CAUSE/EFFECT

A magazine about managing and using information resources on college and university campuses

Engineers and Ivory Towers

Observations on Benchmarking Information Technology Support

Managing Technological Change in Academe

Rolling Out a Data Warehouse Quickly at UMass: A Simple Start to a Complex Task

Evolution of SOLAR, Harvard’s Client/Server Fundraising Management System

Trends and Challenges for Academic Libraries and Information Services

PLUS:

Why Your Campus Should Consider Adopting OSF’s DCE Standards

DCE: A Foundation for Administrative Software Collaboration in Higher Education

Campus Profile: Seattle Pacific University
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Cover photo: Demaray Hall, on the campus of Seattle Pacific University, is the University’s main administration building. The “clock tower” is a primary campus landmark.

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The growing awareness of the importance of electronic information resources to institutional effectiveness in higher education has prompted increasing recognition of three fundamental issues:

- the need for an institution-wide planning process that links academic priorities with information resources strategies and budgets;
- the need not only to build infrastructure but also to focus on information technology training and utilization to leverage IT investments; and
- the role of information resources professionals in addressing these needs.

Electronic information resources are integral both to the administration of our institutions and to the fulfillment of the educational mission, so isn’t it time we stopped planning for them as if they were only a departmental concern? Whether the focus for planning for such resources has been in central IT and library organizations or at the academic department level, these approaches will no longer be adequate in the future—the investments and potential payoffs are too great. Authors Ernst and Segall recommend a “holistic” approach to planning and budgeting for information resources, at the highest level of the institution, where necessary tradeoffs can be made to ensure a healthy academic program with the requisite technology infrastructure to support it. Such an approach was recently adopted at Seattle Pacific University (see Campus Profile), where a technology advisory group—reporting to the President’s Cabinet and taking a university-wide view of technology needs and utilization—will ensure that SPU’s technological investments appropriately support administration and instructional delivery.

This need also emerged as a significant factor in a benchmarking study conducted by the Pennsylvania State University last year in partnership with five peer universities, the results of which are reported in this issue. One of four major principles articulated in the article is the practice of using policy, budget, and strategy measures to maximize the benefits of IT.

Responding to several interview questions following his recognition as the recipient of the 1994 CAUSE Exemplary Leadership and Information Technology Excellence Award, Bob Heterick emphasized the important role of information professionals in making faculty and administrators on their campus aware of the implications of information technology to the education process. The key to playing this role successfully is not necessarily being in an influential position—although that makes the job easier. Rather, says Heterick, information technologists must find a way to articulate the value of IT in terms that campus leaders can understand and relate to, and help define new instructional paradigms through those who do have influence.

Another principle identified in the Penn State benchmark study emphasized customer service as a means of ensuring the integration of technology into the campus culture. Without adequate user support, training, and collaboration to demonstrate the benefits of technology, there will be no paradigm shifts or transformations in the way a campus conducts its business. As Bil Stahl suggests in his Viewpoint about trends and challenges in information resources management, information professionals must now “lead and adapt, rather than control”—lead by applying technology to solve real problems, adapt when customers find new uses for that technology.

Carol McKnight’s article also addresses campus trends and challenges, especially with respect to incorporating electronic information resources into the teaching and learning process. Drawing on information gathered through a series of interviews she conducted last year with leaders at a dozen Northeastern institutions of different types and sizes, she identifies some common strategies for investing in the future.

Given the critical role that electronic information resources are playing and will continue to play in higher education’s ability to respond to cost and productivity pressures (see Richard West’s CNI Report), seeking ways to leverage our technology investments is a critical concern of information resources managers. Working together to find common solutions to the common challenges our campuses are facing has always been a goal of CAUSE members, and it will become even more important in the next few years.

In her inaugural From the Chair column, Polley McClure outlines CAUSE’s priorities for the coming year, one of which is based on the association’s recent endorsement of the Open Software Foundation’s Distributed Computing Environment (DCE) standards. Board member Sam Plice elaborates on why your campus should consider adopting DCE, and Nancy Yuochunas makes an excellent case for this set of standards as a foundation for sharing administrative applications in higher education.

In the coming months, CAUSE will work toward providing more information to help you investigate OSF DCE. We urge you to share your campus’s plans and activities related to these standards, by submitting an article to CAUSE/EFFECT or contributing campus documents to our library.

Julia A. Rudy, Editor
Competition in Higher Education?

by Richard P. West

Whether or not the perception is justified, higher education costs are widely viewed to be out of control. The perspective has been that costs have been passed through to those who pay, rather than that higher education has made any attempts to control costs. It is increasingly clear that the pass-through approach has run its course. The call for productivity improvements is heard as the way to provide better value for dollar paid, for students as well as other benefactors of higher education services.

If other sectors of the American economy have responded as needed to similar cost and productivity pressures, why can’t higher education? As higher education accepts the challenge to improve productivity, technology is most often mentioned as a primary means to achieving more output for the resources invested.

At its first task force meeting in the fall of 1990, CNI identified instructional delivery via networked resources as one of several areas the CNI program would encompass. Educom has also had as a major focus the use of IT as a way of improving the quality and reducing the cost of higher education instructional delivery. For years, Educom supported the Educational Uses of Instructional Technology (EUIT) project, and now its National Learning Infrastructure Initiative (NLII) will concentrate on ways that new forms of information technology can help the learning process.

While the NLII has a primary objective to create partnerships with faculty, academic discipline societies, and universities to encourage different approaches to providing instruction, CNI has focused on the “early adopters” of these networked technologies—identifying them, synergizing them, capturing and disseminating their lessons, and giving voice to their needs—as well as the importance of faculty, library, and computer center collaboration as the key factor in making sustainable progress. CNI has hosted a session at the last three annual Educom conferences where the winners of a CNI-sponsored national competition of the best examples of technologically assisted pedagogy have demonstrated their instructional techniques. In addition, last summer CNI sponsored a retreat for “new learning community” teams of faculty members, information technologists, and librarians drawn from ten competitively selected projects, and plans to do the same again this summer.

Educom’s and CNI’s efforts have provided good examples of how productivity in higher education might be improved. But is this enough? Will the demonstration of technology and pedagogy be sufficient to meet the productivity improvements that are being demanded from higher education? Probably not! Technology, particularly networked technology, is necessary but not sufficient to improve higher education’s productivity. Actually, information technology will be the means to create productivity improvements but, I suggest, in an indirect way, rather than the direct way demonstrated by exemplary projects on how to use technology effectively.

The limits of pedagogical innovation with the aid of technology is only bounded by our imagination. My sense is that we are on the verge of a revolution in the use of networked technology in providing education in cost-effective ways. This has been a vision of all of us who are excited and stimulated by the potential of networked delivery of information. Besides improving the learner’s productivity by more participation in the interactive learning process, information technology resources remove the constraint of space and time—no longer do teacher and student have to be in the same place at the same time. Therein lies the breakthrough required to change the cost structures for higher education.

No longer do students have to come to campus to learn. Institutions of higher education which can effectively use networked technology will be able to deliver quality instruction any place at any time. Traditional regional restrictions on who can attend which institutions will be removed. A more competitive environment for instructional delivery is being created. With a more competitive environment, more cost-effective and higher quality educational methods can be provided nationally. Students will have more choices of how and from whom to obtain their education. With competition, higher education will have the incentive and mandate to lower costs, since survival will be at risk. We will not only compete within the traditional higher education marketplace, but also with new purveyors of advanced educational content—many of which will not have the sunk costs of higher education institutions.

Only with competition will networked technology be employed in higher education to lower costs and improve educational quality. The marketplace for education will change forever once technology is used effectively and competition is created. Just as we once believed the Internet “belonged” to higher education, so we have viewed the delivery of instruction in a certain way to a certain market as higher education’s “right.” But no one has an exclusive franchise in a technology-enabled environment; there are no financial or market entitlements in a competitive world.

CNI Report is a regular CAUSE/EFFECT department that provides reports about the activities of the Coalition for Networked Information (CNI), formed by the Association of Research Libraries, CAUSE, and Educom in 1990 to promote the creation of and access to information resources in networked environments.
I’m very pleased to initiate this column to highlight issues the CAUSE Board of Directors believes will be of special interest to the membership. I hope we will stimulate dialog and direct involvement.

Over the coming year, the Board sees five major priorities for our attention. They all grow out of important changes to the CAUSE strategic plan, adopted last year.

1. Last year CAUSE shifted its focus from information technology to information resources.1 There are deep and important implications of this change. The technology and content providers and managers within our institutions must continue to work together as the focus of our efforts continues to converge. The development of a national or international digital library will call for unprecedented collaboration between institutions, professions, and associations. The focus on distance learning, which many of our institutions are pursuing, raises very significant challenges for the delivery of materials in electronic form. Converting analog information resources to digital is only the first of a series of significant problems that we must address collectively. CAUSE should help to facilitate these initiatives.

2. We will establish a mechanism whereby CAUSE can help our colleges and universities address important issues of institutional policy that grow out of the changing role of information resources in higher education. What we have in mind is not that CAUSE should adopt or endorse specific policy positions per se, but that it should establish a process to bring together those with particular insight on a topic so they can assemble the best thinking available for the benefit of all. Examples of some of the kinds of policy issues that might be the subject of such deliberation include the following: What rights do students have regarding their own servers and home pages? Do institutions have a right or obligation to exclude certain news groups? How “private” should e-mail provided by our institutions be (and should it be the same for a student, professor, clerk, administrator, grounds worker)? What constraints, if any, should we place on use of institutionally owned computing and network resources? Are non-text information resources covered by the “fair use” provisions of current practice? (For the last example, clearly CAUSE cannot decide what is a legal question, but it could assemble current legal interpretations, or it could suggest directions for the shaping of statutes.)

3. Professional development will continue to be a very high priority for CAUSE. One initiative has been identified by the Professional Development Committee and endorsed by the Board for implementation in partnership with Educom: expanding the educational programs to include a new focus on senior information resources officers. In recent years, more and more of our institutions have realized that extracting institution-level benefits from our investments in information resources requires institution-level leadership. An increasing number of us are trying to meet these expectations. Beginning with the summer of 1996, we hope to offer training devoted to the issues and skills of special importance to those in “chief information officer” roles and those interested in this career path. Another priority this year will be the expansion of the very successful regional conferences initiated in 1994.

4. Many universities and colleges are making bold efforts to improve their ability to function in the more diverse human work environment that will characterize the future in this country. In some institutions, the information resources organizations are among the least diverse on campus. (There are notable exceptions.) CAUSE will be looking for ways to assist us as individuals and institutions as we develop a larger pool of minorities with interest and skills in the information professions.

5. We will be supporting new initiatives such as the recent Board endorsement of the OSF DCE standards for developed or purchased applications. We hope to facilitate education relevant to these standards, perhaps in cooperation with programs offered by a member institution. Following this column is a Current Issues article by Board member Sam Plice, which describes the OSF DCE initiative in greater detail. The Board does not see DCE as a “silver bullet,” but believes that it could offer significant advantages to institutions desiring to move in the direction of GUI (graphic user interface) client/server applications at the present time and, if widely adhered to, could facilitate leveraging our IT investments. See also Nancy Yuochunas’s article describing potential benefits of a standards approach for sharing administrative applications.

The CAUSE Board invites your suggestions of strategies for dealing with these initiatives, your direct involvement in their implementation, and ideas for other priorities you believe we should be focusing upon. In particular, we solicit your nominations of thorny policy issues that we need to address through the mechanism being established in the second item above. You may send your comments by e-mail to board@cause.colorado.edu, or by fax to the CAUSE office (303-440-0461), attention CAUSE Board.

1. Jane Ryland gave sharpness to this change in her “From the President” column in CAUSE/EFFECT, Fall 1994, pp. 3-4.
Why Your Campus Should Consider Adopting OSF’s DCE Standards

by Samuel Plice

At their meeting last December, the CAUSE Board of Directors passed a motion to strongly encourage CAUSE member institutions to investigate adopting OSF’s DCE standards, to promote interoperability across heterogeneous systems within an institution and between institutions, to aid in the transition to client/server computing, and to facilitate sharing and leveraging our campus technology investments.

In the spring of 1994, as part of its annual strategic planning process, the CAUSE Board of Directors identified a number of areas where actions by CAUSE as an organization might be helpful in transforming higher education through more effective management and use of information resources. A critical one of these was open computing standards, and the Board agreed to begin to take a leadership role in support of such standards.

Support of standards is not new to CAUSE. Beginning in 1990, CAUSE appointed a representative to participate in an ongoing initiative of the American Association of Collegiate Registrars and Admissions Officers (AACRAO) to develop a standard for the electronic transmission of student transcripts. This initiative resulted in the development and adoption of the SPEEDE/ExPRESS standard for electronic data interchange (EDI) of student- and school-related data. (SPEEDE stands for Standardization of Post-secondary Education Electronic Data Exchange; ExPRESS stands for the Exchange of Permanent Records Electronically for Students and Schools.)

At the urging of many CAUSE members, the CAUSE Board next considered endorsement of another standard, called Distributed Computing Environment (DCE), developed by the Open Software Foundation (OSF), a consortium of major hardware and software vendors. Recognizing the value of building our new distributed computing environments on open standards, the CAUSE Board has endorsed the OSF DCE approach, and is encouraging all CAUSE member institutions to investigate adoption of DCE as part of their information resources architecture.

Why Adopt DCE?

Virtually every higher education institution is grappling with the problem of remaining competitive and delivering higher levels of service while the traditional sources of funding offer limited growth potential at best. In information resources, we are facing the same formidable challenges. We can no longer afford to “go it alone”; we must find ways to work together to develop common solutions and to share applications we develop. A fundamental requirement for sharing of applications is a common information technology infrastructure. Adoption of an information technology architecture which includes a standards-based infrastructure will offer a common distributed computing platform upon which we can share the development of common solutions to the problems we face. The networked environment we create will bring world-wide information resources and shared applications to the desktop machines across all of our campuses.

The creation of a distributed information technology architecture has become a primary role for information technology organizations. Middleware is a key component of this technical architecture, defined by the Gartner Group as the network-aware system software, layered between an application, the operating system, and the network transport layers, whose purpose is to facilitate some aspect of cooperative processing. Middleware comprises a set of core services including directory services, network security services, time services, remote procedure calls (RPC), file services, and threads.

Currently, the only open standard for an integrated set of middleware is that provided by OSF’s DCE—a collection of middleware services intended to accelerate the deployment of hetero-
“Collaboration, cooperation, and sharing can expedite progress and dramatically reduce the cost of distributed computing.”

geneous, networked applications by providing for interoperability across heterogeneous systems. Included are such key services as network security, including encryption; user identification, authentication, and authorization; file services; and a common operating environment that allows institutions to share applications.

There are many reasons why colleges and universities should consider adopting this set of standards:

- DCE achieves interoperability across heterogeneous systems, not just within a single campus but between institutions as well. It provides a glue to link systems from multiple vendors, who can rely on DCE as a robust base for their distributed computing solutions. Vendors providing their own proprietary mechanisms for networking can utilize DCE as a lingua franca to communicate with other vendor environments.
- DCE offers value to users, systems administrators, and application developers. Users can view their networked world as a natural extension of their desktop interface through such features as single login via DCE security. This can work even when the networked world of the user extends beyond the campus to other systems across the country or around the world. System administrators can utilize a single directory for maintaining records for all their networked systems. Application developers get an integrated set of services accessed through the RPC, reducing the complexity of building distributed applications.
- DCE security allows institutions to deploy systems with confidence even on open networks which are easily tapped. DCE’s shared secret model of encrypted communication mediated by the security server means that passwords do not travel over the network in the clear.
- DCE can scale from small applications on a local area network to enterprise-wide use to inter-institutional use. This is increasingly important as the client/server model of computing continues to become more prevalent. The benefits of client/server to date have often come from one-of-a-kind implementations, which don’t scale. A Forrester study released early in 1994 indicated that some 60 percent of Fortune 1000 client/server applications were for a single department’s decision support system and 92 percent of these applications access only a single database. As organizations look to merge their client/server applications into a set of enterprise-wide services, there will be significant barriers to integration if the underlying security, directory, RPC, and other components aren’t compatible. With DCE, the infrastructure doesn’t have to be reinvented for each application, and the problem of connecting gateways between systems for interoperability is eased.
- DCE is an extensible set of technologies. Many vendors are providing value-added services around DCE, such as application development tools, systems management features, transaction processing services, and object-oriented programming interfaces. IT organizations can choose the best source for DCE components to meet their needs, considering price and performance to find the most appropriate DCE solution for each task, independent of hardware or operating system platform. For example, an institution might select a DCE directory service to run on one vendor’s RISC-based UNIX workstation, a security service on another vendor’s mainframe, and a time service coordinated from a personal computer platform.
- DCE opens the possibility for institutions to share applications. If middleware is based on commonly accepted open standards, then applications developed at one institution can be successfully installed at other institutions. Collaboration, cooperation, and sharing can expedite progress and dramatically reduce the cost of distributed computing. For example, all institutions wishing to capitalize on the promise of networked computing will need to develop inter-realm authentication mechanisms; the adoption of DCE will provide the basis for the shared development and implementation of such mechanisms. Open distributed computing technologies offer powerful techniques for open applications that are easier to adapt to different institutional requirements. CAUSE was founded in the 1960s as the College And University Systems Exchange, and now such exchange is a real possibility. (See Nancy Youchunas’s article, pp. 8–10 of this issue of CAUSE/EFFECT, which addresses the possibilities of using DCE as the foundation for sharing administrative software.)
- Because DCE is available for so many different environments, including such proprietary environments as IBM’s MVS, Digital’s VMS, and Hewlett-Packard’s MPE, it provides an evolutionary path to reengineering. Institutions engaged in restructuring their business processes and moving to open systems can use DCE as a way to connect these “legacy” environments to newly deployed systems or as a new, open applications programming interface on these previously closed platforms. This allows organizations to retain their investment in current systems and even facilitates both upsizing and downsizing.
- DCE is an open system. Not only is it based where possible on industry-accepted standards, OSF publishes the complete specification via a series of books from Prentice-Hall. Therefore,
anyone interested in implementing DCE from the specification is able to do so without owing OSF licensing or royalty payments.

Businesses, higher education institutions, and governments around the world are increasingly adopting DCE as part of their information technology architectures. This will facilitate interorganizational links that occur through partnerships, supplier/customer relationships, strategic alliances, and the growing trend of virtual organizations (dynamic environments created by alliances of complementary skills drawn from separate organizations in order to jointly address business opportunities). Common security and directory mechanisms based on DCE, for example, will lower the barriers for tying together the information systems of these partnering organizations. Those that adopt standards-based infrastructures will more readily be able to exploit new opportunities.

Higher education institutions and other organizations are able to participate as members in OSF and thus in the evolution of DCE to ensure that their future needs will truly be met. After a major restructuring in early 1994, OSF is a more vital organization with much greater industry participation than it had previously. In addition, end users have an increased say in OSF technology development. For example, end users sit on the Architecture Planning Council that lays out the technology road map for OSF. The Project Steering Committee that oversees the DCE effort includes an end-user representative along with the vendors funding DCE’s development. This person gathers requirements from end users and shares them with the vendors. End-user input has had a significant influence on the features and functionality of DCE.

In summary, adoption of DCE, as a shared set of technical standards for the implementation of a technical infrastructure that will support interoperability, can facilitate the implementation of a distributed, networked computing environment, establish the basis for institutions to develop common approaches to systems management, provide hardware and operating systems independence, influence vendors to produce interoperable products that meet higher education’s unique requirements, and lay the groundwork for institutions to share applications.

The CAUSE Board encourages all CAUSE member institutions to seriously consider adoption of OSF’s DCE standards as part of their information resources architecture. CAUSE looks forward to feedback from our members about how we can best support adoption of the OSF DCE standards.

Resource List for DCE

OSF sells complete sets of documentation, consisting of 14 volumes and costing $525.
- In the U.S.: Natalie Tarbet, OSF, Cambridge, Massachusetts (617-621-8762; fax 617-621-0631; tarbet@osf.org)
- In Europe: Christine Mambourg, OSF, Brussels (+32-2-772-8888; fax +32-2-772-9228; mambourg@osf.org)
- In the Pacific Region: Haruyo Nogami, OSF, Tokyo (+813-3479-4740; fax +813-3479-4760; nogami@osf.org)

Prentice-Hall also offers an OSF Documentation Set which contains roughly the same material as the OSF set but which has been edited to improve readability. For ordering information: 515-284-6751.

