic forms packages in great detail, but found that they fell short of our needs in a number of ways. Some of them were only available for Windows platforms. Most of them relied on e-mail as the transmission medium, compromising the system’s overall robustness and reliability. All of them required a high-maintenance environment to be fully functional, both at the workstation and at the server level. Because we assessed the potential range of use as a key factor in the ultimate impact of this strategy, introducing a solution that required substantial maintenance was unacceptable.

Since the emergence on several platforms in the fall of 1994 of World Wide Web (WWW) browsers¹ that fully support electronic forms features, many users of the Web have become accustomed to encountering data-input fields on the pages they see. However, fewer people realize how this capability could be put to use to construct a full-fledged enterprise electronic forms and work flow system.

The capability Web browsers deliver is based on openly defined protocols. Browsers have been written that support these protocols on a wide range of platforms, and new browsers are appearing every month. Increasingly, a Web browser is becoming a base component of the personal computer operating system. This fact gives any system built on a Web client (the software resident on the workstation) a potential reach that even widely distributed proprietary

¹ A browser is a program that allows a user to read hypertext by giving some means of viewing the contents of network nodes and of navigating from one node to another. Examples of browsers for the World Wide Web include Mosaic, Lynx, and Netscape; they act as “clients” to remote “servers.”

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electronic forms and work-flow packages can't match.

Web browsers are extremely flexible: they can display a wide variety of objects directly, and because they are MIME-based, these clients can coordinate the use of specialized viewers to handle objects with which they are not directly familiar. When this flexibility is combined with their native electronic-forms capabilities, the result is a versatile work-flow client.

Web "pages" that you see in your browser actually are stored on a WWW server. In the case of interactive Web pages, there is a lot more happening on the server end than simply transmitting an HTML document that is stored there. Special "handler" programs are necessary to respond to whatever the user puts into the page. While a variety of generic handlers have emerged that will e-mail information that comes from Web-based forms to a specified address, they fall short of what is required to support work flow. This includes management of an extended dialog with the user, control of access to different functions, and the ability to "route" objects from one user to the next in an organized way.

Last year, the University of Virginia set out to implement an infrastructure that would allow us to surmount these challenges and use WWW technology in support of its process simplification goals. WWW clients and servers are being used initially to create an enterprise electronic forms "front end" (user interface). We also hope to use the same combination to deliver reports electronically over the institution's broadband network. The anticipated outcome is a major contribution to an institutional program aimed at streamlining its administrative processes and ultimately redirecting resources to more directly support instruction and research.

Infrastructure elements

For Web browsers to be used to meet the needs of colleges and universities for full-fledged electronic forms and work flow, a number of missing components will have to be developed.

Handler program generation. The most obvious need is for a facility that will digest the HTML code associated with a form and generate the "back-end" handler components specific to that form. Servers must be capable of delivering blank forms to the Web client, transferring data from filled-in forms to a centralized DBMS record, and taking the data out of that record and putting them back into a form so that they can be edited or reviewed.

Point-and-click designer tool. Users need a user-friendly tool that will allow them to create new forms without having a prior knowledge of HTML, or other specialized programming languages. Even though workstation-based tools are available, they are specific to particular platforms, and require uploads to move the resulting forms to the server. The tool described in this article is server-based and will integrate seamlessly with other components of the forms infrastructure.

The in-box. A mechanism is needed to present a virtual in-box that will provide easy access for individuals who need to review or approve forms.

Authentication. Individuals filling out or reviewing forms must be able to identify and authenticate themselves to the system and not have to supply a password with every page.

Business rules. There must be a mechanism to check the information coming out of electronic forms and ensure that the entries comply with organizational rules and policies.

Routing. There must be a routing engine that will move the forms to the places where they require review, retaining a log of everything that happens, and providing an easy way of checking on a form's current status. The routing engine must be capable of delivering forms to the points of entry for enterprise transactional systems once they have passed through the business rule filters and the approval chain.

Transactional system point of entry. There must be an easy way to format data for transfer to transactional systems and a mechanism to effect these transfers in an organized and scheduled way.

The system's structure

The University of Virginia's electronic forms system uses special handler programs to manage the interaction between the user and a central database that resides on the WWW server. Each handler program corresponds to a particular form. The programs are actually perl scripts, and they are produced by a code generator that processes the hypertext markup associated with the form and creates the necessary specialized handler program that runs on the Web server. This program accepts data coming in from WWW forms being submitted from client machines and conveys these data to tables in the database that are specific to particular form types or other objects. When the user wishes to edit a particular form, the handler retrieves these data and places them into a form that is sent to the appropriate WWW workstation client. This handler component also implements the form's associated business rules and carries out routing functions.