O’Reilly offers a number of publications that provide different perspectives of DCE. For information, phone 800-998-9938 or 707-829-0515; send e-mail to order@ora.com; or access O’Reilly’s information on the Internet:

http://gopher.ora.com/
telnet gopher.ora.com (login: gopher; no password)

Internet resources include:
comp.soft-sys.dce (Usenet newsgroup)
comp.unix.osf.misc (Usenet newsgroup)
comp.client-server (Usenet newsgroup)
E-mail general or product OSF DCE queries to:
direct@osf.org
OSF URL: http://www.osf.org:8001

The OSF home page includes information on DCE, OSF technology data sheets, case studies, and white papers, as well as the DCE Product Catalog.

For a more comprehensive list of DCE resources, send e-mail to search@cause.colorado.edu containing the one-line message: get CSD0991. A page on the CAUSE World Wide Web server is also under construction to serve as a gateway to many additional DCE resources on the Internet. If your campus has a document related to DCE, please contribute it to the CAUSE Information Resources Library; for information, contact Randy Richter at CAUSE (richter@cause.colorado.edu, 303-939-0314).

"... anyone interested in implementing DCE from the specification is able to do so without owing OSF licensing or royalty payments."
By the late 1960s, serious efforts were underway on college and university campuses to use a new technology—computers—to improve the efficiency of the institution’s administrative processes. Computing was in its infancy and the problems encountered were complex. However, alternatives were also limited. Many institutions turned to a sole-source vendor for primary support for their technology environment. With a vendor focused on providing technology integration, institutional staff were able to concentrate on understanding the administrative offices’ application requirements and writing the application software to meet those unique requirements.

For the next fifteen years or so, administrative computing departments undertook the development of computer systems to support each of the institution’s administrative processes. The results of these pioneering efforts were unique, institutionally focused sets of administrative systems for general ledger, payroll, registration, class scheduling, grade reporting, etc. and a greatly enhanced body of knowledge about the process of applying technology to an institution’s administrative functions.

While the original administrative systems provided great benefit, institutions were over time faced with two problems. First, changing demands on administrative offices resulted in the need to change administrative systems. Institutions were required to make recurring investments to upgrade systems. Second, new technology was available at an alarmingly rapid rate. This availability of new technology provided additional pressure to redevelop and improve administrative systems. Two major technology developments—powerful desktop computers and network enhancements to support the transmission of large amounts of data at very high speeds—provided the foundation for applications designed to use multiple computers. While these new technology developments expanded the possibilities, they also illustrated how quickly complex, expensive, state-of-the art equipment and software become obsolete.

**Current challenges**

Every higher education institution faces the challenge of employing new technologies to improve the quality of its administrative systems and deliver higher levels of computing services while managing the investments required to create and maintain these vital systems. The following are common objectives guiding many administrative computing organizations in higher education.

- Provide quality technology support to administrative offices through the development of administrative systems that are functionally rich and robust.
- Assure better access to and use of the institution’s administrative information resources.
- Promote the integration of administrative processes through emphasis on cross-functional administrative systems and direct use of information.
- Deliver services and solutions that have institution-wide benefits.
- Leverage new technology to improve both the development and operation of administrative systems.

Many higher education institutions are making significant investments in new technology to support administrative operations. As we prepare to use this next generation of technology, can we afford for each institution to proceed independently, as we have in the past, or should we develop collaborative approaches to software development based on a more standardized technology environment?

Nancy Yuochunas is Director of Administrative Information Management at Purdue University, where she is responsible for the technology, application, and data architecture for administrative computing, the development of new administrative applications, and the Master Plan for Administrative Computing. She also serves on the Academic Computing Policy Committee.
• Manage the investment necessary for creation and maintenance of each administrative system.

While working to meet these objectives, institutions face a similar set of common problems.

• Changing demands on administrative offices result in the need to change administrative systems. Each institution is investing substantial resources on an annual basis to update current administrative systems.

• Administrative applications do not last forever. Each campus is in a cycle of replacing and/or upgrading the administrative applications that have been developed over the last thirty years. Whether the new software is developed in-house or purchased, the development costs are high.

• New technologies reach the market daily. Each institution must evaluate new hardware, software, and development techniques, and determine how they should be used.

• The portfolio of current systems does not take advantage of the processing power available in personal computers. For most current system access, personal computers merely emulate non-intelligent terminals.

• The shift from a traditional mainframe computing environment to an open, distributed computing environment is an expensive and difficult one.

Significant investments have been made at many institutions to respond to the availability of new technology. However, the complexity of this undertaking indicates that no single institution can easily afford to independently create a distributed computing environment, rebuild administrative applications to take advantage of the new technology, and still maintain the quality of administrative support provided in the past. If we are to meet the challenges that are facing us, collaborative approaches are needed within higher education. Standards for a common distributed environment would provide a solid foundation for inter-institutional efforts and potentially reduce the effort required of any single institution.

Distributed computing

Open distributed computing, the fundamental design strategy for the next generation of systems, represents a significant change in the technology base upon which administrative applications are run. In an open, distributed environment, computers are connected by a high-speed network to create a single-image computing environment. This open operating environment allows hardware and software from a variety of vendors to function together seamlessly.

Significant effort is required to move our campuses from our current stage, network computing, to this next stage, distributed computing. In the network stage, computers connected to a network have access to basic communication services: electronic mail, file transfer, and (with proper authorization) remote login to other information systems. However, today’s developer must have knowledge about the target system location and operation to work across computers. In addition, coordinating security across all the computers requires considerable duplication of effort.

The “operating system” for a distributed computing environment, however, supports transparent communication between many different computers and maintains the security across these computers. In this transparent operating environment, software and data are shared across many different computers. Applications execute on one machine or multiple machines and developers do not need to know the details about each specific processing environment.

For higher education to create a common operating environment, there must be agreement on network communication through protocols like TCP/IP. However, the essential piece of this distributed computing environment is the operating system that makes it possible to build and execute applications across an open environment. The simple physical connection of single vendor proprietary hardware and operating software to one network is not enough. Again, standards are the key to this integration of systems software from a variety of vendors.

Open Software Foundation (OSF), a consortium of major hardware and software vendors, has developed a set of standards called the Distributed Computing Environment (DCE) to support computing across different vendor equipment and software. OSF’s DCE is a set of standards to establish, manage, use, and secure distributed applications. Its existence provides higher education the basis to meet many of the challenges in a distributed computing environment, like:

• interoperability across heterogeneous systems,

• security in an open network environment with a single security interface, and

• scalability from small local area networks to enterprise-wide networks.

While OSF’s DCE is not yet an official industry standard, it is supported by a number of...
vendors. Higher education’s adoption of DCE would encourage vendors to create products based on these standards and go a long way toward ensuring a standard distributed operating environment.

Sharing administrative software

With OSF’s DCE as the basis for a distributed computing operating system, it is possible to investigate collaboration on software design strategies like client/server and object orientation as a basis for the portability and reusability needed to share the burden of software development and acquisition among higher education institutions.

Client/server is the primary design model for distributed computing. It allows for the three major system activities (presentation of information, processing, and access/storage of data) to be segregated in a manner that allows them to either run on a single machine or be distributed in some fashion across multiple machines on the network. Client/server designs promote the division of systems functionality and allow these pieces to be run on equipment that is best suited to the function. For example, workstations are best suited to handle the user interfaces required by a system because of their support for graphical presentations. Implementation of distributed systems through a client/server design is relatively new, so standard models and guidelines for the design of client/server systems and the tools to develop and maintain them provide an opportunity for collaboration among higher education institutions.

Object orientation is a cluster of technologies and methods that have developed over the last twenty years to deal with complex information systems problems. The object-oriented approach to systems analysis and design can be used to focus on flexibility and reusability.

Computer application systems have been developed for many years with an orientation either to process or to data. Both approaches supported the development of institution-specific applications with unique process rules and data definitions buried inside the thousands of lines of computer code (programs). With either approach reusability is possible, but it is difficult to achieve.

In object-oriented design, the fundamental building block is an object. This object is the association of specific data (variables) with the procedures (methods) that act on it. Each object is defined and maintained independently. Objects are then organized into a hierarchy of classes and sub-classes to build on similarities and recognize differences. (There is a general similarity to the taxonomy used in biology.) A class or sub-class of objects has associated methods that it shares. While sub-classes inherit some methods from a class, they also have their own methods as well as methods that can override the inherited methods. Objects are joined through message exchanges to create systems. Because specific data can only be affected by the methods associated with that object, relationships between objects can be changed without worrying about how data will be affected. Objects thus become standard building blocks (objects) which can be combined in a variety of ways to create extremely flexible information systems.

Object-oriented design is a critical foundation for the reusability of code and the possible sharing of software among institutions. Institutions may be able to share objects and object classes and thus collaborate in application development through the creation of this set of common building blocks. Object-oriented technology is a major paradigm shift that will require careful, thoughtful development of the basic structure and classifications. However, the possible benefits of shared software development to our institutions are so great that we cannot afford to ignore the need for a more standardized distributed computing environment.

Summary

As higher education institutions plan for the future, common agreement to build our open distributed computing environments using standards like DCE can position us to exploit new application design approaches to build applications that can be shared. These collaborative efforts offer us the most promising opportunity to successfully meet the challenges that we face at each of our institutions.
Information Resources and Institutional Effectiveness: The Need for a Holistic Approach to Planning and Budgeting

by David J. Ernst and Peter Segall

Limited financial resources make it more important than ever to develop a coordinated institution-wide process to link academic priorities and expenditures with the technological infrastructure necessary to support the objectives. Trade-offs must be made across the institution, rather than simply within the traditional information resources areas, in order to ensure both a healthy academic program and the requisite information resources.

Peter Drucker once said, “Elephants have a hard time adapting. Cockroaches out live everything.” One might wonder how well higher education in this country is adapting to its current challenges. Colleges and universities are undergoing an era of unprecedented change brought about by a stinging combination of economic, social, and political forces.

Most Americans are asking themselves how they can afford a college education. Since 1980, the average college tuition increased three times faster than inflation. Some estimates have pegged the anticipated tuition at an institution like Harvard at $350,000 for today’s kindergartner, unadjusted for inflation! According to the Association of Governing Boards (AGB), the number-one issue facing higher education in 1994 was the “budget squeeze.”\(^1\) The operating budgets of over one-third of private schools remained the same or increased a small 1 to 4 percent. Forty percent of public institutions and 30 percent of private institutions experienced mid-year budget cuts in 1992–93. Our colleges and universities are in an economic pincer. The increasing inability of families to cope with college costs, caps in federal appropriations, increasing competition for state funds, and the leveling off of sponsored research funding are all shrinking the revenue streams upon which schools are dependent. Dramatic increases in benefit costs, energy prices, and the need to fund deferred investments in physical plants, among other areas of increasing costs, are soaking up discretionary resources for all institutions. The result is a vice grip of economic constraints that will seriously threaten marginal institutions and hobble many middle-tier ones, and, some would argue, may result in an environment of mediocrity at even some of our most highly endowed schools.

On top of this economic squeeze comes the advent of the new student demographics. The face of America’s student population is changing. There has been a decline in the numbers of traditional college-aged students in the population and an increase in the relatively older, non-white, frequently part-time students, who in many cases are more costly to educate because they frequently require remedial studies, special language courses, and financial assistance. Forty-three percent of today’s students are over twenty-five and 300,000 are over fifty. Forty percent of the new students at CUNY in New York are African-American or Hispanic.

In addition, the public’s expectations for colleges and universities are higher than ever before. The AGB cited “public opinion” as its number-one external trend affecting higher education. Last year William Honan wrote in the New York Times, “The question is no longer whether to retract … and adapt in order to bear down on the basic mission of higher education … but whether these reforms can be accomplished from within or must be imposed from without.”\(^2\)

Scandals in college athletics, abuses in research, and an overall uncertainty about the value for the money have contributed to an increasing sense of disenfranchisement towards higher education.

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Peter Segall is a Director of Coopers & Lybrand’s Higher Education Consulting Service, based in Boston. Prior to joining Coopers, he served as the Assistant Vice President for Development Operations and Support at Brown University.


How are colleges and universities adapting? Many are surviving through a combination of academic consolidations, selective investments in new delivery mechanisms, and restructuring of administrative functions. The president of Columbia University has cited the “great deal of overlap” among Columbia’s academic programs and has promised to consolidate certain functions. The president of Yale has stated that Yale doesn’t “have to deal with every sub-specialty in every field ... instead we can create centers of excellence.” A few other examples include San Diego State University, which announced a plan to close nine academic departments, and Northeastern University, which eliminated its physical education, recreational management, and health majors while consolidating other academic programs.

At the same time, some schools are investing in technologies to enhance their competitive position. As we all know, the power of telecommunications is providing new ways of conveying information and responding to questions that arise in the learning process. E-mail makes possible a system of quick and frequent communications between students and instructors. To cite one example, Northeastern recently invested $2 million in automation, including fiber-optic wiring for the entire campus. Many campus brochures now commonly boast of the “electronic links” in residence halls that connect students to on-site faculty, researchers in other institutions, and a whole world of databases through the Internet.

Additionally, many colleges and universities are undertaking a fundamental restructuring of their administrative activities and finding that the most effective long-term approach to reducing administrative costs is to redesign work processes from the bottom up. Hence, such methodologies as Total Quality Management and Business Process Reengineering have rapidly made their way from the corporate world to the campus. William Massy wrote a seminal article in 1990 that characterizes administrative activities as an intricate “lattice ... that has grown, much like a crystalline structure, to incorporate ever more elaborate and intricate linkages within itself.” On many campuses there are major initiatives to control and reduce this lattice. Oregon State University and the University of California at Santa Cruz, for example, have had campuswide quality improvement and process redesign programs. Stanford, Penn, Harvard, and Yale all have comprehensive administrative restructuring programs in place. The goal of these programs, and the many more like them at other schools, is first and foremost to reduce costs, while improving the institutions’ ability to manage themselves administratively and financially.

What most of these institutions are learning, however, is that administrative work cannot be restructured in fundamental ways without making investments in technologies that will enable new ways of doing business. The old, batch-based, central control systems (that never really controlled very much anyway) must give way to information-rich, customer-oriented service systems that provide administrators with the tools they need to manage administrative processes without armies of clerks, checkers, and paperpushers. Hence, many of our institutions have implemented or are in the process of implementing such technologies as student access systems (for example, online registration and inquiry), direct vendor ordering and paying systems, and relational technologies and data warehouses to allow for more effective reporting and analysis.

The problem is that for many institutions, the investments made in new systems are not always integrated with institution-wide strategic directions and needs. Put another way, institutions tend to make all of their strategic trade-offs within the academic program, between academic and administrative activities, and among operating, capital, and investment programs and then determine how much they can spend on information resources. It is as if this latter category were “something we think about once we are done doing our ‘real’ jobs.” Even worse is the situation where heavy information technology investments are made and the institution tries to figure out how it can use these new tools to further its goals and objectives. Too often, information resources managers see themselves in competition with (and usually in a subordinate position to) key initiatives across the rest of the campus. This outlook must change, among both the providers and the users of information resources.

Now, more than ever, the times call for strategic and well-coordinated planning across the institution. There is great need to weave together the interdependent components of academic program, administrative support, and information infrastructure in a way that responds both to shrinking resources and the requirement for increased effectiveness. Managers of campus information resources—whether labeled administrative, academic, or library—should take the lead to push for this integrated planning and for the more important integrated actions that will flow from it. As Patricia Battin has pointed out: Since it is unlikely that the majority of institutions will be able to afford and maintain cutting-edge technology (any more than they could buy every scholarly book published in...
the past), it will be important to develop a coordinated process to link academic priorities and expenditures with the technological infrastructure necessary to support the objectives. Trade-offs must be made across the university, rather than within the traditional information technology, academic computing, and library compartments, in order to insure both a healthy academic program and the requisite information resources and services.\(^4\)

As we implement business process reengineering and redesign at more and more institutions across the country, we demonstrate that information resources—information technology, and services—are important “partners” up front in the change process, not something to be added on after redesign has occurred. It is the iteration between evaluating how the institution does its academic and administrative business and where and how information technology can enable, facilitate, and fundamentally change that business for the better, that makes IT an essential ingredient in stretching resources instead of being a drain upon them. Unfortunately, in higher education, we have not had much experience in having to make institution-wide trade-offs for resources, let alone doing so in an environment where information technology is viewed as part of the solution rather than part of the problem.

In order to move from past practices of across-the-board cuts and local optimization, strategic and integrated planning will be necessary, but not sufficient. Equally important will be a coordinated budgeting capability, driven by the plan, and able to accommodate multiple funding sources supporting a handful of strategic institutional initiatives. In other words, we must be able to implement the concept of “all dollars are green.” We specifically need to break out of the traditional (and limiting) funding mechanisms for information technologies and ‘graduate’ from the rate-based, service-center mentality. According to Battin:

This new and constantly evolving environment of information services and resources requires the development of a coordinated and capitalized budgeting capacity to replace the ad hoc and reallocation practices of the past. These mechanisms served higher education well during the early stages of technology integration, but the combination of growing reliance on technology for critical functions through the institution and the short life cycles of hardware and software characteristic of digital technologies make a more coordinated budgeting process essential to insure a reasonably secure and predictable financial and technological environment.\(^5\)

Armed with a commitment to a “holistic” approach for strategic planning and integrated budgeting for institutional academic, administrative, and information resources, just how does one begin to implement these concepts? The answer, as always, lies first in understanding and appreciating the particular culture of the institution involved. Given that as the context, an approach which relies on three key elements of successful strategic planning should serve well.

First, an assessment of the current state of integration among campus priorities in the academic, administrative, and technology areas is in order. This “environmental scan” will provide a baseline against which to compare the ultimate goal of the “holistic” approach.

Second, a “vision” is developed of how a strategically planned and budgetarily better integrated campus would operate and how that vision would improve the quality of work and life at the institution once implemented. This vision, or set of institutional attributes for the future, serves as the goal state to guide implementation efforts.

Finally, and most importantly, the actual tactical plan and set of action steps are laid out, incorporating the integration of academic, administrative, and information resources priorities and their enabling budgets. The tactical plan may incorporate reengineering efforts, academic program changes, administrative support realignments, and new software and hardware applications. Those tactics, grounded in a realistic assessment of the current state, with an equally acute vision of the future goals, become the new strategy and conceptual framework for institutional effectiveness.

This approach is obviously more easily said, or written, than done. However, embracing the concept of the holistic partnership of academic program, administrative activity, and information resources is the essential first step (and focal point) for increasing institutional effectiveness amid the external and internal forces operating on higher education today. Strategic planning and integrated budgeting are not new concepts, but they are successful ones that can make the essential difference in utilizing a set of information technologies and resources that will determine our future either because of us or in spite of us.

\(^4\) From an e-mail communication, April 25, 1994.

\(^5\) Ibid.
Engineers and Ivory Towers

by Robert C. Heterick, Jr.

At the 1994 CAUSE annual conference in Orlando, Florida, CAUSE presented its ELITE Award for Exemplary Leadership and Information Technology Excellence to Robert C. Heterick, Jr. The award honors outstanding professionals in the field of information technology management in higher education. Dr. Heterick addressed nearly 2,000 information resources professionals at a special luncheon at which he was honored. This article is an elaboration of his remarks upon receiving the award.

People frequently ask how a civil engineer got into the computing business. I have always wondered not how I got into but why I stayed in the business. Thirty-five years ago someone convinced me that the engineering problem I was working on for a graduate thesis could be done on something called a computer. Perhaps not unlike many another eager young graduate student, I bit.

There are two things I recall about that first experience with information technology. I remember the long nights (graduate students only got access to the machine between midnight and 8:00 a.m.) programming, debugging, and waiting. The computer occupied nearly 1,000 square feet of floor space, required air conditioning that occupied about half again as much space, and had the computational power of a seriously crippled HP hand calculator. I spent nearly every night over many months laboring on that IBM 650. The other thing I clearly remember was my advisor taking home the first draft of my computational prowess one Friday evening and returning it the next Monday morning with every example problem meticulously checked by hand calculation. I clearly remember his observing that he was going to trust me that computers might someday be as facile in solving the problem as a good engineer.

I suspect that it is my engineering background and some of that same sense of trust that has shaped much of my view of information technology, resources, and management. I thought I might share a couple of engineering systems principles, as they seem to me to have particular relevance to some of our current technology disputes and policy debates.

Murphy, that clever pessimist, once observed that, “left to themselves, things always go from bad to worse.” This, of course, is just a restatement of the Second Law of Thermodynamics. The Second Law has to do with entropy—the measure of the unavailability of useful energy in a system when the system is left to fend for itself.

About the turn of the century a very clever English physicist, Clerk Maxwell, suggested a way to beat the Second Law of Thermodynamics. Maxwell’s thought experiment was to imagine a demon at a trap door in the middle of a container filled with gas at a constant temperature and pressure. The demon would observe the molecules bouncing around and would judiciously open and close the trap door to permit the faster molecules into one side of the container and the slower into the other. Over time, one side would get hotter and the other colder, organizing the latent heat energy and thereby overturning the Second Law of Thermodynamics. Modern enterprises have introduced just such a demon into their management philosophy and organizational structure. That demon is the array of digital technologies unleashed by the integrated circuit and fiber optics.