Access to individual forms is facilitated by a "virtual in-box" that is stored in the central data-
base. Only those forms or other objects that are currently associated with a particular user are seen in his or her in-box. Forms are visible in one in-box and then another as they are routed through their approval chain. When a form has reached the appropriate stage in its routing process, its handler transfers information to transactional systems through a kind of “data pipeline.”

The handler program
At the center of this architecture is the object handler. It is specific to the object itself, carrying with it all the methods necessary to access the information by both human and other systems.

The most difficult challenge in implementing an architecture such as this is the work involved in creating specific forms handlers. Since there will be typically thousands of different forms, writing specific object handlers for each one is not cost-effective. However, because each electronic form has a unique set of data elements, business rules, and routing processes, the use of generic handlers is also impractical.

The resolution of this problem for electronic forms is approached through the use of a “code-generator” program that determines the syntax of the hypertext markup associated with a particular form and automatically generates perl code necessary to respond to data coming from the form to the server. Sometimes the appropriate response might be to send the form back to the client with the data just entered. On other occasions, the response would be to finalize the form’s data in the central database and make them visible in the approver’s in-box.

Most of the basic information necessary to generate the handler program is contained within the HTML description of a form. Additional functionality necessary to support complex objects, field checks, business rules, and routing is inserted through the use of pseudo-tags (embedded in HTML comments) and special parameters inserted in conventional tags.

A point-and-click designer
One of the most significant barriers to real user empowerment is a system requiring users to represent things in code as opposed to using visual tools. Even though users can be taught to code relatively simple objects, anything with a moderate or greater degree of complexity will present barriers that will diminish the overall usefulness of the forms tool, restrict the role of creating forms to computing professionals, and ultimately undermine the potential for electronic forms to actually reduce staffing requirements. In addition, while program-generated, HTML-based forms can be quite complex and interactive, the existing version of the language is very limited in its ability to completely represent them.

The solution is a point-and-click “forms cre-

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**Figure 1**

<table>
<thead>
<tr>
<th>Point-and-Click Designer Tool &amp; Code Generator</th>
<th>Designer and Code Generator produce form-specific handlers</th>
<th>DBMS stores object’s data</th>
<th>The Object Handler</th>
<th>Common Gateway Interface (CGI) — Application Program Interface (API)</th>
<th>Web Server</th>
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<tbody>
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<td>Transaction Pipeline</td>
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<td>Enterprise Legacy Transactional Systems</td>
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<td>In-Box - Index to Your Objects</td>
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<td>Form Displayed for Review</td>
<td>WWW Client</td>
</tr>
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</table>
“The application of enterprise business rules automatically as early as possible in a form’s processing chain is a major benefit of using electronic forms.”

HyperText Markup Language (HTML) provides only for relatively simple forms components such as input fields or radio buttons. More complex components such as an expanding data grid can be supported by combining the simple field types that HTML does provide and coordinating them with the back-end handler. Within the designer, these complex objects are just another type of object in the system’s overall catalog. The catalog can also include a wide variety of images, backgrounds, and custom buttons, so it will be possible to create attractive pages with this facility. Also included in the catalog can be standardized components such as a name and address or an account code, which carry with them an intricate set of value checks that conform to institutional data definitions.

The designer’s end product is an HTML file that is directly conveyed to the code generator. This file may contain some unique pseudo-tags and parameters to implement special features, but nothing is generated that will cause standardized browsers to produce errors. This interim HTML file is an important feature because it allows users to define forms through other mechanisms or code them directly if that is desired.

The in-box
Access to specific forms is managed through the in-box mechanism. This functionality is made possible by a table in the central database. Each row in this table corresponds to a particular form and identifies in whose in-box a reference to the form appears. Routing is accomplished by modifying this identification as a form goes through its approval chain.

**Access control and security**
Controlling access to objects—forms in particular—is an essential component of the system. This is made more difficult by the stateless nature of WWW technology. There is no “session” with the host, so user IDs and passwords must be embedded within every page and verified with every transaction of the conversation between client and server.

There are two ways the system minimizes the exposure posed by embedding authentication in this way. First, a secure server is used that encrypts the data stream and prevents exposure through “sniffing.” Second, the system uses a temporary password scheme that presents a unique authentication key every time there is an exchange between client and server. The key is periodically re-randomized, making it difficult to “jump in” and “steal” the virtual session.

**Applying business rules**
The application of enterprise business rules automatically as early as possible in a form’s processing chain is a major benefit of using electronic forms. These rules can range from simple edit checks on the data to more complicated verifications.

If a rule is triggered as a result of bad data in a form, the entry is transmitted back to the user in the appropriate form template along with a helpful message pointing out what was wrong and how to fix it. Forms can be “held” in an individual’s in-box until they are ready to be routed. If the user is unable to correct the information, it stays there until it is corrected or deleted.