I have been convinced for the past thirty or so years that judicious use of information technology could provide the means for an organization to get at its latent intellectual energy and improve the effectiveness of any operation—some, of course, more than others. I wasn’t as quick to realize that “judicious” was sometimes paradoxical and frequently meant making major changes to business process—in some cases, causing us to question and even make major changes to the business we are in.

By and large, we have made all the “simple” changes our current ivory tower model is likely to accept. The big task in front of us is to lead our educational enterprises in the difficult work of making major changes in core business process—teaching and learning. To capture more of the latent energy of our educational institutions we will need to seriously reconsider our mission and reengineer our processes.

We see one of those paradoxes clearly these days as computing centers rapidly disappear, displaced by networked environments of distrib-
Academic, administrator, author, visionary, leader—Robert Heterick is one of the rare few in our profession who have consistently contributed effectively at many different levels.

A combination of unique qualities contributes to this effectiveness. His understanding of the academy as an educator and administrator complements his knowledge and vision of the information age as an information technology professional. His insights into the economic and political environment as a scholar and analyst, combined with his knowledge of history, sociology, economics, and technology, enable him to shape plans and solutions to deal with the interplay of these forces on higher education and society.

In his thirty years at Virginia Tech, Dr. Heterick served in a number of academic and administrative positions. He held professorial rank in three different colleges, chaired two departments, directed a laboratory, and from 1986 to 1991 served as vice president for information systems, responsible for a staff of over 500 and a budget of nearly $40 million. He continues to serve as chair of the Board of the Blacksburg Electronic Village, an innovative effort begun during his vice presidency at Virginia Tech to bring high bandwidth communications and Internet connectivity to the Blacksburg, Virginia, community.

During his years as vice president, Virginia Tech became one of the first institutions to integrate computing, telecommunications, library, and media services into a comprehensive information resources organization.

Dr. Heterick served on the CAUSE Board of Directors, both as vice chair and as chair. He was instrumental in the founding of the Coalition for Networked Information (CNI), a cooperative effort between CAUSE, Educom, and the Association of Research Libraries (ARL), and the formation of the related Higher Education Information Resources Alliance (HEIRAlliance), with the same three organizations.

When Dr. Heterick became president of Educom in 1993, he accepted a position that demanded both close attention to internal administrative and management detail and a high national leadership profile. He has dealt aggressively and effectively with the first while sustaining Educom’s momentum on the national scene. Under his strong leadership, Educom is launching an exciting new initiative to create a national learning infrastructure.

Through writing and speaking, Dr. Heterick gives eloquent voice to his vision. In 1988 he published A Single System Image: An Information Systems Strategy, the first CAUSE Professional Paper, considered a seminal work in the profession with its (then) revolutionary premise that a campus’ information resources should appear to be delivered as if through a single system. He has authored many other books, monographs, and articles, and is a much sought after speaker in this country and abroad.

Dr. Heterick has received the CAUSE ELITE Award because of the range and significance of his contributions, because of his relentless pursuit of his vision of the future, and because of his dedication to the work we do. Few others have served this profession as long, as broadly, or as well.
While it may seem obvious that we should favor access over security, without security there will be no digital cash, few useful pieces of intellectual property on the Net, and precious little privacy as well.
It is not possible to be at the leading edge of a paradigm shift without realizing that what we see is highly influenced by where we have come from. And not everyone has come by way of the same path. Our job is to lead our institutions onto unknown shores in an uncertain world. The physicist and philosopher, Arthur Eddington, said it most poetically when he observed, “We have found a strange footprint on the shores of the unknown. We have devised profound theories, one after another, to account for its origin. At last we have succeeded in constructing the creature that made the footprint. And lo, it is our own.”

I have spent a lifetime following the footprints left by others. There are times when I notice that the footprints are deeper than usual; these are places where I didn’t know enough to follow and my colleagues had to carry me. To all of them, and to all of you, thank you for showing me the way. And thank you for honoring me with the CAUSE ELITE Award.

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An Interview with Bob Heterick: Looking Back and Looking Ahead for the Profession

CAUSE/EFFECT used the occasion of the ELITE Award to ask Bob to offer some observations about information technologies in higher education and some advice to the campus professionals who plan for and manage these resources.

Q You’ve been in the higher education information technology field a long time. Looking back, what stands out in your mind as most significant over the years?

One thing that really strikes me is that it is very easy to look at the technology and predict, in the macro sense, what’s going to happen in the world around us, but we always overestimate how quickly it’s going to happen. We think it’s going to happen in two to five years, but it’s always four to ten or even twenty years before it actually comes about. At the same time, in the short term, little things happen that we didn’t predict that totally change the trajectory of where we’re going, without anyone realizing it. But then we quickly incorporate those things into the way we think about the world, and they become part of our predictive basis again. I think after a lot of years in this business that’s really what strikes me more than anything else.

Q You certainly saw the importance of networked information and the implications for higher education many years ago.

Well, I think a lot of people have, but the problem is that people don’t want to face up to some of those implications, so they don’t really push the idea too much. Clearly in a networked world with multimedia available anywhere, anytime, a whole lot of things about our current institutional structures and organizations aren’t sensible anymore. And who wants to be the leader of something that upsets the current paradigm? So people back away from it. I think they see what the future indications are, but they don’t really want to pursue them; they’re not aggressively seeking the change that they ought to bring about.
What do you think is the most important action that information professionals in higher education could take to help the necessary change take place?

I think we see more clearly the implications of all this technology for the educational process than do most other people in our institutions, and we certainly need to find ways to put it in terms that those other people can understand, to have them begin to, in a collective sense, come to grips with all of these issues. We’ve not been very good at that. We’ve tended, historically, to sell the technology for technology’s sake, and we’ve tended to not be concerned about the policy, the ethical, and the other kinds of dilemmas that come as a consequence of change. What we need is for our profession to become much more focused on interpreting this for other people in our institutions and engaging them in the debates and dilemmas that all this produces. We can be more forthright and honest with our colleagues.

Do you see Educom’s National Learning Infrastructure Initiative able to move that along?

Although there are all sorts of neat things being done by people in emerging multimedia-based learning environments, none of them have translated or scaled beyond the local level. The reason for that is that we operate within the confines of a complex system of higher education; simply adding a new technology or strategy to the current system really doesn’t change it. The National Learning Infrastructure Initiative is a belated recognition of the fact that we need to be thinking about building the new system of the future, with different institutional relationships, different roles for faculty and scholars, different roles for students—an entirely different way of looking at the world that supports learners rather than teachers. Absent economic stress, there isn’t any particular reason to change the system we have, but now we are into the middle of the first decade of a multi-decade-long period of stress, where we simply have got to get more learning at less cost—faster, cheaper, better—and we’re not going to do that in the context of the teacher-centered paradigm. We’re going to have to move to a learner-centered paradigm, and that means we’re going to have to have an infrastructure which supports learners rather than an infrastructure that supports teachers.

The NLII is an attempt to get a lot of people focused on the question of what that infrastructure is, how we build it, who participates, how we participate. Engaging the disciplinary societies in this dialogue is very important because higher education is really kind of dichotomized into two worlds that are almost orthogonal. There’s the up-and-down world of the local institution—the president, vice presidents, deans, and faculty—but then there’s the world of math, the world of physics, that cuts across institutions. When one focuses on the learner rather than the teacher, that orthogonal world of math and physics becomes more important, because that’s the world that’s going to set the standards for what it is that people should learn and how one tells whether or not they have learned whatever it is that one’s attempting to inculcate in them. That’s why in many senses we don’t scale, because we stay in the up-and-down world, the institution, where we need to be in the orthogonal world of math, physics, sociology, or religion. Disciplinary societies are front and center as the spokesbodies for that orthogonal world.

What do you think is the most important agenda at the campus level? What should institutions be doing?

I’m not sure that this is a different question than one could have asked last year, or ten years ago, or a hundred years ago. It seems to me there are two pieces to it. One is the short-term tactical questions of how we engage in some kind of continuous improvement of the process that we’re in, reducing costs, improving the quality—all the things that any kind of a business, be it higher education or anything else, is always concerned about. Every now and then you come to periods in which the ultimate goal isn’t going to be reached through these tactical maneuvers, when you just need a huge strategic vision, and at some point a transformation or reengineering, or repurposing process. That’s normal. So I think campuses have to be dealing with both.

By and large we are historically pretty good at dealing with the short-term tactical things, and in the same historical sense we’ve been terrible at dealing with the strategic things …

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1 For further information about the NLII, send e-mail to nlili@educom.edu or visit Educom’s World Wide Web homepage (http://www.educom.edu/).
about what the implications of that are and what we do as an institution to position ourselves for that, how we make that transformation, and how we do it without just simply adding more resources to the process, but through internal reallocations. And that’s a painful process. So it’s easy for people to say, “Let my successor worry about that, I’m going to worry about the little tactical problems; I’m going to do a damn good job there, and somebody else is going to worry about the big strategic issues.” Well, we have to understand that that somebody else is us. As information professionals in the university, we become very important in helping define that debate and helping people understand what it’s all about.

How do we get to be part of the debate if we aren’t already? What can we say to information professionals who aren’t in an influential enough position on their campus to be part of that debate?

Well, I think this is also a classic problem. I think there are people who have a reasonable vision of the future who don’t currently work in a sufficiently visible position to have a lot of obvious influence. What I’d say to them is that it just takes longer and it’s harder, and you have to find people on your campus who do have that influence, convince them, and let them take the credit for your ideas. You have to let it flow through the mouths and the actions of other people rather than yourselves.

Were you always in the position to influence at Virginia Tech, or were you just lucky to have had a president fifteen years ago who understood the importance of planning and organizing for information resources, or did you have to do some conniving?

Well, I think we all connive short of lying, cheating, and stealing, but we were certainly creative in the way we approached all this back then. Seriously, I would say that, looking at my colleagues who have been successful to a large degree, the characteristic that they’ve shared with a lot of their other colleagues who weren’t as successful is that they had a pretty clear vision of the implications of the technological changes. What they did that some of their other colleagues didn’t do so well was to find a way to articulate it in terms that were comprehensible to lay people in this business; they found a way to talk to the president, or the provost, or the dean, that framed these issues in a way that that dean or president or provost could process in terms of their own experiences. They simply won converts. Like any specialty, I think we tend to too much jargon—techy talk—in our attempts to impress people with our knowledge of the technical issues, and very few of the issues at this kind of macro, decision level are really technical issues. They’re sociological issues, they’re economic issues, and that means you need to interpret, take it out of your realm and put it in their realm, put it in a way they can understand it.

Do you think we’re getting better at doing that?

I think it’s hard to say. More and more people are beginning to understand some of the implications of all this, but that may just be time rather than skill or expertise on our part in translating. It certainly is true that, unlike twenty-five or thirty years ago when a generation of people in positions of high influence had no knowledge of these technologies, it’s increasingly the case that campus CEOs and academic officers have had a history of experience with technology, particularly in research environments where they probably have used it rather heavily in their personal research. So it’s a little easier for them to grasp and understand the implications.

Do you think it’s helpful that our associations do things like send CEOs the HEIRAlliance reports and videos that translate the technological issues into more meaningful terms for them?

Oh, absolutely, they’re useful! On the more flippant side one could argue that it’s sort of Machiavellian that if you say the same thing over and over and over again, eventually people inculcate it into their own way of speaking and it becomes a self-fulfilling prophecy. But, yes, I think it’s important that we find the vehicles to reach technology lay people in their own world and their own way of operating and their own terminology to help them understand all this. The secret seems to be that if you keep the information sufficiently short and jargon-free people will actually look at it.
Observations on Benchmarking Information Technology Support

by The Office of Computer and Information Systems, The Pennsylvania State University

Wanting to evaluate their own progress in information technology programs and practices, Penn State’s organization collected information about successful operations in five similar institutions. Although differences in budgeting practices made it impossible to make direct numerical comparisons, they found four broad indicators of model practices.

In the spring of 1994, the Pennsylvania State University’s information technology organization began an aggressive program of benchmarking Penn State’s information technology programs and practices against those of other major research universities. Over a three-month period, the University’s Executive Director of Computer and Information Systems and various combinations of five of his managers visited five institutions determined to be “best-in-class” in their use of information technology (UCLA, the University of Illinois, the University of Michigan, the University of Texas at Austin, and the University of Wisconsin at Madison). These institutions were selected for two reasons. First, they are vigorously and successfully pursuing information technology solutions in a wide range of areas (e.g., academic, administrative, and library computing; telecommunications; computer security). Second, they closely match Penn State—a large, complex, public land-grant institution—in mission and size.

The primary goals of this effort were to identify the underlying processes that facilitate excellence and to determine how similar processes at Penn State can be improved or reengineered. While all six institutions are trying to adapt rapidly and effectively to technological change, it became evident very early in the benchmarking process that there is no single “right way” by which to address this need. Each institution has its own culture, and practices that serve one environment may not be applicable to others. Recognizing our own institutional biases, we made a conscious effort to factor out the Penn State view in identifying processes we felt to be most significant.

Institutional differences were at least in part responsible for what proved to be our difficulty in comparing numerical data across institutions.

Collecting “numbers” was never a limiting goal of this benchmarking exercise, but after analysis the numerical data proved to be the least valuable information obtained. In fact, we found that, with the exception of the most simple measures (e.g., percent of buildings with adequate inter- and intra-building telecommunications wiring), we were sometimes not just comparing apples and oranges, but apples and orangutans. For example, where some institutions include capital expenses in the information technology budget, others do not; comparisons would be irrelevant, at best. Thus, while benchmarking is usually synonymous with numeric comparisons, this article, which shares our benchmarking experience and findings, contains no specific numbers.

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Although our study did not harvest numeric measures, we were able to identify four broad principles that we believe offer major research universities sound guidelines for change. The degree to which institutions have internalized these principles seems to be directly related to the excellence that we perceive to characterize best-of-class institutions.

**Principle 1: Best-in-class institutions use policy, budget, and strategy measures to maximize the benefits of information technology.**

**Policy measures**

We found that best-in-class institutions are struggling to address a number of pivotal policy issues. These can be characterized as follows:

*Defining the appropriate institutional roles and relationships for senior information technology management*

Many institutions are struggling to formalize the institutional role of the senior information technology officer, and few recognize the senior information technology officer as a member of the "president’s cabinet." As the importance of information technology increases in all aspects of university operation, the senior information technology officer must be more directly involved with senior university management. For example, the broadening role of information technology tools in all disciplines means they will demand a larger proportion of a university’s budget. Yet few institutions have formal relationships established to enable frequent exchanges between the chief financial officer and the senior information technology officer and their staffs.

Information technology is a key factor in the future competitiveness of research universities, and all institutions in our study agreed that it is critical for senior information technology officers to have a "seat at the table" as a key advisor. At least one benchmark institution has moved to place the senior information technology executive as a member of appropriate university-wide, strategic/advisory/planning committees. This positive move recognizes the increasing importance and the increasing budget share that technological growth will require. (The benchmark institutions noted that if the most senior administrators are well-versed technically and aware of the many difficult issues surrounding information technology implementation in complex institutional environments, direct involvement of information technology officers may not be as critical. However, it may not be practical or prudent to expect such detailed knowledge from senior decision-makers.)

*Encouraging process reengineering*

Best-in-class institutions are attempting to reevaluate and reengineer both business and instructional processes to take advantage of technology. In business process reengineering, senior management support greatly enhances the probability of success. For example, the Senior Vice President for Finance at UCLA has taken leadership in eliminating paper and converting current business processes to electronic processes. Particularly noteworthy in this reengineering effort is the adoption of post-audit procedures for electronic forms, in which most forms can be acted upon without a lengthy pre-approval process. UCLA expects to save $500,000 per year in data entry costs and recognize significant reduction in key business office staff as a result of this practice.

The large research institutions surveyed also recognize the need to reengineer instructional delivery that technology can enable. Two of the six institutions are strongly committed to developing innovative instructional uses for technology, with the support and personal involvement of interested faculty. The other benchmark institutions are in various stages of implementing similar programs. Nationwide, classroom instruction is evolving from the standard lecture format to collaborative learning, where the instructor is more of a mentor or coach than a dispenser of knowledge. This transition will rely heavily upon investments in information technology.

*Implementing incentives to overcome institutional inertia toward adoption of new technical standards*

We found near unanimity in the practice of offering financial incentives for users to migrate away from obsolete technology. The most widespread example of this is in charging for outmoded SNA connections to encourage use of TCP/IP as an Internet working standard. Five of six institutions currently charge for SNA network connections while offering TCP/IP at either no or greatly reduced cost.

*Internalizing or institutionalizing the development of information technology staff*

Those institutions that appear farthest along have managed to couple institutionalizing training with human resource policies that recognize training’s implicit value. The University of Texas has a novel approach to administrative program-
“While computing itself is becoming more distributed, distributing funding for computing is not universally advantageous.”

Engaging users effectively in application development

We found two differing views of how to achieve the common goal of enabling or encouraging the user community to participate in the development of computing applications. The first model places technical responsibility closer to the level at which the end product will be used; the second maintains central responsibility but emphasizes coordination to ensure user satisfaction. The effort at the University of Texas involves direct participation of the user community in the development of administrative computing applications. In the Texas model, support at the user level is provided by programmer/analysts who began their careers as very comprehensive, centrally managed training program. Penn State has also distributed to using organizations the responsibility for much administrative applications development, though the training infrastructure and hiring/promotion paths are not as clearly integrated into the institutional fabric and human resources policies as they are at Texas. The institutions that have developed this type of direct-support model believe that vesting technical capability and responsibility in user organizations allows better response to user needs.

Other benchmark schools encourage user participation through close coordination and consultation with user organizations to identify requirements and necessary resources. However, actual development, testing, and implementation is done by the central information technology organization. Those that have adopted this model believe that as long as user requirements are adequately addressed through consultation, centrally managed technical efforts provide a uniform level of support, consistent standards, and common solutions that can be applied to more than the requesting organization. They feel that this helps avoid situations where programs are departmentally rather than institutionally optimized, resulting in redundant effort, incompatible solutions, and cost inefficiency.

Budget measures

Each institution’s budget figures reflect individual institutional accounting practices, making direct comparisons difficult. Our comparative data are necessarily approximate and no specific numbers are included below. Nevertheless, it is possible to make a number of general observations about budget practices that affect information technology.

A hurdle all institutions are facing is the fact that information technology organizations must meet the unparalleled growth in demand for services in times when university budgets are tightly constrained. To achieve the needed levels of service in the current fiscal climate will require internal reallocation of institutional funds and innovative alternative funding strategies.

Central vs. distributed funding issues

While computing itself is becoming more distributed, distributing funding for computing is not universally advantageous. All of the benchmark institutions are investing heavily in central information technology organizations and, in some cases, are actually recognizing a cost benefit by centrally funding certain services. An important theme in our discussions was the need to find innovative solutions to funding needs while achieving an appropriate balance of central and distributed funding.

Perhaps the most interesting budget observation was that some of the best-funded institutions not only spend a higher absolute dollar figure on information technology infrastructure, but they also invest a significantly larger percentage of their overall budget than some of the more poorly funded institutions. This may well be a result of a longer history and a better institutional understanding of the importance of investing in information technology as a critical institutional resource.

A related and similarly important observation is that there is no direct relationship between the extent to which a university is centralized and the level of central investment in information technology infrastructure. Some of the more traditionally decentralized institutions make significant central investments in information technology infrastructure. Their level of investment in central information technology services frequently exceeds that of the more centralized institutions.

Our study found that distributed funding of widely used services may, in some cases, increase the institution-wide cost. Central funding can result in de facto standards that reduce the cost of a widely used service, such as e-mail or site-licensed software, both for support and the actual cost of the service provided. Moreover, centrally funding items such as training may provide a baseline for user skills, improving overall institutional efficiency and productivity. The University of Illinois estimates the cost savings for
centrally funding selected services may be three-to-one.

However, the benchmark institutions were also sensitive to the fact that a balance must be achieved between that which is centrally funded and that which is distributed or cost recovered. A no-cost service, by its nature, will generate infinite demand. In implicit recognition of this fact, one benchmark institution has appointed a funding committee to evaluate the appropriate mix of central versus distributed funding.

**Student microcomputer labs**

The need to achieve an appropriate balance between central and distributed funding is particularly evident in funding student microcomputer labs. While no benchmark institution entirely funds microcomputer labs centrally, one does fund and operate all labs as college and academic department facilities. Where the primary model of funding is local (college or departmental), the support level available to students varies widely. In some cases, only students with junior or senior standing have access to microcomputer lab facilities. The result is very uneven discipline-based lab support for undergraduates.

At the other extreme, the University of Michigan provides a very large number of machines centrally so that access to microcomputers by undergraduates seems to be quite uniform and adequate. Michigan also facilitates college and departmental laboratories but recognizes the importance of centrally funded facilities in helping to ensure uniform support to the majority of the student population. The other benchmark institutions also employ mixed funding models. Two report that approximately half of all machines are provided centrally, with the remainder supported by colleges and departments.

The issue of student microcomputer facilities highlights the observation that entirely distributing funding may not provide consistent support to the largest number of students. On the other hand, complete central funding (a strategy not used by any of the institutions surveyed) would not enable colleges and departments to run and manage information technology facilities unique to their needs. Most large universities, therefore, use a combination of central and distributed funding and operation; the problem lies in determining the optimum mix in a constrained fiscal environment.

**Numerically intensive computing**

Different approaches to resource management are also being pursued in numerically intensive computing. Two of the six benchmark institutions centrally support extensive numerically intensive computing capabilities; a third has a national supercomputing facility on campus; a fourth provides some central facility support but allocates operational support and coordination to the College of Engineering. Penn State has pioneered the use of “cluster” computing, or sharing cycles from clustered UNIX workstations among numerous participating departments. Departments have the option of adding their workstations to a virtual resource pool where computing cycles that are not in use at a given time may be provided to another application (perhaps unrelated to the original department). This cooperative arrangement maximizes the use of computing resources and relieves participating departments of system administration tasks for which they may not have qualified support staff. The clustering concept (decentralized procurement, central management, decentralized but centrally coordinated use) is seen as a “win/win” situation for all.

**Life-cycle funding**

The rapid pace of technological change has left all institutions struggling with life-cycle funding. Software has a useful life of about eighteen months; hardware becomes obsolete in three to five years; yet university fiscal pressures are usually too tight to provide the sinking funds common in business for such purposes.

The most noteworthy means of addressing life-cycle funding is the use of federal indirect income. Federal indirect charges on research grants and contracts are a major source of funds for research universities. A parallel can easily be drawn between the services provided to researchers by libraries, traditionally recipients of such funding, and by centrally funded computing facilities. However, many have viewed them as different under the terms of OMB A-21 and related federal regulations. Two benchmark institutions have nevertheless addressed these concerns and are using this category of funding to help meet some of their critical life-cycle funding requirements.

**Other solutions**

At least two of the six institutions are pursuing innovative budget methods to fund good ideas mid-year. Many have found that the long lead-time requirements inherent in university budget cycles run contrary to the realities of the information technology industry. Precisely defining information technology resource needs eighteen to thirty-six months in advance is often impossible when the industry develops new products on a nine- to fifteen-month cycle. Significant flexibility in budget planning is neces-

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"... the long lead-time requirements inherent in university budget cycles run contrary to the realities of the information technology industry."
“Formal university-wide planning for information technology initiatives, addressing the needs of all academic areas, appears to be non-existent in the major research universities in our study.”

Resource allocation

Some institutions have recognized that the fast pace of technological change requires significant resources just to assess trends and their implications for the future. At least two of the benchmark institutions have dedicatedstaff resources within their information technology organizations to examine future directions on a continuing basis.

Two of the six benchmark institutions have moved even more boldly to address future changes by restructuring their central information technology organizations. Both are moving toward flatter organizations and are strongly emphasizing responsiveness to customer needs and customer satisfaction as critical measures of success. One has taken a project and consumer orientation, organizing into teams that will remain with a task from inception to full implementation. The projects are in large part decided by the customers (the using organizations) who buy into the projects with a part of their computer budget allocation.

The other institution has reorganized its entire information technology organization with the assistance of an outside consultant. It is restructuring based on a set of guiding principles. At the top level, the new structure is divided into:

- “service bureaus” that deal with the operational and administrative aspects of the organization;
- technologists who provide the systems engineering, application, and tools/methodology functions;
- consultancies that provide users with information on services and products that are offered by the organization and, in turn, coordinate new user requirements; and
- an architecture group to develop/advise on enterprise standards.

It is too early to gauge success or failure of these efforts.

Quality improvement

Most benchmark institutions are seeing formal quality improvement efforts as a strategy for analyzing and implementing processes to enhance information technology support. Three of the institutions have adopted formal quality improvement initiatives to improve service to customers. Quality improvement is, thus, a routine
element of the information technology agenda at half of the institutions studied. Also in an attempt to focus on customers and quality of service, at least two benchmark institutions are changing internal priorities to focus more directly on the needs of colleges and academic departments. One is directing more administrative development staff to departmental needs; the second is facilitating a market-driven approach to information technology services and believes that this will necessarily focus priorities where they will best serve the using organizations.

Principle 2: Best-in-class institutions encourage early implementation of information technology infrastructure and standards.

The benchmark institutions have, in many cases, adopted a two-level approach to the development and implementation of institution-wide networking. First, even in an era of constrained budgets, they have found methods to fund critical university-wide information technology infrastructure on a priority basis, and to implement that infrastructure in a timely fashion. Second, they have adopted funding strategies that encourage widespread use of more modern networking protocol standards (e.g., TCP/IP) as the basis for campuswide connectivity.

Not surprisingly, placing a high priority on early and sufficient funding for information technology infrastructure leads to faster completion and availability. Five of six benchmark institutions have essentially completed installation of basic cabling infrastructure both between and within buildings and are now able to turn attention to other critical needs, such as facilitating greater use of the technology. Priority investment strategies, such as those used to implement the basic infrastructure, are now being used to extend full network connectivity to student residence halls. Some strategies for completion of residence hall networking projects take advantage of non-traditional funding opportunities; others involve formal institutional funding initiatives such as bond issuance.

Principle 3: Best-in-class institutions emphasize customer service in order to integrate technology into the institutional culture.

All best-in-class institutions strongly emphasize user support. Most of the benchmark institutions are actively encouraging a customer focus, meaning to “serve the customer,” not “control the customer.” Users have many choices to support their information technology needs as a result of the increases in desktop power and connectivity. They are not necessarily bound to solutions developed centrally. Therefore, the relationship between information technology organizations and both using organizations and individual users must be viewed as collaborative and cooperative, not dictatorial. Computing organizations exist to serve users, not vice versa. Some of the benchmark institutions are re-orienting their internal economies or funding strategies to further emphasize the role of the customer and the importance of customer service.

Help desks

Those benchmark institutions that have most thoroughly internalized the customer service orientation within their central information technology organizations are placing increased emphasis on help-desk functions. For a number of reasons, help desks are seen as critically important in providing satisfactory user support. The help desk often provides the first-level contact for users with the information technology organization. First impressions are important. Moreover, the more assistance can be rendered by the help desk, the less secondary assistance is needed. A technical specialist should not be needed to answer a general question; many of these can and should be answered at the first, or help-desk, level.

To further emphasize the importance of the help-desk function, two of the benchmark institutions have consolidated their help-desk functions, providing the user with a single point of contact and lessening user confusion about which office to call in a given situation. A consolidated help desk provides:

- a single point of initial contact for faculty and students;
- an entry point for “one-stop shopping” for information technology services; and
- easy referral for more difficult problems to specialty areas within the organization.

Not surprisingly, those that have made strong philosophical commitments to customer service as a measure of quality have also implemented large, centralized user support organizations. These centralized support organizations are seen as the primary coordinators of customer requirements and information technology services. They can handle training, software site licensing, sales and services, departmental ser-
services, student lab management, and planning with the schools and colleges, in addition to providing basic consulting.

Residence halls

The benchmark institutions are also seeking better ways to support student technology users within the residence hall environment. In some cases, on-site support is provided by fellow students hired as technical support and living in the residence halls. In other cases, student micro-computer labs are located in residence halls, either for exclusive use of the residents or for all students. In still others, site-licensed software is being provided for residence hall use.

Information technology training

Traditionally, universities have provided only limited support staff for information technology training efforts. However, with the widespread use of information technology tools and the growth of the Internet, demand for information technology training has grown exponentially. Many of the benchmark institutions are developing creative means of coping with the increased demands for information technology training. Examples include:

- One benchmark institution has consolidated information technology training into a single administrative unit.
- For Internet access training, Texas has developed a model in which the operation of technical tools is taught by the information technology organization, but library personnel teach how to use the tools to access different subject areas. This is seen as an extension of the traditional library role of facilitating user access to information.
- Some institutions are using commercial software packages to address some of their needs, rather than developing in-house training packages.
- Another approach to meeting the increasing demand for information technology training is to enlist the aid of students in instructing other students. Advantages of this approach are multiple. Most courses “for students, by students” are free; the content is driven by peer needs; and peer instruction provides a more collaborative learning environment.

The training issue has been extended to address critical emerging needs, such as network security instruction. At Michigan, volunteers have been trained as ethics discussion leaders and Student Open Forums are held to discuss the ethical implications of actual incidents.

In short, although institutions are still grappling with ways to stretch the traditionally small staff allocations dedicated to training, most are actively implementing enhanced information technology training programs.

Principle 4: Best-in-class institutions use the elements of standards, security, and architectural planning to create a supportive environment for change.

Standards

All benchmark institutions are attempting to articulate standards that will facilitate growth. However, there is divided opinion (sometimes even within an institution) on the value of open standards. Some are embracing a strategy of evolving to open systems standards (e.g., the Open Software Foundation’s DCE) while some are choosing not to do so. Those in the latter category (a significant minority) believe that better support can be provided for growth by remaining with proprietary standards, at least for the near-term. Among the institutions committed to open, standards-based approaches, there was widespread sentiment that proprietary solutions are ultimately more expensive because the vendor(s) can hold the prices high. Moreover, applications will not be portable cross-platform, and there will be significant interoperability and compatibility problems.

Security

Institutions are also examining strategies to provide secure technical environments that support change and growth. Many are seeking a reliable means to provide more secure authentication for the highly heterogeneous environments that typify large research universities. The strategy for many involves Kerberos authentication for those applications that can take advantage of it, centralized Kerberos server availability, and possible integration of token card support when that is technically feasible. Some go one step further and envision implementation of DCE in the future. Concerns have been voiced about cross-institutional compatibility and technical complexity of solutions. Most institutions seem to recognize that network security is an extremely complex problem to which the “answers” are evolving.

The schools most actively engaged in examining network security problems and current
security technology are beginning to explore options for encrypting at least some data. The concern driving examination of encryption options is not only with the confidentiality of the information but also with its integrity. At present there is no firm consensus on how to accomplish this objective technically, nor even on the degree of technical difficulty. Several institutions seem to be hoping that when Kerberos is more widely available in their environments session key encryption can be employed. Some are investigating encrypted Internet utilities (e.g., encrypted Telnet), and some are investigating public key encryption, particularly for e-mail (both signatures and data).

Two of the institutions were less concerned with “network” security per se. Their strategy for providing a secure means for network growth was to vest all responsibility for security in the hosts interfacing with the network. Because a network is only as strong as its weakest element from a security perspective, this approach would necessitate, at some point, a minimum security level for all attached hosts and strong physical security for critical network components.

Thus, again, there is not a universally accepted “right” way applicable in all institutional contexts. The majority of benchmark institutions are examining options for enhanced network security, but the degree to which security is an issue and the specific technical means being evaluated vary according to institution.

Architectural planning

Architectural planning is the third area in which institutions are implementing or examining technical environments to facilitate change. Architecting a future institutional distributed computing path and transition strategy is on the agenda of three of six benchmark institutions and under discussion at the others. Moreover, there are at least incipient moves to examine cross-institutional architectural issues. For example, several institutions are looking at the same generic types of solutions for the same problems. Areas of shared interest include more secure network authentication (Kerberos, token cards), open client/server solutions based on DCE, Novell implementations of Kerberos, and eventual transition to DCE. For those institutions whose architectures are evolving in similar directions, there is interest in examining key common issues that could be solved collaboratively. While the cross-institutional differences in evolutionary strategy may preclude a truly common solution across the board, for those areas where interests and projected architectures do coincide, it may be beneficial and cost-effective to establish collaborative relationships. Establishing collaborative or cooperative partnerships may provide vendor leverage. At the very minimum, information in these areas of shared interest needs to be exchanged at the technical level to prevent possible conflicts in implementation that might affect all concerned institutions.

An architectural issue for several institutions is that of “data warehouses” for administrative data. The single greatest challenge facing administrative computing is providing users with access to their own data. With the reasonable prices of mid-tier servers, it is possible to create “data warehouses” dedicated to providing better access to data through user-structured queries/reports based on SQL. While certainly many commercial database management systems could be applied to this type of problem, Oracle seems to have taken the most aggressive position with regard to the implementation of open software standards that run in a heterogeneous environment. There are acknowledged security issues that must be resolved before sensitive data elements are introduced. Nonetheless, the data warehouse concept does appear to be emerging as a common architectural element for several of the benchmark institutions, with Oracle most frequently mentioned as the database management software of choice.

Another common architectural feature was the inclusion of Mandarin as an element in implementing client/server solutions at several benchmark institutions. (Mandarin provides a “tool kit” for building client/server applications.) There are currently seventeen universities in the Project Mandarin Consortium and that number is expected to grow to nearly sixty by the end of the current fiscal year. Three of the benchmark schools are members of the Consortium. Those applications currently in place or under development at the benchmark institutions using Mandarin are geared towards providing students with direct access to their own data. Mandarin is a proprietary product today, but it is evolving to compliance with OSF’s DCE standard. It was designed with security provisions to help guard against unauthorized access. Mandarin represents another opportunity for those institutions with common architectural interests or strategies to collaborate for their mutual benefit.

Library computing

One critical architectural area in which all institutions appear to be struggling is in defining the path for library computing to transition to client/server technology. At present there is no clear-cut consensus on whether building or buying client/server solutions is the best strategy.
Those that would opt for a “buy” strategy are troubled by the fact that no one single library automation vendor has all the needed components to support a major research institution. Further clouding the architectural vision for library systems is the fact that current library systems are mainframe-based with little hope they can be easily converted to client/server systems without extensive reengineering. For all of these reasons, the library system of the future will probably emerge as a combination of off-the-shelf components and locally developed subsystems, with standards providing the “glue” to make the pieces work together. Z39.50 is a particularly vital standard for future library systems.

An interesting observation in the area of library system architectures was that few of the benchmark institutions rely completely on NOTIS. Even with a fairly comprehensive library system such as NOTIS, a local library development staff is needed to adequately support the needs of a large research university. Moreover, NOTIS and the other automation vendors are not providing the next generation of library information support, such as integration of CD-ROMs, imaging, and client/server tools.

The University of Wisconsin has raised the lowest common denominator for the library computing environment. High-end personal computers are used for all public and staff access to library information facilities and tools. This architectural model provides the basis to support additional information services such as full text and image database access, as well as sound and other multimedia services.

Overall, the most valuable result of this benchmarking effort was establishing relationships among the institutions and formally discussing common problems and solutions. Penn State and the five benchmark institutions have agreed that there are areas where collaboration could help address some of the common problems we are facing. One of the most pressing issues is how to support the incredible growth—in size and demand—in our user communities. The University of Wisconsin has agreed to take leadership in putting together a Union Catalog of User Support Materials and Tools. Our intent is to reduce duplication of effort by sharing usersupport materials from each of our institutions. We hope that if this effort is successful, we will be able to apply it to other areas of overlapping concern.

As noted in the introduction, our comparative numbers proved to be quite useless. The primary reason for this is that we were asking the wrong type of question; we were asking about “input measures” when in fact what we wanted to gather were “quality indicators.” All of the institutions in our benchmarking study are interested in gauging the quality of their information technology resources and services. Thus, we have agreed to try to develop a set of quality indicators, questions that will provide a measure of the contribution of information technology to the fulfillment of the institution’s mission. The University of Michigan has agreed to be the coordinating point for gathering and consolidating our suggestions for quality indicators.

Was the benchmarking effort worthwhile? Yes. For Penn State, the effort has paid off by identifying a number of areas in which it can examine its own “soul” and possibly incorporate the best elements of the practices observed into its own institutional environment. As a group, we learned, first, that identifying useful quantitative measures of quality is extremely difficult. Second, we learned that there is immense value in recognizing the cultures of each institution and the ways in which each is accommodating change. Finally, both the benchmarker and the benchmarkers have benefited through sharing findings.

For those considering the benchmarking process, the most valuable results may not come from gathering numerical data. Clearly, in this effort, the real value of benchmarking has been the synthesis of the experiences of the institutions, and finding common processes that may benefit all.
Managing Technological Change in Academe

by Carol B. MacKnight

Colleges and universities are grappling with the spiraling costs of education, a decline in revenue, changing student demographics, and a competitive marketplace. Technology offers a solution to some of these problems. This article describes what several institutions are doing to support access to networks and communication services needed by a new information-age curriculum.

Colleges and universities are under pressure to change the way instruction is being delivered on their campuses. The lecture approach, a labor-intensive instructional model, falters before today’s students and adult learners who come with a wide diversity of needs, interests, and educational backgrounds. Information technology offers the attraction of enhancing learning by giving students access to learning resources in a variety of forms whenever and wherever they are needed. There are now several technologies available for delivering instruction to students on the campus, in their homes, or on the job.

Providing a better education to more people is not an issue of asking the faculty to teach more classes. Increasing the teaching load will not significantly reduce institutional costs nor increase student learning. Rather, the focus should be on using the flexibility of information technology to find new models of instruction that are more appropriate for the information age. The shift is toward an instructional model in which students have access to a variety of resources made available by the faculty, whose role becomes one of a collaborator or a mentor in the learning process. Complete lectures, demonstrations, tutorials, library and research materials, and other learning materials are some examples of instructional media that can be stored on courseware servers and retrieved from a network by students and faculty. In this model students will no longer be chained to time, space, or even to local resources.

The greatest challenge to higher education comes from the exploding interest in the Internet. The Internet has significantly changed the way business is being conducted in the United States and abroad, from marketing and selling products to the development of new products with customer participation. The virtual corporation will become the norm. In essence, the Internet is the world’s largest public library, offering instant global communication. Leading-edge software is distributed on the Internet, and valuable databases, research materials, documents, libraries and indices, current events, etc., are published there. Students can now interact with faculty worldwide and take courses internationally for credit. MIT students, for example, are conducting joint architectural projects with students from other nations. As it has transformed business, the Internet heralds the inevitable transformation of higher education.

How do we get there from here? Several colleges and universities are making the transformation of infusing technology into academic life through a well-thought-out campuswide plan. As Steve Gilbert points out, “Most significant new applications of information technology cannot be integrated widely and effectively within a college or university without both the commit-

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“The shift is toward an instructional model in which students have access to a variety of resources made available by the faculty, whose role becomes one of a collaborator or a mentor in the learning process.”

1 Alan E. Guskin, “Restructuring the Role of Faculty,” Change, September/October 1994, pp. 16-25.
ment of the institution to the relevant infrastructure and the commitment of many individual faculty members to the particular approach. Faculty will not be successful with these new technologies without full support from a combination of services available from the centers for teaching, libraries, media centers, academic computing units, and other campus organizations. Without a strategic plan that demonstrates an understanding of the technological options available and identifies the necessary support services and other resources, the future of our institutions will be at stake.

What are the computer-teaching requirements; what new instructional tools can faculty expect in the classroom of the future; and what combinations of the old and new will be most effective? Will faculty be locked into an instructional environment that seems oblivious to a changing student body, to new models of instructional interaction, to real-world experiences? As part of a sabbatical study, the author interviewed academic leaders from several private and public colleges and universities to see how they were approaching the technological challenges facing their campuses. The discussion that follows highlights some achievements, successes, and shared challenges.

There is great diversity in planning styles among the institutions discussed in this article. What they have in common, however, are very similar concerns. All campuses are striving to provide improved access to computing resources and to meet the instructional needs of their academic community. Their administrators are struggling with rising technology costs and debating what future breakthroughs in technology will mean to their campuses. Some campus strategies aim at just trying to stay viable; some are finding ways to support both connectivity and instructional computing; and a few are betting on the future and testing technologies they think will put their institutions on the cutting edge. A view of common institutional goals, ideas, and advice related to improving access and support of information technologies is presented below. Topical highlights are divided into three sections: current campus trends, common instructional needs, and future challenges and visions.

Current Campus Trends

Distributed computing and increased specialization

Computing in higher education is moving toward a more decentralized information-processing environment, which in turn has decentralized some of the decision-making surrounding computing. However, central computing organizations continue to have an important, though changing role. It is this change that many fail to appreciate when they notice that the central organizations have not gone away or decreased in size.