The rules themselves are included in the handler programs and are invoked when appropriate by its various methods. Simple “edit-check” rules are defined in the designer and are carried to the code generator as pseudo-parameters embedded within conventional tags. A great deal of complexity can be supported, including value checks against external databases, comparisons against summary calculations, and queries involving enterprise facilities such as an X.500 directory.

**Routing**
Because the system’s objects are server based, they never actually move—they are always contained within a single database management system. However, access to them

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5 A sniffer is a network monitoring tool that can capture data packets and decode them to show protocol data.

6 X.500 is the set of ITU-T (International Telecommunications Union, Telecommunication Standardization Sector) standards covering electronic directory services such as white pages.
changes as a result of the operation of routing functions, thereby giving the impression of movement.

Like business rules, routing rules are embedded in the object handler and invoked at appropriate times by specific methods. Different routing rules must be used at different times in the routing process. Each step in the process has a series of rules associated with it that are only invoked when that step is current.

Routing happens because routing rules manipulate entries in the in-box table. Appropriately written rules can do much more than route—they can kick off events such as e-mail notifications, logging events, or transactional update processes.

**Transaction pipeline**

An important step in the routing chain for many objects—especially electronic forms—involves the transfer of information to a transactional system. This is handled by methods contained within the object handler that act very much like the methods that cause the information to be sent to a human user with a Web client.

The demons that convey information to transactional systems access the link table to determine when an object is ready for data transfer. This is indicated in the same way as other routing steps. When the right conditions have been met, the data are conveyed by the pipeline demon to a batch file. This file is sent to the appropriate transactional system on the University’s administrative mainframe.

**Implementation**

A fully functional prototype of the electronic forms system described here was written by the author in the summer of 1995. Following this, a team of programmers began implementation of a production system and testing of the first two forms began in February of 1996. Some features in the prototype did not make it to the production version, but the basic design and functionality are the same.

A pilot effort is underway to test the new system in two administrative departments. We have provided short training sessions to familiarize new users with the forms as they appear in their WWW browsers. Not only has resistance to the change among administrative staff proved to be considerably less than anticipated, users appear to be approaching the new system with enthusiasm.

One of the lessons learned so far is the importance of focusing on features that will make data entry easier. This includes the ability to support templates specific to a particular group of users and deliver blank forms with certain fields already filled in with values appropriate to them. Another feature frequently requested is the ability to “repeat” values from one form to another.

At the approver level, the interest is in sophisticated routing. What people at this level want is for forms bearing information that meets particular conditions to be routed in a particular way. For example, all expenditure requests for a particular type of commodity might need to be routed to a particular approver for special examination.

Another way electronic forms are adding value involves sophisticated data verification. With the current paper-based system, a fairly high level of resources is expended resolving bad data that come into the system. This can include things as mundane as bad account codes or accounts charged to inappropriate submitters. Capturing this kind of error at the moment of submission rather than later in the approval chain will enable the University to save a considerable amount of money and reduce bureaucracy.

**Conclusion**

The architecture outlined here takes advantage of Web client capabilities to facilitate reengineering of business systems by reducing their dependence upon labor-intensive paper-based processes. It does so by relying upon client software that is rapidly becoming a standard presence in every network-attached personal computer workstation. It is standards-based and highly modular in design, affording the maximum opportunity to take advantage of new technology as it appears. Finally, by using it we hope to deploy a secure, highly robust electronic forms system at an enterprise level with a minimum of system support costs.

**Acknowledgements**

The author wishes to acknowledge the contributions of Dr. Polley A. McClure, Dave Saunders, Mike Jewell, Candace Graves, Debbie Luzynski, and the Wookie to the work described in this article.

This article was adapted by the author from a presentation he made at the September 1995 Monterey Conference, “Higher Education and the NII: From Vision to Reality,” which was included in the Monterey Conference Proceedings. These proceedings are available from Educom (202-872-4200).

Footnoted definitions of terms used in the article are adapted from the Free On-line Dictionary of Computing, located at: http://wombat.doc.ic.ac.uk/cgi-bin/fooldoc/Free+On-line+Dictionary

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Footnotes:

1. A demon is a program or part of a program that is not invoked explicitly, but that lies dormant waiting for some condition(s) to occur.
E-Mail Etiquette: When and How to Communicate Electronically

by Joseph M. Saul

How would you notify personnel in your department of a policy change? Set up a meeting with a colleague in another department? Wish a sister who lives in England happy birthday? Inform an employee of a change in job responsibilities?

Five years ago, most people would have said “official memo,” “phone,” “mail a card,” and “face-to-face meeting,” respectively. These are all very different methods of communication, and they have different requirements.

Because the policy change is an official action, you would want people to see it on letterhead and have a file copy for reference. A quick phone call would suffice for the meeting, though. Phone calls to England are expensive, so you would probably mail your sister a card. Job actions, however, are sensitive and best handled face-to-face.

These days, many of us are turning to electronic mail for communications we used to handle by phone, letter, or even face-to-face meetings. E-mail is easy to send and does not depend on both parties being available at the same time. It even provides a written record.

E-mail may seem to be the perfect form of communication, but it does have some limitations, and it is not always the appropriate choice. It is important to understand its pitfalls and how to work around them. The four major pitfalls of e-mail are missed signals, lack of context, permanence, and unfamiliarity.

Missed signals

You can’t communicate as broad a range of information in e-mail as you can in a face-to-face meeting, or even in a telephone call. Your words come across, but all the non-verbal signals—facial expressions, eye contact, body language, tone of voice—are lost. We usually don’t think about it, but we depend on those signals for information about the context of what is said; we need the signals to help us interpret the meaning beneath the words. Without them, we are often left to guess at the other person’s intent.

These non-verbal signals are the main reason that most people prefer to handle sensitive issues (such as employment actions) in face-to-face meetings. When the situation is already potentially tense and you want your meaning to be absolutely clear, you want to have as much information as possible flowing back and forth.

Conversely, this is why e-mail conversations can become so heated. It’s hard to say something “with a smile” in electronic mail, and it is all too easy to misinterpret an offhand, joking remark as a personal attack.

Once tempers flare, both parties—each operating without those important nonverbal cues to meaning—tend to read their worst fears into the written words and react in kind. This can happen even among friends, but when the parties involved don’t know each other well, it can be worse.

As a result, experienced e-mail users have developed conventions for showing when they are joking—interjections such as <grin> or the use of “smileys,” such as this: :- )

(If you haven’t seen one of these before, tip your head to the left to see the smile.) Unfortunately, these methods are not universally understood and communicate only a limited amount of meaning.

What is the best way to avoid misunderstandings due to missed signals? Give e-mail correspondents the benefit of the doubt and seek clarification (for example, “You sounded annoyed in that last reply. Am I reading you correctly?”). If there is a dispute, don’t hesitate to call someone on the phone or talk to him or her in person.

Lack of context

A note stuck to your door is informal; a signed memorandum on departmental letterhead is official. The way a message is sent tells the recipient a lot—people have learned to recognize the status of a message from its context and formatting cues.

In e-mail, however, both kinds of message look the same. You can’t send an e-mail message on letterhead or on scented stationery. As a result, your recipient not only lacks the non-verbal content of your speech, but he or she also lacks the traditional symbols that would show its status.
and context. If people in your department receive 
an e-mail message saying “Please get all grades in 
by the 25th,” they don’t necessarily know 
whether it is an official statement of policy or a 
plea for help from an overworked administrator. 
As we start to use e-mail interchangeably 
with all of the other communication methods 
available to us, we have to develop ways of 
making the context of the message clear. Eventu-
ally, we may have “electronic letterhead” for 
verifiable official messages. Until then, the best 
solution is to explain your message’s status and 
context right up front. You might, for example, 
state, “This is a formal announcement from the 
office of the director” (if indeed that’s what it is). 

Permanence

Unless your phone is bugged, a phone call 
leaves no permanent record. E-mail, however, 
does—and it can be forwarded again and again 
and come back to haunt you long after you have 
forgotten why you sent the original message. 
(This is especially true on discussion lists, where 
some list members may not see your message 
until weeks after you sent it.) 
Because electronic mail is so easy to send 
and seems so ephemeral, people often forget just 
how permanent it is. You can achieve a kind of 
immortality through your e-mail well out of pro-
portion to the amount of effort it takes to send it. 
It can be a good idea to explain your inten-
tions to the recipient of a message. If you do not 
want your message forwarded, say so. 
The convention on discussion lists and 
Usenet newsgroups is that private e-mail should 
not be publicly posted, but people are occasion-
ally thoughtless or unaware of the convention. To 
be safe, think very carefully before sending a 
hostile or angry message; you can wind up de-
fending your writings long after the feelings that 
motivated you to write them are past. And you 
can wind up defending them to people you never 
thought the message would reach. 

Unfamiliarity

Most people learn to use the telephone and 
to write letters as small children. Appropriate 
phone or letter etiquette is second nature to most 
adults. Most people on your campus, however, 
have had electronic mail for a much shorter 
time—maybe one to five years. Many incoming 
students have their first experience with e-mail 
during orientation. Electronic mail is a very new 
method of communication for most of the people 
worldwide who use it—and they’re still learning 
the ropes. 
As a result, they make mistakes. This isn’t 
surprising; e-mail etiquette is no more intuitive 
than phone etiquette, and everyone has heard 
children answer phones with “Who is this?” or 
simply with silence punctuated by giggles.