Some activities or resources, like network design and administration, file servers, reference databases, software licensing, technology classrooms, faculty development, and support are most effectively managed centrally. Without central coordination and selection of “standards,” a community of individuals loses the ability to communicate electronically. The electronic equivalent of the traditional library activities—namely, developing and maintaining collections—is another example of resources most effectively managed centrally.

The trend in decentralization is toward client/server architecture and multiprocessor integration, with more computing being done at the departmental level. Moving processing from the mainframe to high-function workstations and to lower-cost desktop computers enables cost-conscious academic computer directors with tight budgets to meet the specialized needs of departments. More reliance on flexible information systems can be seen now in departmental computing, with network servers and file servers replacing mainframes.

Today, there is even a greater demand for computing support services, as more faculty, staff, and students become interested in computing and what it can do for them to support teaching, research, and other administrative services. These new users need help in dealing with activities (hardware, software, multimedia peripherals, networking, backups, viruses, etc.) on their personal systems that were previously taken care of for them on central time-sharing systems, in addition to learning those skills necessary to use the computer in enhancing the educational experience.

Staff people are increasingly needed to act as interpreters and resources in acquiring, searching, and retrieving data, text, and images, and in using a variety of other information resources. Without an adequate support staff, faculty members, who are integrating computing into their curriculum, are often forced to teach basic computer skills and have little time for more creative applications. Using the computer in his course on Milton, John Huntley, for example, considers the amount of time he spent as a computer counselor to be misspent. “I should have spent more time in class challenging superficial inter-
pretations of Milton and more time in the library helping people move toward the resources that most likely dealt with their interest."8 Huntley’s experience demonstrates that the cost of technology does not end with the purchase of hardware and software. Academic support personnel need to be factored in for user training, without which the best examples of technology will not lead to successful implementations.

For institutions that are able to provide a wide variety of support activities, from online help to the development of complete technology-based courses, the future looks quite bright. In their approach, instructional support staff act as campus information technology evangelists, encouraging and supporting faculty as they integrate technology into the curriculum. These instructional technologists are highly specialized instructional designers, programmers, and multimedia consultants, who can provide direct assistance in the creation of large projects and can offer instruction under different formats such as group introductory demonstrations, training workshops, and individual consultations. Together, faculty and staff at places like Penn State and MIT have a track record of developing high-quality instructional courseware, which is frequently shown at national conferences.

On a daily basis, instructional support staff are also available to provide other services. The demand for transferring images to computers for display—a service that is unlikely to be rendered by individual departments—is increasing. It is one case where having a centralized facility where faculty can create digital media for their classes has the distinct advantage of eliminating duplication of costly equipment and of specialists to operate it on a campus.

When resources are scarce, many institutions limit the scope of services. For example, workshops provided by technical support services staff generally focus on basic packages (word processing, spreadsheets, and the like) and on the various resources available on the Internet. The main objective of this approach is to develop self-sufficiency in faculty users on a limited number of software packages, as institutions try their best to survive severe financial constraints and do more with less. Under these circumstances, faculty have the responsibility for finding appropriate commercial courseware packages for their classes or have the option of learning an authoring system or presentation software and developing their own instructional materials.

Connectivity

Instructional technology has achieved its greatest success through e-mail and exploding interest in the Internet. Internet connections offer the attraction of making rich “information resources accessible from low-end computers."9 The Internet transports information to desktops from all corners of the globe. By tapping in, scholars have immediate access to databases, library catalogs, and other library resources, and to the work of colleagues anywhere in the world.

Newer browsers like Mosaic (a networked, multimedia hypertext tool for information discovery, retrieval, and collaboration) add another dimension to documents. Such tools handle all forms of multimedia (pictures, movies, audio, and text) and support public and private annotations (those stored on a specified file server vs. those stored on a local computer). Annotations, which can be text and audio, can be left on any location in the World Wide Web and will appear at the bottom of a document like a footnote. The collaborative features of Mosaic, Netscape, and similar software offer many exciting possibilities.

Providing Internet connections from classrooms, offices, and residence halls remains a crucial element for many institutions. “Connectivity is only the first step in instructional uses of computing, but a necessary one. Lots of work must also go into providing high quality data sources and making them simpler to use."10 Charles Bender recommends that, at a minimum, we should strive to provide for every member of the academic community a basic computing infrastructure, consisting of access to word processing, data manipulation applications, and network information services.11 Policy makers must have a strategic plan for information technologies and be able to translate that plan into the financial resources necessary to implement it.

Impact of technology on teaching

The exploding rate of new information resources available to faculty and students impacts on teaching, research, and administration. Networks make it possible to deliver instruction to every desktop in every office, computer lab, classroom, residence hall, and home. With terminals in different locations, physical space is replaced with an access path. Networks have the potential to create the virtual classroom, with people logging in at set times or at their own convenience and discretion.12 Education can now take place on demand at any time, in different forms, and at any place in the world.

Some faculty argue that there is no reason for us to have lectures anymore, because there are...
Campus Profile

SEATTLE PACIFIC UNIVERSITY

Founded in Seattle, Washington, in 1891 under the sponsorship of the Free Methodist Church of North America, Seattle Pacific University (SPU) today is a small, comprehensive university with a full-time enrollment of 2,850 students. SPU offers forty-five undergraduate majors, eleven master’s degree specializations, and one doctoral program through a College of Arts and Sciences and three professional schools: Business and Economics, Education, and Health Sciences.

Seven years ago, Seattle Pacific University began a series of substantial investments to build an information technology infrastructure that would improve administrative productivity and enable SPU faculty and students to teach and learn in an information-age environment. To date, those investments have totaled over $5.5 million, nearly $2 million of which has come from gifts to the University.

Investing in IT: 1988-1992

The first significant gift SPU received, in 1988, was one for $1.2 million from the Digital Equipment Corporation which was parlayed into $2.5 million worth of purchasing power. This allowed SPU to move quickly from outdated PDP-11 systems to a DEC VAX environment, all within a year’s time.

By the spring of 1989, the first phase of a major campuswide fiber optic network installation had begun, and that fall an Information Systems Long Range Plan outlined some of the key planning areas that needed to be addressed over the next few years. By late 1990, a decision had been made to purchase SCT’s Banner systems for student records and financial aid, after a thorough investigation of available packages had been conducted and a consultant had affirmed that Banner running under Oracle on DEC VAXes was a suitable choice for SPU.

By the summer of 1992, with the administrative systems implementations well under way and the University engaged in an institution-wide five-year strategic planning process, the All-university Computer Planning Committee (ACPC) turned its attention to educational technologies. The plan developed by the ACPC, called Technologies in Education, emphasized the need for a coordinated strategic planning process, as well as increased and sustained funding, for technology at SPU, and included a vision statement to guide future technology investments: “The vision for educational technologies at Seattle Pacific is to bring technology into the fabric of the learning process.”

One of the key features of the plan was that information technology proposals were tied directly to five long-range goals that had been identified in the University’s strategic plan: improving academic reputation, achieving enrollment goals, improving academic program quality, implementing a faculty development program, and establishing student quality and selectivity goals. The following priorities were defined as essential to meeting those five goals:

- get computers into the hands of students
- provide most faculty with a computer
- provide campus access to wide-area networking
- install a library automation system
- refocus computer labs to meet specialized curricular needs
- improve ongoing hardware and software support structure for repair and replacement
- integrate educational technology into academic classrooms

Building Infrastructure: 1992-1994

According to David Tindall, executive director of Computer and Information Systems (CIS), by late 1994, essentially all goals of the plan had been met. Every faculty member now has at least a 486-level desktop computer and high-speed Ethernet connection, and microcomputers in student labs have been upgraded and refocused. Over 80 percent of the more than 1,000 PCs and terminals on campus are connected to SPUnet, a fiber-optic backbone network that links essentially all primary campus buildings. A PowerHub switch does full routing, which makes it possible to have Internet Protocol (IP) on every desk and allows for the potential of ATM technology in the future. Tindall explains, “Our song used to be ‘four pair everywhere’ and now it’s ‘IP everywhere.’”

For the past two years, emphasis has been placed on wiring residence halls. Every dorm room is provided a telephone, voice mail, a cable TV jack, and computer network connections. An innovative partnership with TCI facilitated this wiring project, with SPU agreeing to purchase cable programming and TCI underwriting two-thirds of the construction costs to install the cable while providing the network wiring for computer connections (worth over $100,000 to the University). Included in the package were four SPU-dedicated channels, laying the groundwork for delivery of University-driven content.
CIS continues to provide central printing services, but these are now delivered via a Xerox DocuTech machine instead of the high-speed laser printer formerly used, and for a cost that is not much higher than in the past. Now documents throughout the University can be kept up to date online and printed and bound on demand—a capability that is already proving cost-effective and efficient for many campus departments.

Another significant donation to the University came by way of Microsoft Corporation’s matching-gift program. When an SPU alumnus employed by Microsoft elected to donate licenses for Windows for Workgroups and Office Professional, the University received $139,000 worth of software. This software was initially installed on faculty computers and later installed throughout the campus.

Standardizing on a set of software for all campus users greatly facilitated user training for these tools. CIS was able to negotiate a contract with an outside vendor to offer a substantial training program of introductory classes for all of the various software packages. With the endorsement of SPU President C. Arthur Self, who went on record about the importance of learning to use these new tools, the program has been a great success.

Another major addition to infrastructure was the completion of the new SPU Library in July 1994. A converging point for the traditional academic setting and technology, the building provides the campus and community with a state-of-the-art facility into which significant technologies have been built: fifteen online catalog terminals, twelve CD-ROM stations, sixty computers in student labs and classrooms, and wiring that enables access to the campuswide network and beyond. In addition, the library acquired and implemented Data Research Associates’ automated library system.

**Today’s Challenges: Content and Utilization**

In Tindall’s view, IT planning to date has revolved around “bits and bytes, hardware and wires,” but now it must begin to address content and use: “We’re in the content business now—not that we create the content, but we enable easy access to content by developing the necessary tools and architectures.” Applications such as e-mail, access to the Internet, Gopher, and World Wide Web are heavily used by SPU faculty and students, and now that the infrastructure is in place, a key value of IT—information access—is in the spotlight.

An important task for Computer and Information Systems is to organize and manage the providing of content by appropriate content “stewards.” Whether it’s the student directory, the online library catalog, scholarly or research results, or information extracted from administrative databases, people will increasingly expect to access it through the network, particularly through Web-like technology. Tindall says, for example, that just about everything in the Banner legacy systems is ready to turn over to the user via the network, and the issues that remain are not so much technological as policy-related.

Vice President for Enrollment Services Marj Johnson believes the fundamental value of IT—and rationale for SPU’s heavy investment in integrated student and financial aid systems—is the ability to bring information together at one point in service to the student, instead of sending the student to many different places. One of the University’s administrative challenges, in her view, is utilizing technology as a tool, to be more effective: “We have to remind ourselves that if it’s not useful to a purpose we hold dear, then we ought not to move in that direction.”

For any academic institution, there comes a time when IT utilization questions become focused on teaching and learning. For Phil Eaton, vice president for academic affairs and provost, the “end” of technology ought to be defined in terms of SPU’s educational purpose and mission. He has created a task force to first articulate an educational vision, and then define how those who have technical expertise can help to support that vision. “We must do our work in higher education differently in the future,” he says. “We simply cannot go on doing what we are doing the way we are doing it. When you look at spiraling costs year after year, something has got to give. I believe that technology will be very influential in the change in the way we do business.”

SPU has an increasing interest in distance education as a potential solution to the challenge of accommodating its share of an estimated 45,000 new students in the Puget Sound area by the year 2010. A small urban university with no room to grow physically, President Self says SPU cannot afford delivery of education in the future to be time and place bound. The University is investigating two-way interactive video technology to deliver classes simultaneously to multiple locations, and it may be that...
a partnership with the Boeing Corporation—which has an interest in SPU providing training to its employees—will result in another creative funding mechanism to provide the infrastructure for more sophisticated distance education in the future.

Information Resources Management

CIS has evolved dramatically over the last few years. Formerly primarily an administrative computing organization with large-computer operations responsibilities, this central information technology organization now additionally oversees voice and data communications (both the conduit and the services), microcomputer support, user services, and the University’s printing and mailing services. Although there currently is no central academic computing planning function, there are several centralized functional activities, such as networking in academicians, software maintained on academic servers and in student labs, telecommunications across campus, and so forth.

Assignments and accountability for centralized services are managed within four CIS teams: Microcomputer Systems Support, User Services, Administrative Software Development and Support, and Central Systems Maintenance and Support.

Pervasive network connectivity has dramatically changed the environment at SPU; consequently CIS’s approach to services is changing. Most of its functions now relate to serving users. Tindall estimates that this shift to “customer service” means CIS has gone from serving 150 to 3,000 users in five years, i.e., from a handful of central-office users to the entire campus. To accommodate this shift, staff needed to be refocused, no longer simply writing code but now acting as “middlemen” between the application and the user who has some very specific needs. Now that the infrastructure is in place, Tindall says, “Our job is becoming helping people figure out how to use the tools effectively.”

Vice President Johnson adds, “Our real management challenge comes in managing the culture change. When we implement student and financial aid systems, we realized we had to have a good marriage between functional and technical components for the systems to work. We instituted the Computer Service Manager concept—individuals at the department level who could understand enough of both function and technology to make it work. This has been a very successful program; it helped people change the way they think about their work.”

Planning for the Future

Don Mortenson, vice president for business and finance, to whom Tindall’s organization reports, is a firm believer in the need to plan for and manage information technology appropriately to avoid its consuming too many resources. At the same time, he acknowledges the need to do a better job of institutionalizing funding for maintenance and replacement: “It’s not that difficult to get donors for the initial IT acquisitions, but repair and upgrading costs need to become part of your ongoing budget.”

In discussing how technology is being provided over the whole university, Vice President Eaton’s task force has recognized the lack of a sufficiently unified planning approach at SPU. Although numerous specialized small advisory groups are engaged in different aspects of planning for IT, the group identified a need to do more overall planning for the management and use of technology campuswide, and recommended a structure they believe will provide the ability to strategically move forward in a unified way. President Self shares this view: “Planning for information technology is moving from a marginal to a more centralized, core activity—such planning decisions are becoming mainstream. Certainly we cannot plan strategically for academic arenas, or for buildings and facilities, without considering technology. It’s much more pervasive than it used to be.”

The recently adopted planning structure will create a highly focused Technology Advisory Group that will be appointed by the provost and will report directly to the President’s Cabinet. This group will ensure that technology plans at the department level fit into the institution’s overall vision and strategic plans, and that ongoing support for IT continues at an appropriate level.

In summarizing the role of CIS today, Tindall says, “We are not data processors; we are information technology providers. We’re in the business of providing tools, teaching how to use them, and encouraging their use. Providing infrastructure is important, but if it ends there, the IT organization has failed in its calling.”

The planning documents referenced in this article, as well as a residence hall technology services guide and a network user guide created by CIS staff, are available from the CAUSE Information Resources Library (call 303-939-0310 or send e-mail to orders@cause.colorado.edu for ordering details). The network users’ guide is also available on SPU’s gopher (gopher://gopher.spu.edu/) and World Wide Web (http://www.spu.edu/) servers.
better mechanisms (online collaboration, etc.) for achieving everything that we wish to achieve. Nevertheless, having technology and people in the same room where students and faculty can interact with displays that can be manipulated is invaluable.13 In teaching a course on meteorology, Dr. Alistair Fraser at Penn State University, for example, uses weather maps to heighten students’ understanding of the mathematics behind meteorology. He grabs a satellite picture showing storms and radar echoes during his class to emphasize or clarify a point, and then brings the point home with, “You’ll need a raincoat when you leave class.” The advantage of visualizing things, he suggests, is that it allows students to grasp concepts rather than symbols and is a much more effective way of communicating difficult topics.

In this application, Dr. Fraser stimulates the mind and creates excitement and purpose in learning. He feels it is simply a powerful way to teach. Utilizing technologies like this one must be facilitated in different ways: technical, organizational, and in training. “Implementing an infrastructure for networking and communications capabilities is probably the single most important project for a campus or school preparing for the new education paradigm.”14

In a technological environment, there is a definite shift away from the standard pattern of initiation/response/evaluation that dominates the traditional classroom. Instead, there is a “new set of relations between instructors and students, among students, and between all members of the group and the body of material whose meaning, it now becomes apparent, we are all here to construct.”15 The most apparent changes in the teaching and learning process are the students who are more actively engaged in the classroom environment,16 and faculty who are honing their skills on a new line of questioning and guidance. For institutions, the question may be one of redefining their mission, now that students can interact with professors, fellow students, and friends around the world—“face to face.”

**Common Instructional Needs**

**Facilitating the use of technology**

Helping faculty discover and become proficient in the resources for presentation or classroom uses that are available on file servers and on the Internet is a priority for many institutions. Some institutions, like Dartmouth, have achieved this objective in part by dealing “with several resources through the same user interface.”17 They also have created a system-wide directory, similar to the online catalog, pulling together resources from around the campus and the Internet. Their aim is to create a seamless environment that facilitates the discovery of useful information and reduces the demand for training.

Whether faculty members have missed benefits offered by computer networks depends on their awareness, level of computing skills, and their perceived usefulness of the network offerings. Some institutions try to bridge the gap between technology access and appropriate uses in the curriculum through a series of faculty development seminars. Since faculty sometimes view academic computing personnel as technocrats, Vijay Kumar believes multimedia training is frequently more effectively handled by inviting guest professors who are actively engaged in integrating computing in instruction and learning.18 At these multimedia seminars, faculty learn about available resources and applications and how technology can be implemented in their discipline from persons whom they view as peers.

What has become clear to this writer is that the level of comfort faculty reach in integrating different information resources into the curriculum is not achieved through a single event but through continuous exposure, encouragement, and support from colleagues, students, and academic support personnel. The process involves moving from one successful experience to another—from word processing to e-mail, from explorations of the Internet to ultimately collaborating with colleagues over the Internet. The speed with which faculty become fluent with various technologies may hinge on whether the administration encourages their development and provides them with appropriate classroom facilities and technical support along the way.

**Supertech classrooms**

Another common objective among diverse institutions contacted is the desire to improve classroom facilities. If faculty are encouraged to use technology, they must have a suitable space and not be expected to set up equipment for each use. High-tech classrooms push the state of the art in software by mixing film, video, sound, and text. Although the setups may differ among institutions, the professor’s podium is the central command center. Depending on the room size and function (whether it is an auditorium or a classroom), the space may be equipped with one or more large screen video and data projection systems. Or it may have, in place of additional

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“**If faculty are encouraged to use technology, they must have a suitable space and not be expected to set up equipment for each use.”**

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13 From an interview with Gregory Jackson, Director of Academic Computing at the Massachusetts Institute of Technology, December 1993.


15 Slatin, p.135.


17 Brentrup, p. 10.

18 From an interview with Vijay Kumar, Director of Academic Computing at Mount Holyoke College, November 1993.
large screens, several video monitors. Either system can be used to display images from VHS recorders, videodisks, CD-ROM disk players, remote video cameras, slides, films, television, satellite programming, and multimedia software. All of these sources can be controlled from the teaching platform by direct remote control or via a Macintosh or IBM computer.

Integrated into an auditorium is a quality audio system with balanced acoustical treatment. Media include audio CD and audio tape. Live microphone audio is usually available. For hearing-impaired students, the University of Connecticut has installed a special-needs audio system. There is also connectivity to the college network and to the Internet. The University is committed to renovating and equipping ten classrooms per year to meet the anticipated demand.

At the University of Maine, faculty can begin using the high-tech auditorium long before they are up to speed with the many instructional aids that their versatile facility provides. Included with the equipment is a documentor, a sophisticated overhead projector, which allows faculty to project graphics directly from a book or from their teaching notes and gives them the capability of writing on the object as they would on a transparency. At the next level, faculty can begin including other media with what is being projected on the documentor—a one-step-at-a-time approach toward proficiency. Vanderbilt’s Chancellor Joe Wyatt believes that “the only way to bring new ideas to fruition is to provide a setting,” that is, provide institutional support and incentives to faculty members and thereby demonstrate the institution’s commitment to integrating new instructional applications of information technology.19

Providing an electronic instructional setting is becoming more difficult in the current economic climate for those campuses where networks have yet to be completed. The distance between the long-term computing infrastructure goal and the present computing infrastructure is so great at many institutions that it may take at least ten years to close the gap.20 “Budgeting for departmental local area networks (LANs) is an essential first step toward moving a department into the information technology arena.”21

**Future Challenges and Visions**

**Developers or purchasers?**

Academic computing directors support a wide range of computer needs. Can they afford the costs involved in the development of courseware, or must they limit their services to providing resources, technology workshops, space, and equipment? Because of the development time and costs required to create a complete course, it is reasonable to expect that some institutions will be purchasers of courseware and application tools rather than software developers. Some institutions will share development costs through collaborative computing over Integrated Services Digital Network dial-up connections or over the Internet worldwide. The high cost of development makes sharing and partnering more important than ever. Others will purchase discipline-specific courseware through associations and other organizations that will spring up in answer to the challenge.