E-Mail Etiquette for the ‘90s

Do

◆ Do review messages before you send them out to 
  make sure you are really saying what you want to 
  say. This is especially important as end-of-semester 
  stress rises.
◆ Do be as polite as possible; terseness can be taken 
as hostility.
◆ Do make it clear to the recipient what type of 
  message you are sending, especially if it is official.
◆ Do give correspondents the benefit of the doubt; try 
  not to assume the worst.
◆ Do be patient with inexperienced e-mail users.
◆ Do, if possible, include the portion of the message 
  you’re replying to in your reply; people often forget 
  the original context.
◆ Do enjoy and use responsibly the e-mail resources 
  available to you as a member of your college or 
  university community.
◆ Do be sure that the subject line reflects the subject 
  of your message.
◆ Do include your name at the end of your message 
  when replying to a discussion list.

Don’t

◆ Don’t send a message when you’re angry; cool 
  down, look at the message again, and then decide 
  whether you really want to send it. Most e-mail 
  programs let you easily save a message for sending 
at a later time.
◆ Don’t copy an entire, large message in your re-
  sponse just to add a line or two of commentary.
◆ Don’t reply to “all recipients” unless they all need to 
  see your reply.
◆ Don’t type in all capital letters; this is SHOUTING 
  and is considered RUDE.
◆ Don’t send off-topic messages to mailing lists, espe-
  cially work-related lists.
◆ Don’t “spam” (broadcast messages to multiple lists 
  and/or individuals regardless of their interest in your 
  message).
◆ Don’t send chain letters or messages recruiting 
  participants in make-money-fast schemes; doing so 
  not only usually violates campus policy, but may 
  also violate federal law.
◆ Don’t edit quoted messages to change the overall 
  meaning.

(continued on page 53)
Building Internet Firewalls
by D. Brent Chapman and Elizabeth D. Zwicky
(O'Reilly & Associates, 1995, $29.95, 544 pages,
ISBN 1-56592-124-0)

Reviewed by Kathleen Kimball

Building Internet Firewalls is a “must-have” resource for anyone interested in network security. Whether your passion is policy or protocols, there’s enough in this book to satisfy all tastes. Moreover, the writing style is clear and understandable, with the minimum amount of techno-talk necessary to explain the underlying concepts. Where technical terminology is used, it is explained in sufficient detail that a newcomer to the field can easily follow the discussion, yet this book won’t bore the professional. The fluid style makes it a wonderful starting place for those who are only beginning to become familiar with the peculiar vernacular of the network security practitioner.

While it is possible to read the book cover to cover, its organizational structure makes it easy to jump between topics of current interest. Certainly all readers should, at some point, read the excellent foreword by Ed DeHart and Part I, “Network Security.” They nicely set the stage by reviewing the risks associated with various Internet services, the types of individuals who compromise systems, and the basic types of security models available to deal with the rising trend in incidents.

If your institution’s hottest security issue lies in formulating security policy and in determining how to respond to incidents, you can easily skip to Part III, “Keeping Your Site Secure,” and save the technical meat in Part II, “Building Firewalls,” for a later date. If you have already committed to a firewall strategy either globally or in some departments, Part II will give you more than enough information to discuss the advantages of a screened subnet versus a dual-homed host architecture with the best of them!

Although I often find appendices to be on the decorative or “fluffy” side, in this book they are much more than an afterthought. Even jaded networking experts will find themselves returning to Appendix C for a brief, well-written description of how the TCP/IP protocols work, adapted from Craig Hunt’s TCP/IP Network Administration (O’Reilly & Associates, 1992). It would be difficult to find a more compact resource for explaining the basics of TCP/IP. Newcomers will also find Appendices A and B, on “Resources” and “Tools” respectively, extremely valuable as pointers for follow-on study.

Building Internet Firewalls may not be the best book ever written on network security, but it would certainly rank among the top five. It has earned a place of honor on my bookshelf, right next to Cheswick and Bellovin’s Firewalls and Internet Security (Addison-Wesley, 1994), and Practical Unix Security by Gene Spafford and Simson Garfinkel (O’Reilly & Associates, 1991). (A substantially revised version of the latter was recently published under the title Practical Unix and Internet Security, 2nd Edition). Building Internet Firewalls is well worth a trip to the library or bookstore and is recommended for all information technology professionals, regardless of their prior background in network security.

Reviewer Kathleen Kimball is University Computer, Network, and Information Security Officer for The Pennsylvania State University, where she is responsible for the development of University-wide security policies and procedures, the establishment of effective security training and awareness programs, and security incident response.

Pritchett Change Management Handbooks Series
by Price Pritchett and Ron Pound
(Pritchett & Associates, 800-992-5922, $5.95 each)

Reviewed by Carole A. Barone

Even those who “get it” will find The Employee Handbook of New Work Habits for a Radically Changing World and the other Pritchett Change Management Handbooks useful. Our organization orders them by the case. Since they are a quick read, these handbooks serve as an easy, yet powerful, vehicle to keep us from reverting to the old, and still more comfortable, habits of behavior.

The Pritchett handbooks remind us how fragile the new ways of conceptualizing our environment really are. I always have one or two on my desk and I frequently turn to them when I feel the need to refresh my paradigms.

New Work Habits for a Radically Changing World offers “13 Ground Rules for Job Success in the Information Age.” Each “chapter” is just two pages long and packed with punchy exhortations. For example, the chapter entitled “Speed up” contains this advice:

So many of the changes you see going on these days are designed to help organizations pick up speed. These are not casual moves or random acts dreamed up by bored and heartless top executives. What you’re witnessing are raw survival instincts at work. Organizations must accelerate, or they will die. ... Take no part whatsoever in resistance to
change. If the organization decides to turn on a dime, follow it like a trailer. Corner quickly. Turn for turn. The organization can’t wait for employees to go through some slow adjustment process. It can’t afford to gear down while people decide whether or not they’re going to get on board.

The chapter entitled “Stay in School” ends with a straightforward recommendation that speaks to the importance of such activities as CAUSE’s newly expanded and expanding professional development program.

So just forget about “finishing” your education. Defend your career by developing a better package of knowledge and skills than the next person.

Although this and other handbooks in the series would be useful tools for anyone in an organization, some focus specifically on managers. High-Velocity Culture Change tells managers on page one that “… you’ll have trouble creating a new culture if you insist on doing it in ways that are consistent with the old one.” The authors Price Pritchett and Ron Pound advocate a blunt, hard-hitting, persistent, results-oriented approach to changing the culture of an organization. The title for their final chapter, for example, is “Go Flat Out.”

In Culture Shift: The Employee Handbook for Changing Corporate Culture, Price Pritchett offers guidelines to “Stop doing what comes naturally... and do what works.” In so doing, he attacks many of the shibboleths of our behavior in organizations and, indeed, our self-image and identity as members of organizations. For example, although it is natural to “rely more heavily on your strengths,” Pritchett admonishes, “don’t let strengths become weaknesses.”

Each of the more than a dozen handbooks in the series has a slightly different format. Most are fewer than fifty pages and offer a dozen or so guidelines for achieving the personal or organizational change recommended in the title. The series confronts us with the brunt of the new reality of the information age. While the series does not let us shrink from the full implications of that new reality, it does offer guidelines that enable individuals to establish habits, identities, and goals that are in harmony with it, and it does it with humor and panache.

Reviewed by Carole A. Barone, Associate Vice Chancellor for Information Technology at the University of California Davis. She was the recipient of the 1995 CAUSE ELITE award and currently chairs the CAUSE Professional Development Committee.

CIO Constituent Group...

(continued from page 9)

meeting with topical breakout sessions was new at CAUSE95. Participants agreed that it was successful enough to try again at CAUSE96 in San Francisco, with some suggested improvements: having each participant come with a list of questions to be answered, beginning the meeting with a panel discussion on controversial issues with recognized leaders/innovators in information technology, and focusing more on the big-picture issues (such as the future of transformation in higher education) and less on technical detail.

In the meantime, back on the CIO online discussion list, exchange of ideas has been frequent, detailed, and informative.3 Recent topics have included the pros and cons of specific commercial administrative systems solutions, the best ways to set up student computing labs, the potential effects of the telecommunications legislation, outsourcing information technology services, World Wide Web policies, technology fees, using Social Security numbers for ID numbers, staffing patterns in information technology services organizations, budgeting practices, methods of assessing technology services, and the effectiveness of strategic advisory councils for technology. With this level of online interest and energy, the 1996 face-to-face CIO meeting should be lively and productive.

E-Mail Etiquette ...

(continued from page 51)

People do all kinds of things that offend experienced e-mail users—copying entire messages just to add “I agree,” passing on chain letters, replying to entire discussion lists instead of just the sender, typing in all capitals (which is interpreted as shouting) or all lower case letters. The list of “sins” goes on and on.

Never assume that another person is deliberately trying to be annoying over e-mail without supporting evidence; he or she simply may not know better. Most people, if told politely, will be happy to follow the conventions. They just need to know what the conventions are.

Use with care

E-mail can be a wonderful communication tool when used with care. Avoid the pitfalls, think before you act, and remember that we are all learning the ropes together.

3 The CIO constituent group’s online discussion is archived on the CAUSE World Wide Web server at: http://cause-www.colorado.edu/member-dir/cg/cio.html
**Question:** What is your campus doing regarding authentication of users accessing information resources on your network? If you are using PGP (Pretty Good Privacy) and/or Kerberos, to what extent are they solving real end-to-end problems for you today? What are your plans for the future?