Many institutions today are able to help faculty create presentation materials within a reasonable time period for their classes. Hard copy, slides, graphics, animations, simulations, QuickTime movies, and the like are put on disks for computer display in classes. This type of service is provided in college and university settings in different places by different people—academic support staff, librarians, and help-desk personnel. One can surmise that such material could eventually develop into substantial class materials, if not full-blown courseware.

After upgrading their computer clusters with multimedia computers, the University of Iowa set about providing faculty, staff, and students with the necessary support to produce multimedia-based curriculum materials. Some projects, according to Joan Huntley, Research and Development Project Leader, were large-scale projects like Teaching Milton by Computer, where an instructional designer provided assistance from
the inception of the idea to the production of the final computerized program. This project is particularly notable, for it also resulted in the development of a general-purpose authoring environment called the interText, which can be used for creating electronic books. The interText program is an outgrowth of the Second Look Computing program of the Weeg Computing Center at the University of Iowa. Second Look derives its name from its mission: to give computing a second look, not as complex technology that one struggles to learn, but as a tool for practical use.

Ease of use and inexpensive computing technology are empowering more faculty to develop presentation materials. The next step is to provide students with electronic access to their courses. In the near future, it would not be unusual to put a student’s complete undergraduate and graduate program on a CD-ROM or some other emerging technology. Textbook publishers and researchers are already considering the possibilities. Researchers at Indiana University, for example, envision “virtual textbooks” about the size of a clipboard, containing lessons, review drills, and data banks of reference materials. This approach would build on the strengths of their undergraduate program, using technology to improve learning.

Moving away from computer labs

Richard A. Detweiler, president of Hartwick College, equates computer labs with phone booths; both are useful at certain times but extraneous to one’s normal everyday needs. The potential of information technology, he thinks, lies in information seeking, processing, and communicating—as a tool for thinking and learning. This can happen only if the tool is available to individuals wherever they are. The only viable student workstation is a portable system of some sort, because students think and work in the dorm room, in class, in the library, under a tree, or at home during vacation. The increasing capability of the notebook system is making the delivery of computing needs in a portable unit very viable. In the future, Detweiler foresees the addition of wireless networking that will make communication with the rest of the world possible on demand.

Similarly, Glenn Ricart, former director of the computer science center at the University of Maryland and now with ARPA, predicts that future students will carry high-powered, portable computers, thereby obviating the need for most institutional computer laboratories.

Instead, campuses will need to provide ‘touch-bases’ of some kind that students and faculty members will use to update the information in their computers. Mr. Ricart says that those touch-bases could be radio devices embedded in the walls of campus buildings that would transfer electronic mail and other information to students’ computers. He suggests that campus administrators begin preparing their campuses for the era of portable computing by developing ‘work spaces’ where students and faculty members could plug their portable computers into the campus network. Those who are building new classrooms, he said, may want to provide an electrical outlet and a network connection at every seat.

Clearly, there may be a need to maintain some public access labs at research institutions until the changeover can be made, but the idea of building more labs has long passed.

Obsolescence and rising costs

Finding solutions to the problem of rising costs takes different turns. MIT’s Gregory Jackson, director of academic computing, has a replacement plan to upgrade one-fourth of their workstations each year. Once an institution has such a plan, he says, protecting it requires several changes in the way we think about technology. First, administrators need to stop thinking about computers as though they are buildings. They are not a capital expense and should not be paid for out of capital budgets. Computers must be amortized and regularly replaced to keep pace with the changes in technology. Second, administrators must acknowledge that technology is not free. The days when technology vendors could afford to equip a campus lab have long since passed. Finally, it is important that the network be priced properly, by building in fees for the wiring costs, equipment, staff, and a certain amount of development that is network related. According to Jackson, “Pricing the network and not giving it away feeds itself very nicely.”

Other institutions are redirecting a part of the financial burden to students. Many business and engineering schools, for example, are simply charging students a computing fee to cover their costs. Still, a growing number of institutions are providing either a loaner program where the students return the equipment at the conclusion of the program or a lease-back arrangement where there is an option to buy the equipment for a nominal fee upon leaving the program.

The Columbia University model requires that students buy a new notebook computer upon entering the university. According to James A. Haggard, assistant dean and executive director for information technology at Columbia’s,

22 From an e-mail communication with R. A. Detweiler, president of Hartwick College, March 1994.
23 Carol B. MacKnight, "Geist und Technik,” Laser-Letter, 1990, Berlin, Germany, pp. 10-13, and Hubert B. Herring, “Business Diary,” 15 May 1994, New York Times, S3, p. 2. IBM has announced a new technology that allows digital disks to hold more than ten times more data than they do now, with the result that several movies or a million pages of text can be put on a single CD.
25 From an e-mail communication with R. A. Detweiler, president of Hartwick College, March 1994.
27 Jackson interview.
28 The results of The 1993 USC National Survey of Desktop Computing in Higher Education showed that 44 percent of those surveyed operated without long-range plans for replacing outdated machines and, therefore, may not be able to keep up with the accelerating rate of technological change.

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Investing in the Future: Common Strategies

- The task of building an infrastructure consisting of high-speed networks and communication services is a precondition to support the access needed by a new information-age curriculum. High-speed networks and distributed computing environments are laying the foundation for the delivery of multimedia materials and information on any subject to every desktop, whatever its location.

- Some classrooms are becoming virtual classrooms, with faculty and groups of students sharing common interests connected electronically across distance, time, and space.

- Computing centers are moving away from being suppliers of hardware toward becoming information centers. With that change, we can expect the need for new public computer labs as we currently know them to disappear.

- Students will own portable computers, which will come loaded with a variety of basic packages, including word processing, data manipulation applications, spreadsheets, graphics packages, presentation applications, and network software. These students will likely add personal software programs and, consequently, will learn many more software packages by the time they graduate, because of the convenience of having a computer always with them.

- Distance learning will have an effect on instructional content and learning resources, the time needed to earn a degree, the delivery of higher education to include a broader constituency—in short, on many of the ways of thinking about higher education.

- Knowledgeable faculty and staff will be key in implementing a new curriculum that takes advantage of information technologies.

- Partnerships and collaborations with other educational institutions and organizations and with vendors for the delivery of instruction; sharing of libraries, databases, software, supercomputing capabilities, and degree programs; and creation of course materials will become more commonplace.

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29 From a telephone interview with James A. Haggard, Assistant Dean and Executive Director for Information Technology at Columbia University’s Business School, March 1994.

30 Wilson, p. A32.

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Business School, the push for student ownership of computers is based on a revision of the curriculum and a realization that one could neither keep up with the “technology curve” where leading-edge products are introduced every 90 to 120 days, nor meet the needs of students in a lab environment when the average student spends twenty hours per week on a computer. Now, faculty can plan instruction with the knowledge that the computer, loaded with certain applications, is a resource available to every student.

There are several advantages to the Columbia model. “Money saved by not providing computers,” says Haggard, “means that more can be spent on providing several hundred network

jacks and a lot more on application software on the network. Having classrooms, the library, and student lounges wired has freed up much needed space in buildings, yet another advantage.”

The trend for the future is to get away from being the suppliers of hardware and move toward becoming information centers.

Another emerging trend includes establishing partnerships to help cope with rising costs. For example, universities like California Polytechnic State University (Cal Poly) plan to offset the cost of maintaining the information technology infrastructure by joint development projects with vendors, other institutions, and organizations.

The University has a working alliance with the University of Nebraska in Lincoln and with Rensselaer Polytechnic Institute in Troy, New York, to produce “education on demand” and make learning available from almost any place. Via the computer network, students can access full-motion video lectures, demonstrations, self-paced tutorials, e-mail, and conferencing. This effort represents the beginning of what Cal Poly hopes might become the virtual university campus.

Distance learning

Some administrators see delivering education off-campus as a means not only of cutting costs but also of providing greater access to the institution and dealing with learning challenges. Their target audience includes branch campuses, industry, adult education, continuing education, and high school students.

While sending video tapes to different sites was once valued as a way for higher education to reach and involve distance learners, today changes in technology and telecommunications are propelling the knowledge explosion with interactive video, multimedia software for presentations, and wireless communication. Distance learning not only offers access to information and to enriching quality educational experiences, but it also offers the means to significantly transform and possibly reform our societal institutions.

The University of Maine expects to educate 10,000 students using interactive television by the year 2,000. The University has made the Education Network of Maine an eighth campus—an electronic campus offering seven full-degree programs. Here and at colleges and universities around the nation, technology is toppling the ivory towers. Approximately 4,000 corporate engineers currently “earn advanced degrees at their workplace via satellite from the National Technological University, now one of the largest engineering schools in the nation.”

33
The Rochester Institute of Technology offers graduate and undergraduate degrees in applied computing, telecommunications, health administration, and environmental management to students in sixteen states. Another institution with impressive enrollments is Maryland's College of the Air. It offers ten telecourses per semester via the Maryland Center for Public Broadcasting to approximately 10,000 students. The cost-effectiveness of communication also means that institutions of higher education can expect new competition.

Are these potential services more than an educational institution can be expected to provide? There is a shift away from schools as the central site for learning towards the home, businesses, libraries, museums, and other organizations, representing a significant change in our society. Partnerships and corporate alliances are gearing up to deliver instruction directly into the home. For quite some time, businesses have been training their employees worldwide, using computer technology with state-of-the-art teletext technology. During these sessions, students can be quizzed on topics or polled on the effectiveness of the presentation. More importantly, these students can take training programs without ever going to the company's main training center. The scope of potential applications will prompt a reconceptualization of what it means to educate, where we learn, what we learn, how and why. The impressive array of telecommunications technologies will have a profound effect on the content and delivery of higher education in ways yet to be appreciated on many campuses.

Fiscal problems are forcing many colleges and universities to rethink the way they use technology in an effort to provide instruction more efficiently and effectively. Many believe that the erosion of the quality of higher education can be countered by a fundamental change in the way technology is used to cope with such factors as the public's demand for better undergraduate education, the reduction in state support, the pressure to hold down tuition, and the increase in the number of non-traditional students.

Some administrators, like Ira Fuchs, Princeton's vice president for computing and information technology, believe that technology proponents have not persuaded enough college presidents and chief academic officers that computers can enhance teaching. If colleges and universities fail to make a persuasive case for using technology to increase the value of existing resources and if our policy makers fail to recognize society's increasing dependence on access to information, the inevitable unevenness of information technology resources on different campuses will affect enrollments, retention, and employment opportunities of our future workforce. In the final analysis, it will be necessary to make some serious restructuring adjustments of academe to change the way higher education operates and to move forward in the information technology age.

Acknowledgments:
The author wishes to thank Judith V. Boettcher and Robert J. Brentrup for their helpful comments and also the many people who so generously gave of their time from Columbia University, Dartmouth College, Haverford College, MIT, Mount Holyoke College, New York University, Ohio State University, Pennsylvania State University, University of Connecticut, University of Maine at Orono, and University of Maine at Augusta.


34 Lowenstein and Charp, p. 119.

35 I. H. Fuchs, Instructional Technology Newsletter, University of Massachusetts, Fall 1992, p. 11.
Rolling Out a Data Warehouse Quickly at UMass: A Simple Start to a Complex Task

by Michael Bosworth

Many organizations are seeking to build a data or information warehouse to meet their executive information, decision support, and general management reporting needs. There is great pressure to get these storehouses of data/information up and running quickly. The University of Massachusetts is using a pragmatic approach: delivering summary data first, before any detailed data. This approach—a seeming contradiction to the very nature of warehouses—can have many benefits, but definite risks as well. After early success at UMass, new evidence regarding overall pluses and minuses is accruing.

The purpose of this article is to discuss one approach to getting a data/information warehouse up and running quickly, to delivering some functionality before a fuller implementation takes place. Commonly accepted definitions of the data warehouse, as championed by Bill Inmon, are reviewed, followed by a discussion of the complexities of constructing a warehouse. Finally, the following question is addressed: what is a good strategy for delivering something quickly while also setting a foundation for subsequent progress?

The University of Massachusetts System provides a case study to demonstrate these issues. We have employed a strategy for early delivery of a warehouse with summary data only. Within six months of project startup, we were able to deliver a small warehouse, including three years of data and including infrastructure/connectivity support to enable access to the desktop level. The results of this approach, from its feel-good early success to our lingering worries about the future, are shared in this article.

It is important to note that we have used client/server technology as a basis for our warehouse. This was possible because our multi-campus network was already well along, we already had intelligent machines on many desktops, and some of the desktop tools we intended to use only work on a client/server basis. While you can elect to use other technologies, such as a mainframe server with non-intelligent terminal access, many organizations like ours have chosen to go the client/server route.

Inmon’s definitions

Bill Inmon is often quoted and referenced for his ideas on data warehouses. Through a series of articles and lectures, those ideas have gained considerable acceptance in the information systems world. But Inmon’s basic concepts are, as even he would probably admit, simplified ideas. A host of pragmatic issues separate these concepts from reality.

In Inmon’s eyes a warehouse has a multi-tiered structure of data/information (see Figure 1, which includes examples from employee data). Snapshots of current, detailed data from operational systems are extracted, reformatted, and loaded to the warehouse tables. These detailed data form the basis, the foundation for the other layers. Then, from the detailed data can be developed one or more layers of summarized data tables (which he would call “lightly summarized” and “highly summarized”). Also, as detailed data are historically accrued in the ware-
house, the older snapshots can be archived to a historical layer. Inmon also adds a supporting element of metadata—descriptions of the data and of the data transformation rules—to the mix. This descriptive/help information enables much greater understanding of the data by all warehouse users.¹

It is important to remember that the detailed data gathered from the operational systems are not just a redundant set of data, with designs matching the operational databases. Operational systems have traditionally each built data structures with no elaborate attempt at consistency with other operational systems. For the warehouse a major effort is made to redesign the data, with attention given to such aspects as consistent fields for matching and retrieval of information. The goal is to ensure that the different portions (tables) of the new, enterprise, cross-departmental database work well and effectively together.

The inherent complexity of building a warehouse

Warehouses are decidedly not easy things to build. There are at least five major challenges awaiting those who attempt to build one:

• determining what operational data are of importance—and what the design should be;
• getting the data to the warehouse;
• holding onto the data with integrity and flexibility once they arrive at the warehouse;
• delivering the warehouse data to the organization’s decision-makers and direction setters; and
• working out change control.

A number of people from different functional areas play important roles in these tasks, making this a complex project (see Figure 2).

But building the data warehouse is only half the work. No functioning warehouse can work well without supporting metadata—descriptions about the data—to help users understand what it is that they have at their disposal. This means that there are really five additional necessary tasks for the metadata, parallel to those involved with the data, making this a complex project (see Figure 2).

Figure 1: Inmon warehouse tiers

The first and last tasks—determining data (and metadata) selection and design and change control—can be viewed as logical management challenges. The other three tasks—moving data (and metadata) to the warehouse, holding them there in an environment of integrity, and delivering them from there to the warehouse users—can be viewed more as physical (technological infrastructure) challenges. The three tasks have to deal with the database management system and network infrastructure and, in a client/server environment, middleware technology. Middleware is the software that allows the desktop client programs to communicate over the network to the server database. Its importance is fundamental where so much data (and metadata) must be moved.

Logical and management tasks

Inherent in the warehouse concept is a fundamental redesign of the detailed data of the business. This implements a switch from the functional, departmental orientation of the operational databases to the organization-wide perspective needed to support executive information and decision-making. Determining this new design ideally means determining an enterprise-wide model of the business, a time-consuming process that must involve the organization’s decision-makers to be done correctly. (Anything less than a full enterprise model will mean risking non-integration as the portions of the warehouse get phased in.) Other tasks will include determination of what light summary and high summary data will be of importance to the organization, and determination of which warehouse data should be moved into the historical portion of the warehouse, and how often.

Steve Chatman of the University of Missouri System Office aptly described some of these differences between operational data and warehouse data in a 1993 CAUSE/EFFECT article.² He described how “informational links” integrate

data from separate operational systems, and stated that warehouses must often answer the need for top-down analysis, such as reporting by a hierarchy of organizational units. A third distinction he identified is the creation of "preprocessed conditional values" and aggregate values not found in the operational systems but which can then support various analyses.

The second logical task is change control, a management undertaking. There may be changes to the enterprise's business, necessitating changes to the warehouse data design. There may be changes to the operational data, necessitating changes to the extracts and quality checking. There may be changes to the corporate definitions of critical data. Finally, this all may necessitate changes to the desktop delivery applications that get rolled out. Tapping into the operational data custodian offices is important to elicit their advanced knowledge of change. Taking advantage of existing—or setting up new—communication channels is key.

Physical/infrastructure tasks

And what of the three technological challenges? Whether or not the warehouse data are put on a separate machine, there will be data movement. This requires programming to create valid extracts. It also requires setting up an automated system to schedule these data extracts and transfers on a regular basis. In addition, if the warehouse is on a separate machine, the network technology for getting the data there must be in place and stable. Of course, there will be changes to all the vendor tools that play a role along the way. The various pieces of software (extract, transfer, load) must be kept in sync, including the important middleware when a client/server technology is involved.

What is involved with ensuring data integrity in the warehouse? This may include learning a whole new technology, especially if an organization has not yet used relational technology. It may include learning a new operating system, new backup and recovery mechanisms, and new security systems, especially if the warehouse will be on a separate machine from the operational data. Database administration expertise is fundamental to support of this.

Delivering the warehouse data to the organization's decision-makers and direction-setters is a major challenge in itself. An enterprise network must be put in place and must be stable. Experts in middleware must be hired or trained. Also, decisions about the desktop machines must be made, and a suite of preferred client tools must be chosen (and then supported).

It is no wonder that developing a warehouse is such a daunting (but fun) undertaking, and takes so long to implement. But experiences of some organizations have shown that, despite the best of intentions and high levels of competence, the results are not always fully successful.3

Difficult physical challenges

From early on in the warehouse project at the University of Massachusetts, we envisioned a robust and multi-featured warehouse. At the initial planning and design level, we pictured the end product shown in Figure 3. Our infrastructure challenges to build to this goal were many. Our operational data reside on a mainframe, but we used a separate platform for the warehouse server. This meant supporting connectivity...
between the mainframe and server. It assumed learning data transfer technology and scheduling the extracts. It also meant learning the operating system and database technology of the server.

Getting the warehouse data to our clients involved other connectivity work. It included installing and maintaining a wide area network to link our data center with our key business areas, specifically our systemwide and campus administrative offices. It included choosing, installing, and supporting appropriate middleware to enable both PC Windows and Macintosh computers to connect.

Along with supplying data, we delivered desktop options to our key users. This included Excel spreadsheet technology against any data in the warehouse; Holos for a management reporting, multi-view, graphical display, point-and-click system; and Data Prism and Data Pivot for easy selection and display of data down to any level of detail. We had to learn these desktop tools to effectively connect up with the warehouse data, and to help our key clients effectively take advantage of the available data.

**Simple logical challenges**

We had to determine how we could deliver all this, and yet get something of high utility up and running in a short time frame. We decided to simplify the challenges of designing, extracting, populating, and delivering the first data to be implemented. We did this by greatly limiting the amount of data in our first implementation.

We called our first rollout of the warehouse at UMass “Event1.” On the surface, from a data point of view, it was a rollout of limited ambition. Just two tables were to be created, and each with a limited number of data fields. And all of the data were summary data.

We based the Event1 on a set of summary data that were already in use through a management report from the Human Resources operational system. It was a report—of headcounts, FTE counts, and weekly earnings—by campus, employee category, and funding source (see Figure 4). The basis for the report were detailed, weekly payroll records, but these data were transformed through business rules to high-level counts and totals in categories of interest to decision-makers throughout the UMass system.

The management report, on a monthly basis, was already being used by a key client, a vice president in our system’s president’s office. Thus, we knew we had at least one user whom we would not have to sell on the value of the data in our new storehouse. And this first client of ours was an important one.

We transformed this management report into an integrated, logical design for the two summary tables (see Figure 5), and created an extract to populate the warehouse from the operational system. These two tables contained data at what Inmon calls the “high summary” level.

We began to run this extract/populate step monthly, to accrue the historical comparison data. This was an important advance over the limitation of the hard copy report for our key user. Moreover, since we had approximately three years of historical management report data in various spreadsheet files in the president’s office, we were able to backfill the warehouse to cover this key time period.