**George Mason University** provides students access to academic records (grades, transcripts, financial aid, admissions, degree analysis, personal data) and course schedules through WWW-accessible servers containing an extract (copy) of the data from the official records. The extracts are updated nightly or weekly, depending on the application. Access is granted with authentication (PIN number).

We plan to expand intranet operations to support other common administrative uses, such as grade reporting by faculty, in the near future.

Jerry H. Jenkins
Executive Director
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The **University of Michigan** uses Kerberos as its network-based authentication system. Approximately 70,000 active users access many Kerberos-enabled applications. Some uses include: students accessing grade and schedule information, e-mail, file systems, directory services, printing, workstation login, Web services, and dial-in access. Kerberos allows us to administer a single security domain and allow single sign-on to our distributed computing services.

Our plans include establishing a public key infrastructure, migrating our Kerberos environment to the OSF/DCE version of Kerberos, having wider use of smart cards to enhance Kerberos authentication, and establishing a more comprehensive single sign-on environment to integrate different security domains.

Ted Hanss
Director
Human and Technical Resource Management
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The **University of Virginia** is currently in the process of investigating, for probable implementation, Kerberos security; DCE has been installed and is currently in production, but used by few applications. KERBEROS is scheduled for production this calendar year. A few of our users (estimate less than 2 percent) are using PGP on their own. One large mainframe application, Accounts Payable, uses the CICS four-character terminal ID for those mainframe clients requiring update access (dial-in access is limited to browse/read only). We have also implemented SecureID cards on some of our critical mainframe applications.

Richard A. Patterson
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for Security and Capacity Planning
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At the **University of Oregon**, we offer about ten courses for our undergraduates in physics and astronomy via networked curriculum. The use of PGP and/or Kerberos is really overkill for the purposes of user authentication. A simple fix makes use of the .htaccess file in which the domain name for access is specified. Thus, for some classes that we don’t want the outside world to see, we restrict access to only machines with domain name uoregon.edu. This seems to work fine for student access.

Very recently, we have implemented a PIN system for use with internal departmental voting procedures. The PIN is entered into a forms-based Web page which is processed by a perl script. To date, this electronic voting/authentication procedure is robust and a real time saver.

Gregory D. Bothun
Professor, Department of Physics
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At the **University of Colorado-Boulder**, we currently use some primitive tools such as domain name restrictions and unencrypted table look-up of student PIN numbers. Library databases are restricted by library card identification. Administrative systems use cleartext passwords and simple authorization schemes. There is no encryption of e-mail widely used. Some Web applications use SSL, and Kerberos is used on all central systems to protect system passwords.

We are planning to move to a uniform security environment built on DCE, with privacy of communications addressed by X.509 certificates. We will use DCE for both authentication and authorization, intending to link the authorization into both applications and databases. DCE will be used to manage the X.509 processing. Time frame: within a year.

Kenneth J. Klingenstein
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The **University of Memphis** currently relies on host-based user authentication systems in addition to a directory-based system for dial-in authentication and access control. In the coming academic year we will implement Kerberos-based authentication and begin converting hosts and dial-in systems to Kerberos under a program called “Universal UserIDs.” This will be among the first steps toward implementing a comprehensive distributed computing infrastructure.

Also in the coming academic year we intend to move to a common e-mail system. One of its specifications is (eventual) support of standards-based authentication, non-repudiation, and confidentiality mechanisms. Although it is one tech-
nology with these attributes, PGP per se will not be required.

I am currently following developments regarding LDAP (Lightweight Directory Access Protocol) with great interest. It appears to be the first approach to solving the unified directory problem that has the technical potential, the weight of standards bodies, and the industry momentum needed to be successful. My “holy grail” is to integrate our various host and application authentication and access control systems with a common directory. Perhaps that will be LDAP.

Tom Barton
Director, Network Services
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At Indiana University Bloomington, PGP-encrypted messages play a role in our “distributed account generation system,” which annually manages the creation of tens of thousands of user accounts on a multitude of time-shared systems across the campus. The central generation system encrypts user account requests (including sensitive information such as passwords) for immediate automated processing on the target system.

Aside from using Kerberos in a few traditional ways, we also use it as a back-end authentication service for some WWW-based applications (such as the aforementioned account generation system). Users enter their Kerberos principal name and password into a form (preferably over an SSL-secured connection), and the CGI application verifies this against the Kerberos database. Although this is not at all what Kerberos was designed for, it easily and pragmatically solves a major problem for us: it allows multiple Web servers on campus to authenticate a population of some 60,000 users.

Larry J. Hughes, Jr.
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Cornell is using Kerberos for authentication. Although not all of our client applications are Kerberized, we are moving towards that goal. One of our biggest concerns is network security. All of our residence halls are wired, and network sniffing has now become a serious problem. We had several reports of passwords stolen in this manner. We try to encourage the use of Kerberized passwords where this is an option (e.g., Eudora) in order to prevent this. Our Kerberos database also provides us with one single repository for passwords, and all of our distributed servers can authenticate users without maintaining passwords locally. We are able to provide a wide range of services that users can access with their single netID and password.

For the future, we are looking at PGP (or something similar) to provide secure e-mail and signature verification. We hope that digital signatures will reduce the amount of prank e-mail. Encryption of messages will provide protection in cases where confidential e-mail is misdirected or where the network is not secure.

Barbara Skoblick
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All students, faculty, and staff at Clemson University use NetWare Directory Service (NDS) version 4.1 for authentication. Authentication clients were written for the mainframe (MVS/RACF), the primary e-mail server (UNIX/POP), and NT World Wide Web servers. The authentication server application NLM runs on multiple NDS servers for fail-over and load balancing. Passwords may be changed from mainframe applications as well as with standard Novell commands. Novell “intruder detection” and password rules are implemented. Future enhancements will include “single-point” network login and password changes from other clients.

Dave Bullard
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At Université Laval, Quebec City, Quebec, Canada, we are not yet using Kerberos or any other similar tool. PGP is used on an individual basis by those few persons who know what it is, when they think it is absolutely necessary. We don’t foresee a big use of it until it is friendly and fully integrated within popular e-mail tools like Eudora running on Wintel and Macintosh.

About network and information access, the staff (faculty and administrative) is authenticated by local managers when they request access codes and passwords.

For the students, we are still using a paper contract that they have to sign to activate their access code and its password, after they have registered on a server. For authentication, we ask them to attach a filled-out registration form that we are sure they are the only ones to receive. We hope to be able to change that when there can be a secret and secure PIN for each student record.

J. M. Poulin
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“All of our residence halls are wired, and network sniffing has now become a serious problem.”
With an overall design goal of “reusing existing resources whenever possible,” security schemes used for touch-tone registration were enlisted at the University of Delaware to provide similar protection to the Intranet applications. ID and PIN (Personal Identification Number) authentication was already known and in use by students and staff for many touch-tone applications. Additionally, PIN-based authorization tables were also in place for existing administrative systems.

In order to protect the authentication information as well as the private records of students, faculty, and staff, Netscape’s Secure Socket Layer (SSL) encryption protocol was adopted. This protocol was selected because of the popularity and success of the Netscape’s Web browser and because its socket-level encryption is ideal for supporting the re-use of existing authentication and authorization schemes.

SSL uses encryption to enhance user privacy by providing a communications channel that is secure against eavesdropping. When an SSL-aware browser connects to an SSL-secured server, all information passing between browser and server is fully encrypted. This secure data circuit allows existing authentication and authorization information to be safely exchanged on the network.

Re-using existing authentication schemes enabled Delaware to quickly and inexpensively provide secured access to all administrative systems.

Carl Jacobson  
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UC Davis has two Kerberos servers for authentication. A directory service based upon a relational database model of all University affiliates has been created to use SQL queries to quickly populate the Kerberos server as the service is requested. This service is available to all departmental machines that wish to use Kerberos for security. A Kerberos password is required for access to student information through the World Wide Web.

Access controls for the Student Information System have been enhanced with the Enigma Logic one-time password system. We have contracted with Cybersafe, a leading supplier of Kerberos software, to integrate the use of the Enigma Logic password system with Kerberos authentication. This configuration will be available in the Summer of 1996 for all UNIX systems at UC Davis.

We are also using RSA certificates in limited applications and have done some work with PGP and electronic mail. However we do not have any plans for widespread use of these systems in the next six months.

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Computer system security is recognized as a high priority at UC Davis. Information Technology has two staff members acting as Security Coordinators, developing and implementing policy in coordination with campus departments, assisting in the resolution of security problems, and developing security systems for the distributed computing environment.

Selected responses to the Fall 1996 Readers Respond question will be printed in the next issue of CAUSE/EFFECT, space permitting. All replies will be included in the online edition available on the CAUSE Web server.

Fall 1996 Readers Respond Question

Is your institution experiencing a crisis in support for information technology, in terms of both human and financial resources? How is your organization responding? What are some of the mechanisms that are working well?

Please send your response, along with your name, title, e-mail address, phone and fax numbers by electronic mail to eharris@cause.colorado.edu; by fax to 303-440-0461, or by regular mail to Elizabeth Harris, CAUSE/EFFECT Managing Editor, CAUSE, Suite 302E, 4840 Pearl East Circle, Boulder, CO 80301.