**Evaluation of the UMass approach**

Our Event1 was a success. Admittedly, the amount of data was limited, but the data we chose enabled our success. We were able to please a very important user, with the prospect of pleasing others once they understood what was now available.

Our Event1 was also a success because it allowed us to test our infrastructure. We had to employ what was for us new technology, in the database engine, in the transfer technology, in the middleware, without which we would have had nothing.

Further, our Event1 was a success because it set the basis for testing many additional parts of our general concept and technology design, including the following:

- production support for data transfer;
- production support for backup/recovery;
- distribution of data to other sites; and
- other client tools.

But did we really implement a warehouse?
We did not have an enterprise model in place. And we did not extract and re-configure detailed operational data.

So, no we did not truly implement a data warehouse. But we did extract and re-configure some data. And our intent has always been to subsequently support that summary data with the detailed foundation data. This seeming reverse approach to the project at hand set us up well for subsequent progress, for it sold others—at least one very important other—on the concept of the warehouse, and it bought us valuable time. Ultimately, Event1 was a success because it secured backing for, and prepared us well for, going forward with our warehouse work.

There are other pluses and some minuses to the approach we took, and probably not all of them are evident yet, but the following are identifiable results:

✔ Since our summary data tables were not initially accompanied by any detailed data tables, we could not drill down to the supporting details. Nor could we flexibly do other summarizations from a lower level up to a higher level. We do now have a substantial amount (six months’ worth) of detailed data that we have developed in a test mode, but we have not yet rolled this out nor successfully implemented drill-down in our client tools.

✔ We based a lot of the utility of our Event1 on its value to one vice president. We have since spent considerable time trying to convince others (non-users of the original management report) of the value to them of our Event1 summary data and of the desktop tools to use it. We are suffering from having to catch up in this area. A different approach would have been to first get widespread buy-in to the general concept of warehousing and management reporting data.

✔ Our response times with the summary data, as you might guess, were quite good. However, we have been running into problems with response time against our six months of detailed data. We are spending time tuning our database. Some redesign of detail tables may be necessary.

✔ We originally delivered the summary data without the underlying metadata support to help users interpret sudden changes in the historical data, to help them understand the basis (detailed data) for that summary data, and to help them understand the rules used to transform the detailed data into summary data. We have since added the beginnings of a helpful “encyclopedia” of descriptive metadata. However, this encyclopedia must be expanded greatly to offer maximum utility. This involves both design decisions regarding what descriptive data are important, and decisions regarding how to deliver them. (We are considering hypertext implementations as well as use of metadata from the catalog of the database management system itself.)

✔ Because we knew that the Event1 data were valuable to our key user (and these data had

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"Ultimately, Event1 was a success because it secured backing for, and prepared us well for, going forward with our warehouse work."

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Figure 4: Human resources management report

<table>
<thead>
<tr>
<th>Employee Category</th>
<th>Full-time Headcount</th>
<th>Part-time Headcount</th>
<th>Hourly Headcount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff</td>
<td>nnnnn</td>
<td>nnnn</td>
<td>nnnn</td>
</tr>
<tr>
<td>Faculty</td>
<td>nnnn</td>
<td>nnnn</td>
<td>nnnn</td>
</tr>
<tr>
<td>Classified</td>
<td>nnnn</td>
<td>nnnn</td>
<td>nnnn</td>
</tr>
<tr>
<td>Graduate Appointments</td>
<td>nnnn</td>
<td>nnnn</td>
<td>nnnn</td>
</tr>
<tr>
<td>Total</td>
<td>nnnn</td>
<td>nnnn</td>
<td>nnnn</td>
</tr>
</tbody>
</table>

Weekly Earnings

<table>
<thead>
<tr>
<th>Employee Category</th>
<th>State Appropriation FTE</th>
<th>Earnings</th>
<th>Grants &amp; Contracts FTE</th>
<th>Earnings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Staff</td>
<td>nnnn</td>
<td>$nnn,nnn</td>
<td>nnnn</td>
<td>$nnn,nnn</td>
</tr>
<tr>
<td>Faculty</td>
<td>nnnn</td>
<td>$nnn,nnn</td>
<td>nnnn</td>
<td>$nnn,nnn</td>
</tr>
<tr>
<td>Classified</td>
<td>nnnn</td>
<td>$nnn,nnn</td>
<td>nnnn</td>
<td>$nnn,nnn</td>
</tr>
<tr>
<td>Graduate Appointments</td>
<td>nnnn</td>
<td>$nnn,nnn</td>
<td>nnnn</td>
<td>$nnn,nnn</td>
</tr>
<tr>
<td>Total</td>
<td>nnnn</td>
<td>$nnn,nnn</td>
<td>nnnn</td>
<td>$nnn,nnn</td>
</tr>
</tbody>
</table>
already been determined through the management report design), we spent virtually no time in any process to determine data requirements. We made a conscious decision to select those data, and did not have to practice more elaborate data design techniques in doing so. In trying to “catch up” with our summary data by loading detailed data, we have not embarked on an enterprise modeling effort. We are instead depending on past data modeling efforts carried out for subsets of the UMass organization.

Finally, we did not know whether our initial summary tables were well matched to our eventual enterprise model—a great concern for future data administration. For example, was the organization-code we used for Event1 the same as the organization-code we would use at the detailed level? We have since been able to use this same organization code at the detailed data level. This was reassuring. However, we also found that we needed other codes that really represented the organization code for other business needs. This was, and will continue to be, a worry. Perhaps these multiple organization codes are necessary. Perhaps, though, going through an enterprise modeling exercise would show us that our business needs are not really that diverse, that we need to rethink the business, and that we really do not need multiple organization codes.

Whenever we begin to worry too much about these unknowns, we remind ourselves that our first two tables are, after all, only summary tables. Although, despite their size, they do offer much functionality, they can be phased out if better summary tables can be designed. And, as we subsequently design and load our detailed data, we will be enabling multiple possible new summary perspectives.

Inmon’s ideas

One of the reasons it is beneficial to consider Inmon’s discussion of data warehouses is his business-oriented approach to selling the concept. Drawing upon stories he has collected from actual organizations, he speaks of what business problems and initiatives are being served through their involvement with warehousing.

What Inmon tells us, and it would seem intuitively obvious, is that actual implementations of warehouses vary greatly due to the differing circumstances in diverse businesses. While there is “a general pattern found in most shops that have an information warehouse environment,” there are also other forms “that do not fit the structure … in a standard way.”

At UMass we have tried a form that does not fit the warehouse structure in a standard way. We have implemented our first phase with no detailed data. In doing so, however, we have had to work out many of the challenges of a fuller implementation. And we have managed to do so in a manageable way.

The various warehouse construction tasks seem not as daunting as they once did. We can make headway now with detailed data, knowing that we have some degree of control over many aspects of warehouse technology. That control has come with some measure of success, because we have already delivered something of high utility. And we feel good about it.

Summary: A business approach to
Evolution of SOLAR, Harvard’s Client/Server-based Fundraising Management System

by James E. Conway

Harvard University’s central computing and development office personnel joined forces to develop a prototype of a client/server fundraising system. SOLAR provides management and fundraising personnel the ability to access and share summary and prospect information. Its successful development can be attributed to the employment of some traditional project management principles and practices.

The rapid development of personal computers, network capabilities, and the software that ties it all together has made it possible to apply technology to support major fundraising and other development efforts. Harvard University recently took advantage of these new technologies to support a $2 billion fundraising campaign. The campaign is unique for Harvard, not only because of the size of its goal, but also because it is the institution’s first “University-wide” campaign.

For most of its history Harvard has followed a decentralized organizational model: “Each tub on its own bottom” is the saying here. This model also applies to development. Each of the University’s schools has its own development staff and computer system; each occasionally runs a campaign to raise funds, defining needs and goals, soliciting gifts, and ultimately retaining most of the funds raised.

Harvard also has a central development office and computer system; this unit consists of the University Development Office (UDO), Faculty of Arts and Sciences Development (FAS), and the Recording Secretary’s Office. UDO staff act as consultants to the individual schools in areas such as fundraising, research, and major-donor coordination. UDO also maintains biographical records of all University alumni/ae and donors. FAS’s charge is to raise monies for the Faculty of Arts and Sciences, while the Recording Secretary’s Office is responsible for processing and depositing all gifts to the University.

Although decentralization has many strengths, it produces duplication of effort in the areas of gift processing, maintenance of prospect biographical information, and development computer systems. Each school can only work with information contained in its system, not knowing what a prospect’s total University giving has been or what another school’s fundraising plan may be. Also under the decentralized structure, each school makes its own decisions regarding its computer system—retain or build its own, choose a package to suit its individual needs, or use the central system.

With the impending University-wide fundraising effort, the central development office realized that campaign success would demand changes to the central computer system. Installed in the 1980s, the existing legacy system employed excellent COBOL-based transaction processing. This system supported over $200 million in gifts and easily processed over 300,000 bio-

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Figure 1: Stage two of the strategy

“Harvard needed to develop an overall strategy that leveraged existing technology.”

Graphical changes a year, but it needed improvements in its support of fundraising efforts: critical reports, for example, could only be run centrally, creating delivery delays of up to one week.

**System development strategy**

Early in 1993, a Development Steering Committee consisting of central and FAS development management was formed to lead the system development project. This committee asked the central Development Computing Services department (DCS) to propose a system that could support central fundraising efforts and also easily be expanded to support a University-wide user base. DCS proposed a two-stage strategy. The first stage called for retaining the investment in the existing transaction system while moving forward with client/server technology to support the central office’s ambitious fundraising efforts. The second stage called for the inclusion of those schools desiring to be part of the system.

In the first stage, the transaction-processing legacy system would be extended to a client/server environment. This environment would make fundraising information readily available for integration into the fundraiser’s overall scheme for information display and analysis. By following this strategy, Harvard could preserve its investment in its existing system and current desktop computers while giving administrators and development/alumni support personnel access to information through their microcomputers. Alumni, prospect, and gift information would be available directly from the server, in report or online, and could easily be extracted to desktop spreadsheets and word processing documents. The legacy system would continue to process gift and biographical information. As the transactions were applied to the old database, information would be transferred to the relational database located on the database server, providing secure, efficient access to current biographical and gift information. The day-to-day gift and biographical transaction process would be separated from the more ad hoc inquiry and reporting process. This separation of data-gathering and data-access functions would lead to a more efficient use of the legacy system. It would also improve reporting by enabling fundraisers to generate their own reports quickly and locally.

As shown in Figure 1, the objective of the second stage of the strategy was the introduction of the new system to schools desiring system access. During this stage, the individual schools would maintain alumni and prospect core information on desktop computers connected to the
Organizational structure

The eventual successful development of the client/server system, called SOLAR (SOLicitation and Alumni Records), demonstrates an important point about the strategic use of information technology in support of the University’s overall objectives. Harvard needed to develop an overall strategy that leveraged existing technology. Critical to the success of the new system was a committed, informed executive management that understood both the needs of the University and the value of information technology.

Figure 2 illustrates the SOLAR development project organization. In addition to identifying critical high-level support, the organization identified several key team members, including a project sponsor, project manager, and user coordinator. The project sponsor needed to be a high-level manager with overall responsibility for both the new system and the primary function it would support: fundraising activities. The SOLAR project sponsor was therefore the UDO director. The project manager needed to be both technically competent and knowledgeable about fundraising, able to match the business problems with a variety of solutions—not all of them automated. This person was responsible for developing estimates and schedules, preparing funding recommendations, managing the project team, and communicating project status to the project sponsor and Steering Committee. The SOLAR project manager was a full-time, highly experienced consultant who reported to the director of DCS and the project sponsor. The user coordinator’s responsibility was to ensure that staff from interested departments were available, as needed. Working at the manager level, this person reported to the director of FAS development and kept the project sponsor informed of any problems in allocating user resources.

The project team itself was composed of the best available personnel, staff members who understood fundraising requirements and objectives and who had years of development experience and were responsible for raising funds from the University’s major prospects. Finally, a Quality Review Committee was established to review the project at specified milestones and make appropriate corrections to the project’s direction throughout system construction; this group consisted of senior staff and supervisors from affected departments.

Problems encountered and progress to goal

During the analysis of requirements in summer and fall of 1993, it became clear that some problems were at the managerial level rather than at the operational level. Although it was not difficult to define the day-to-day needs of the fundraising staff, it was difficult to grasp campaign organization and goals. The changing of the University culture was proving to be significant. Defining which University organizations would participate and what constituted a campaign gift was a lengthy process. Realizing this dilemma, the project sponsor charged the SOLAR team with developing a full prototype of the system, meeting all defined day-to-day fundraiser needs and including ideas on how to present management information once it became finalized. The expectation was that by the time the prototype for day-to-day operations had been completed and reviewed, management requirements would be known.

During the next few months, the project team constructed a fully operational prototype of the online portion of the system. In-depth reviews of the prototype were provided for the entire 200-person user base active in stage one. Problems and requested changes raised in each review session were applied to the prototype prior to the next review, demonstrating to the users that the project team valued their input. Although time consuming, this approach raised overall morale, increased desire for the new system, and minimized the trauma commonly associated with change.
By December 1993, the prototype had been completed and accepted, but work on finalizing campaign management issues continued. The project team now had an opportunity to improve the graphical user interface. Steering Committee members suggested that a professional graphic artist be temporarily added to the team to work on screen aesthetics. The artist established a number of GUI standards, including the shades of gray to be used in each screen, the use of off-white for data entry areas (suggesting the color of blank paper), button formats and operation, fonts for labels and buttons, separators and frames, text, scrollbars, and screen-to-screen flows.

By March 1994, the campaign structure had been fairly well defined. The technical members of the project team could now proceed to develop all sections of the prototype with the exception of online management charts. Once development was completed, in the fall of 1994, the user members of the team tested the new system and proposed corrections.

The system goes live

During system testing, the project team was expanded to include a group of individuals charged with developing a system-introduction package. This team consisted of members of the University’s Publishing Office, a professional writer, a graphic artist, and a professional trainer. They raised user community awareness of the system through a series of communications that discussed SOLAR, why it was developed, the benefits it would bring, and the planned implementation schedule. A multimedia SOLAR “kick-off” event was held the day before the system was introduced. During this event, each attendee was presented with a package of material containing a letter about SOLAR’s significance from the vice president of alumni affairs, professionally printed copies of screens shown during the system’s demonstration, and Post-It® notes printed with the SOLAR logo.

DCS had trained some of the fundraisers to be trainers themselves. Each day, these fundraisers provided in-depth training for the twenty users scheduled to be added to the system the following day. This would continue until all 200 users had been added. The client software was loaded to each user’s personal computer, and each new user received a SOLAR user guide.

The SOLAR application

The new client/server system, unlike many warehouse systems, is not designed for data access only. SOLAR contains two categories of information: core and fundraiser-specific. Core information is entered and maintained by the legacy transaction system: individual gifts, pledges, and matching gifts. Fundraiser information is entered and maintained directly by the SOLAR system. Fundraisers work with prospects in much the same way that marketing personnel in the business world work: rating the prospect’s ability to give, researching the prospect’s background and interest, developing cultivation activities and events, and completing solicitation of an actual gift.

In addition to the prospect management function (prospect tracking, research summaries, prospect clearance, gift and gift history tracking, volunteer and committee activities and membership, and the future functions of planned giving and event management), SOLAR provides data extracts, ad hoc report writing, and the ability to merge selected prospects to word processing documents.

Using the graphical interface, a fundraiser can obtain all relevant information on a prospect simply by entering pertinent search information, e.g., prospect’s name. The resulting Main Prospect Screen (see Figure 3) displays the prospect’s name, identification number, and giving rating; names of family members; and preferred address. The user may view other addresses—e.g., business, home, seasonal—by pressing the buttons B, H, and S. (To save the fundraiser’s time, a button related to a specific address will only appear when the prospect has that particular address type.) Also available is information on prospect’s school, degree, concentration, honors, years of attendance, and house of residence, as well as related solicitations. Buttons located on the bottom of the screen allow the fundraiser to access or enter more in-depth information on the prospect. A sample screen of research information (produced by pressing the research button) is shown in Figure 4.

One of the most popular SOLAR features is the tracking function. Fundraisers can use this feature to enter and date specific comments or to request that the system send them reminders of a certain event at some specified future date.

Fundraisers can select pre-programmed reports directly from their desktops, view reports on their screens, output reports in Microsoft Excel or Word formats, and print directly on a local laser printer. The system also provides a powerful report-writing facility for ad hoc reports with the same choices of output. With over forty local laser printers throughout the organization, report turnaround has been reduced to minutes, paper volume has been decreased, and users can select the specific information and sort sequence they wish to see.

“The project manager needed to be both technically competent and knowledgeable about fundraising, able to match the business problems with a variety of solutions—not all of them automated.”
“Without the guidance and understanding of management during times of delay due to culture changes, the SOLAR project most certainly would have floundered.”

Figure 3: Main prospect screen

Behind the scenes
A client/server environment is a complex one because each segment of the architecture needs to work well with all other segments and each affects overall performance. Architecture components were therefore chosen for compatibility and speed. The SOLAR server stores information on nearly 600,000 prospects and two million individual gifts. The server is a Sun 690MP utilizing Sybase System 10 relational database. The Sun 690 has four co-processors and is configured with 640 megabytes of memory and 20 gigabytes of disk capacity; it is connected to the clients over an Ethernet network.

At the time of SOLAR hardware/software evaluation, all central development office fundraisers were using Apple Macintosh SE and SE/30 computers and were comfortable with the ease of use commonly found with Macintosh computers. Selection of desktop hardware was therefore rather straightforward; the only concern was that the Macintosh SE and SE/30 computers lacked processing and storage capacity. To provide the required computing capacity demanded in a client/server environment, all 200 SEs and SE/30s were replaced with Macintosh 610s, 650s and PowerPC 7100s configured with 20 to 40 megabytes of memory and 230 to 500 megabytes of disk.

Selection of client software was also simplified by the fact that although there are a number of vendors’ products available for the Macintosh or Windows environment, there are fewer available for both environments. The project team decided it would not evaluate products based on vaporware. The two major considerations used in the evaluation were ease of portability and software distribution. Distribution of the client application becomes significant when the client software needs to be distributed to hundreds of users spread over a large geographical area every time a modification occurs. Blyth’s Omnis 7 product was selected because it operates in both Macintosh and Windows environments in a nearly seamless way and because it provides efficient software distribution. When a client logs onto the system, Omnis checks the application version number on the client against the version number of the centrally stored master application. When the version numbers differ, the system automatically updates the client only with the current changes, not with the entire application.

Critical management factors
A number of factors were critical to the success of SOLAR.

Obtain senior management support—Without the guidance and understanding of management during times of delay due to culture
changes, the SOLAR project most certainly would have floundered. Management helped keep SOLAR moving forward, thereby underlining the importance of information technology to campaign success.

Consider total costs—The SOLAR team needed to consider costs for a wide range of areas: server hardware and software, database management system (in the case of Sybase, the cost of the database software on the server and on the clients), upgrade of the desktop computer hardware, Omnis client software (developer and client copies), network hardware and software, network and database management software (resource monitoring), and training and consulting. The construction of SOLAR could be equated to setting up a computer department from scratch—without the need to build an actual computer room. An area of future concern is the cost of maintaining and upgrading such a wide range of hardware and software: the hardware and software need to be compatible during the initial installation and they must remain so as individual vendors upgrade their products, throughout the system’s life. Although application software development of systems such as SOLAR may be quick, time and care will need to be exercised during testing and installation of vendor upgrades.

Follow a methodology—The development and introduction of a mission-critical system is difficult and should be approached carefully. The characteristics of systems development and installation of a client/server system are the same as those found in the development of mainframe systems. It was therefore decided that the existing project life cycle used by DCS in other projects would be followed. This life cycle contains four phases: proposal, requirements, development, and implementation.

✓ Proposal phase. During this phase the idea of SOLAR was explored and evaluated. The current environment was reviewed, a statement of objectives was developed, possible alternatives were identified and evaluated, and preliminary costs and time estimates were prepared. The main purpose of this phase was to develop a proposal for management’s review and approval.

✓ Requirements phase. This phase provided the system’s foundation. Initial emphasis was devoted entirely to an analysis of user operations, both present and future, with the intent of developing a detailed definition of the requirements the system had to meet. During this phase the prototype was constructed.

✓ Development phase. This phase included a number of steps encompassing detailed de-
Many of the methods used in developing a client/server system are the same as those used in developing mainframe systems.

Establish standards and procedures—Many of the methods used in developing a client/server system are the same as those used in developing mainframe systems. We all use accepted project methodology in developing systems, talk with each page, and with a wire binding and index of the methods used in developing a client/server system.

Support the users—A system should support the institution’s mission and goals, not just use the latest in technology. The design team must consider the production environment and the final operators of the system. The users will need training in how to use the system and help when something goes wrong. Following the model described by Kelly McDonald and Brad Stone in a Winter 1992 CAUSE/EFFECT article, the SOLAR project established a network of customer support representatives (CSRs). Located in and coming from the user area, CSRs are responsible for first-line training and support. When CSRs are unable to resolve a problem, they are backed up by phone support from a Customer Support Coordinator (CSC) located in DCS. If on-site support is necessary, the CSC is further backed up by DCS technicians who can be dispatched to the problem area.

Another area of support that needs to be considered is user documentation. Due to SOLAR’s ease of use and intuitive design, the project team was able to design a simple and compact user guide. The guide was designed to unfold and rest on a support base, standing upright next to the user’s computer. The guide provides pictures of the most frequently used screens with simple how-to-use text located on each page, and with a wire binding and index tabs to ensure easy flipping of pages.

Achieve and maintain buy-in through listening and communicating—Management support and involvement are critical to the success of any information technology project, but buy-in from the people who are expected to use the system is just as critical. If users feel a system is being forced on them without their input, they will not use the system to its full potential or, in the worst case, they may not use the system at all. The SOLAR team included fundraisers as well as computer specialists. All screens and their content were developed by the fundraisers.

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In conclusion, SOLAR is expected to contribute to a success unequaled in the history of fundraising in higher education. Working with 600,000 prospects, Harvard plans to raise $2 billion over the five-year life of the University-wide campaign. These critical funds will help provide a first-rate education for Harvard’s student body into the next century.

Trends and Challenges for Academic Libraries and Information Services

by Bil Stahl

Many trends and challenges are, or will shortly be, confronting academic information professionals. To successfully accommodate these trends and meet these challenges will require us to undertake radical rather than incremental changes.

General principles of technology

Predicting the impact of developing technology is difficult. The following set of general technology principles has proven useful to me in trying to anticipate the future impact of an emerging technology.

The first paraphrases an infamous bumper sticker—“Technology Happens.” Rough starts do not signal the failure of a technology. Current examples of technologies that some are declaring fumbles, but which will likely become major technologies, are personal digital assistants (PDAs) and voice recognition.

The second principle is that the “best” technology is not always the most successful. We have to go no further than the Beta vs. VHS videocassette competition of a few years ago. Beta was widely acknowledged to be technically better, but the standard was set by marketing, not engineering. We can never lose sight of marketing’s impact on the success or failure of a technology’s adoption.

The third principle is that technology is additive. We do not always get rid of old technologies when a new one comes along. However, new technologies do change the use of old technologies. For example, the telephone did not displace the postal system, but it did change our use of the postal system.

The fourth principle is that the developers and early implementers of technology rarely accurately predict the technology’s best use. The telephone was originally conceived as a device to help the hard of hearing. Technology’s integration into our lives is far less controlled than we often believe.

The rate of change

Modern society is experiencing a more rapid rate of change than any before. Change brings with it uncertainty, which is generally threatening. In the post-World War II period up until the 1980s, it was not uncommon for U.S. industries to take seven years to bring a product to market. Now automobiles go from design to product in less than eighteen months. In “high tech” industries this timeframe is often less than six months.

The rapid rate of change applies not only to product development, but to an industry’s ability to recognize a change in the market and to shift by eliminating obsolete products while developing their replacements. A current case of failure to do this is that of the Encyclopedia Britannica. The Encyclopedia Britannica Company underestimated the impact of CD-ROM-based encyclopedias on the market and planned to depend on their technical excellence to retain market share (a violation of the second principle above). The consumers quickly realized that they could buy a PC with a CD-ROM drive and a CD-ROM-based encyclopedia for about the same price as a printed set of the Encyclopedia Britannica, and be able to do many more things with the PC than they could with the books.

Our students

Today’s students come from an educational environment few faculty and staff in academic institutions have ever faced. In North Carolina the official illiteracy rate is 25 percent of the population, and is probably actually much higher because of phenomena such as “intentional illiteracy.” (Intentional illiteracy occurs when a person who could read does not read for an extended period of time and becomes functionally illiterate due to lack of practice.) On the other hand many homes have much more sophisticated information technology available to the students than they have access to at school. The majority of educational computer software sold is sold to parents and children, not to educational institutions. Schools are generally lagging behind...
in use of even basic technology. The national average for the number of telephone lines in K–12 institutions is three.

What this means is that students entering academic institutions probably span a much greater range of educational experiences and proficiency than was true ten or twenty years ago. It also means that their understanding of and experience with technology ranges from being highly skilled to being completely in the dark.

Likewise, students leaving the college or university are going into a world unlike that most faculty and staff have ever experienced. Experts predict that the average graduate will make seven career changes, not job changes, before reaching retirement. Obviously this puts a whole new emphasis on types of retraining and retooling that do not require additional four-year degrees.

In addition, it is predicted that three of these careers will be as self-employed individuals. An article published in *Fortune* last year describes the relatively common situation today where college graduates start their working careers as self-employed entrepreneurs and eventually move into a job working for an organization.\(^1\) Some predict that by 2005, 50 percent of the workforce will be self-employed at any given time! A common scenario will be that self-employed individuals will come together to form virtual companies to accomplish specific projects and then disband. The ability to use and apply networked information is vital to this type of economy, and is therefore a vital survival skill for our students to acquire.

Some small rural towns are already beginning to capitalize on the new form of economy by investing in high-speed telecommunications infrastructures. This in turn allows entrepreneurs to enjoy the quality of life of rural small towns while being linked to financial markets and industries around the globe. Towns like Delta, Colorado, have substantially increased the number of jobs and significantly raised the per-capita income within one or two years by using this strategy. The advent of pervasive information technology linked by telecommunications networks may result in large population shifts away from the densely populated urban centers and the ruralization of America.


“Race the leader, not the car beside you”\(^2\)

This advice was given by one NASCAR driver to another, but is good advice for anyone today. We are truly in a global economy, and we must compete with the best in the world, not simply the best in our town, state, or country. Talent can be involved in just about any project from almost anywhere in the world. This not only applies to low-wage production work, but to high-tech skills and even to more common trades. Frank Knott of Vital Resources, Inc., in a recent presentation described the technology at a large law firm. In that firm any attorney can dictate a brief at any time of day or night and have it transcribed and a printed copy on his or her desk within three hours. The surprise is that the transcription is done in mainland China! This global competition is made possible by relatively cheap, high-speed telecommunications networks and digital technologies.

Businesses such as some academic institutions, which view their primary stock and trade as serving the people in their local region, must begin to move away from that focus. As telecommunications networks become more robust and more pervasive, location becomes less important. Regions can be quickly invaded by competitors arriving via digital telecommunications networks. Students can already take a wide variety of courses from a wide range of institutions offering courses via everything from electronic mail and cable television to full-motion, interactive video networks. It is possible that within a decade students will routinely take courses from a vast selection of academic institutions without ever having to leave their home or workplace.

Automation vs. transformation

It is always helpful to remember our roots in order to understand how we have to change. Information professionals have been very successful in automation. Automation is the process of applying computing technology to an existing process. The process is the application. An automation project is a highly controlled activity. We can automate just about anything now. Show a good systems analyst a process, and s/he can probably design an automation project around it fairly easily.

However, automation is no longer enough. Technology is getting into people’s hands in many uncontrolled ways. People gain access to computers to do one thing, and find out they can do so much more! Information technologies have truly become “enabling technologies.” The technology enables a change in behavior, which leads to a change in the process. This is the reverse of the traditional automation project and often puts the information professional at the back end of the process rather than the front end.

As information professionals we must now lead and adapt rather than control. This is what is meant by AT&T’s motto: Ready—Shoot—Aim. We must ready information technology that we anticipate will be enabling technology. We must lead by applying that technology to solve real
problems. And we must quickly adapt when our customers find new uses for that technology.

Disintermediation

One of the things automation did was to enable people to have access to information they could not readily get before. Automation was often a mechanism of disintermediation; that is, it removed the need for an intermediary. People no longer had to see a particular staff member to check the status of their budget, their inventory, etc. People have always wanted to be able to do things for themselves. Books are a technology of disintermediation. They eliminated the need for storytellers. In fact the creation of writing was widely viewed as a threat to civilization by some of the early cultures for this reason.

In more recent times, if one looks at the number of telephones installed, one sees a modest increase in early growth until the advent of dial telephones, at which point there is a sharp rise. People usually prefer to place their own calls. Likewise many of us can remember when self-service stores were first introduced. As with the initiation of many new ideas, the idea of self-service was often carried too far. Stores quickly learned an important lesson. It wasn’t that customers didn’t want any assistance, they wanted “point of need” assistance.

The important point of disintermediation is that we must find ways to eliminate a required intermediary. If a customer is required to go to a clerk, librarian, or computer support person to do something, then review of that activity needs to be a high priority, and ways must be found to remove the requirement. We must constantly evaluate whether the function of the intermediary is as a barrier or as a value-added service.

There is often a misunderstanding of “value added.” It is vital that the customer can readily see the value added, not just the provider. The makers of Beta video recorders and the publishers of the Encyclopedia Britannica certainly added value—it just wasn’t sufficiently apparent to the customer. Bob Freedman of Southern Bell uses the following story to explain this concept. A person is told this odd-looking piece of plastic costs $170 to make and $15,000 to install. The person really isn’t too interested in it, until she is told that the odd-looking piece of plastic is a heart pump, and without one she will die. Suddenly it becomes a bargain, because the customer clearly sees the value added. Value added is, of course, often more of a product of marketing than of engineering. We information professionals need to learn and practice marketing at least as well as we do engineering.

A value-added service that runs counter to the training of many librarians is that of filtering information. As we are increasingly surrounded by information, providing access to information is of less and less value. People cannot afford to consider every source of information about a topic. They need to find the one piece that gives the best state-of-the-art understanding of the topic, or that supports their position. Our value added must increasingly focus on the quality of the information provided rather than the quantity.

Continuum of ephemerality

This is a term used by Charles Tuller of IBM to help explain why the transition of information from analog forms to digital ones is causing the information explosion. Because analog information is comparatively difficult to reproduce and distribute, ephemeral information tends to disappear rapidly. People such as publishers and librarians decided what information was worthy of being retained and what was “ephemeral.” This environment made such functions as bibliographic control relatively easy.

By contrast, digital information is very easy to reproduce and distribute, and therefore, even the most ephemeral information can be readily retained. Production streams cannot be controlled, so neither can we assume we can continue to provide adequate bibliographic control. Increasingly we must find ways to assist our clients in accessing information which we cannot rigidly describe and classify. While our control systems do continue to have value, we must be leaders in adapting new means of accessing information, such as content-based retrieval technologies.

This change can be described using the analogy of a well and a river. Historically we have been keepers of the well. We engineered systems to provide input into the well, which was our library or our central database. We also maintained highly controlled output systems so we could always keep the well functioning to everyone’s advantage. Our wells are now being over-run by an ever-deepening river. We are less and less able to simply turn on a tap to fill a customer’s glass. We must find ways to extract the glass of water from the river, not the well. Throwing the customer into the river is not an option!

The real common thread through all of these ideas is often missed. Our fundamental goal is not the use of information or technology. It has always been, and continues to be, to facilitate communications between people: the sender and the receiver.
New students at the University of Delaware are required to pass an Electronic Community Citizenship Examination (ECCE) before getting access to computing resources. The process is teaching students about responsible computing and good citizenship in the Internet community.

ew students at the University of Delaware had to prove that they were Internet-worthy last fall before getting clearance to use University computing resources. The students studied a little manual and took a quiz that posed questions in several categories about responsible computing practices and standards. They responded to multiple-choice questions about good password construction, exclusive use of their access codes, software license regulations, policy and disciplinary proceedings for violations, privacy, chain mail, and rights vs. privileges as they pertain to the University’s computers and network. In all, they had to correctly answer ten questions.

Approximately 3,500 of the 4,000 new students this year have passed the quiz, called ECCE (Electronic Community Citizenship Examination). ECCE, which is also the Latin word for “Behold!” (or “Pay Attention” or “Yo!”), asked new students to identify the responses that make up the University’s standards for responsible computing.

As certified citizens of the electronic community, they now know why the University makes access to the Internet available and how its intent defines acceptable use. They know that, in addition to its concern for the integrity of its own computing resources, the University is determined to do its part to contribute good citizens to the Internet community.

In their manual, Responsible Computing, they read about the University’s aspirations for its students to become competent in information technologies:

• Students should know how these technologies are used in their disciplines.
• They should be able to take full advantage of resources available on the network.
• They should be able to use electronic tools—electronic and voice mail, the voice response registration system, and word processing, for instance—to make them more productive.

The students were asked to imagine the Internet as a frontier or wilderness waiting for civilizing settlers. They can now think of the Internet as an emerging community and can assume responsibility for helping with that process.

They got pointers on being good Internet citizens. “Know what it means to be responsible,” they were told. “Be aware of the thousands of others who rely on University computing resources to do their work.” And they learned something about how the outlaws operate and about the common activities of hackers—cracking passwords, crashing systems, invading privacy, etc. Students began to realize how casual attitudes to system security can make it fall prey to the outlaws.

They became familiar with established disciplinary procedures for abuse of computing privileges. When system integrity or performance is at risk, a student’s access can be disabled summarily. Serious problems are referred to the student judicial system. Misconduct in the course of using computing resources is subject to the same code as any misconduct.

How we warmed up to it

University of Delaware students are eager to get on the Internet, and they come to campus expecting access to the network. The University first made e-mail access available to all students in the spring of 1992. Several hundred students took advantage of this access that first spring, a few thousand the next year, and 12,000 in 1994. Nearly all students currently access the Internet. They exchange e-mail, participate in news groups and games, and explore the World Wide Web using Mosaic. Increasingly, they protest the computing resource limits imposed on them. This was according to plan—a five-year plan for all students to be competent in computing by
1995, including electronic communication. Anticipating questions and confusion, if not problems, about appropriate use of computing resources, the University established the Policy for Responsible Computing, which was approved in the spring of 1992 by the administration and the Faculty Senate.

Introducing 15,000 students to electronic messaging, discussion, and information resources presented a formidable challenge. While we talked about community and responsibility, the Internet seemed to set them free. Some of them seemed to shed all vestiges of civilization, lighting out for the territories.

In general, students seemed oblivious to the notion that responsibility, or any kind of standards, pertained to using computing resources. This was especially frustrating because of our efforts to include the policy in the student handbook and to publicize its importance.

They were unaware of their responsibilities in different areas. Many students simply enjoyed telling their friends what they picked for their “secret” passwords or letting “little brothers” use their computer accounts. One model student/citizen who crashed the computer confessed, “I’ve never done anything wrong!” He was dismayed. A handful of crackers, stopped in their tracks, were dumbfounded that anyone would interfere with their antics or cramp their style.

When confronted by the terms of the Policy for Responsible Computing, they returned not looks of embarrassment, annoyance, or penitence, but blank stares. We realized that we needed to put the policy into operation. We needed each student’s undivided attention, even if just for a few minutes.

Sharper images

It is too soon to measure the impact of the awareness program on new students. The fall semester was not free of electronic chain mail and complaints of stolen accounts and harassing messages. But students did not complain about the test. We haven’t seen a “down” side. Students are able to log in to the central computing systems over the network to take the test, so it is readily available for the taking around the clock. The test is designed to report the correct answer when a wrong one is entered and to be taken over again as often as necessary, in the manner of a tutorial. Last fall, new students waited in very long lines to activate their access codes, but this was primarily the result of so many of them wanting an early start in using computing resources.

We would like to extend the test requirement to upperclassmen and are working on some schemes for doing this that won’t disrupt their computing access or incur their wrath.

The program had a favorable impact on faculty, who helped initiate it by distributing manuals and discussing responsible computing during new student orientation. Many welcomed the manual and test as tools to enable them to join in the education effort. Some used the material with upperclassmen.

Perhaps the most significant outcome of the awareness program is the creation of some clear images. We used images of the frontier and outlaws, inspired by Lonesome Dove, as a way to affirm good citizenship on the Internet. Gus’s comment on Jake Spoon’s hanging, “Ride with an outlaw, die with one,” was a harsher image than we wanted, but, “Don’t ride with the outlaws!” seemed good. We wrote about driving a “civilized wedge” into “unsettled territory.”

The test has helped students to understand the Internet as a virtual community, themselves as good citizens of that community, and hackers as outlaws. With well-defined models, they can now make responsible decisions as they explore the Internet.

Sample questions from the ECCE quiz

1. Just as I might lend my car to my roommate, it is OK to share my computer account with a friend.
   a. This statement is true. It’s my account.
   b. This statement is false. I may not share my account with anyone.
   c. This statement is true if my friend and I are taking the same class.
   d. This statement is false, but it is OK to share my account with my younger brother because he is also a student here.

2. The best place to keep your password is
   a. written on the back of your ID card.
   b. on a piece of paper you carry in your wallet.
   c. on the bulletin board in your room or office.
   d. in your head. You should never write your password down.
   e. in a computer file on your UNIX account.

9. If I am found guilty of violating the University’s Policy for Responsible Computing,
   a. I may lose my computing privileges.
   b. I may be subject to other sanctions from the Dean of Students’ office.
   c. I may be suspended or expelled from the University.
   d. I may receive counseling on proper computing behavior.
   e. I might be liable to prosecution under federal, state, and local ordinances.
   f. If found guilty, I may be subject to all or any of the sanctions listed in items a–e above.

15. Who is responsible for the smooth running of the Internet and all computer networks connected to it?
   a. The computing center staff at the University.
   b. InterPol, the international police agency.
   c. Everyone who uses the network, including students, faculty, and staff at the University of Delaware.
   d. No one.
   e. The Interstate Commerce Commission.

1 The full set of thirty questions that the ECCE quiz draws from are available as CAUSE Information Resources Library document CSD0990. It is available by sending e-mail to search@cause.colorado.edu. In the body of the message type: get csd0990.
"We get to see clearly how team members bring not only their talents and skills to the work of a team, but also their bumps and warts."

**A Model for the Reinvented Higher Education System: State Policy and College Learning**
by Babak Armajani, Richard Heydinger, and Peter Hutchinson
(a joint publication of SHEEO and the Education Commission of the States, 1994. 37 pages, $10.00)

This is a provocative book. It looks at how higher education structures might be redesigned to make them more responsive to two external forces: "the public's demand for more attention to teaching and learning and the reality of limited resources."

Using the principles of reinvention and enterprise management put forward in Osborne and Gaebler's *Reinventing Government* and *Breaking Through Bureaucracy* by Barzelay and Armajani, the authors contend that our nineteenth-century toolbox has outmoded tools and can't repair the old bureaucratic system. The new tools that are needed for a twenty-first century paradigm, called the enterprise model, call for three new items in the toolbox: focus on the customer, accountability for outcomes, and the more positive assumptions about student and employee motivation.

Not covered is the growing impact of technology, telecommunications, and distance education on the "old bureaucratic model," but this booklet is still a very worthwhile addition to the field.

**Reviewed by George P. Connick, President, Education Network of Maine. Formerly President of the University of Maine at Augusta (1985-1995), Dr. Connick was appointed president of the Network in January 1995.**

**Productive Teams**
featuring Tom DeMarco and Tim Lister
(Dorset House, 1994. VHS, 60 minutes, $98.75)

In their new video, *Productive Teams*, Tom DeMarco and Tim Lister present a solid introduction to the role of teams in changing organizations. Their message is presented as an informal conversation punctuated by a surprise message from "the boss," who aptly illustrates "how not to do it."

The authors take the viewer through five levels of team development, each requiring greater management acceptance and support. They provide concrete advice on how a manager can contribute to the success of a team and why that support is essential. DeMarco and Lister agree that traditional gimmicks such as slogans for teamwork can do more harm than good, then lead the viewer to a valuable discussion of the harmful effects of competition in a team setting.

I found their successful use of humor (yes, humor!) in this video to be a refreshing touch that could be used to benefit beginners and the experienced alike.

All in all, the Lister and DeMarco video provides valuable insights into why teams are so important to the success of our organizations, and how we can help them to emerge and "jell." Today's IT organization simply must rely on teams to meet rapidly changing and increasingly complex demands. This video can help the IT professional to manage, lead, and participate in more successful teams.

**Reviewed by Mark Luker, Chief Information Officer for the University of Wisconsin-Madison. Mark has engineered the reorganization of three separate units into one Division of Information Technology (DoIT). He is a champion of the TQM philosophy, and several quality teams have work in progress at DoIT.**

**Flying Fox: A Business Adventure in Teams and Teamwork**
by John Butman
(AMACOM, a division of American Management Association, 1993. 214 pages, $19.95)

When folks ask me what my reading preferences are, I routinely respond, "Trash novels." Now, that is a bit harsh, but I am an aficionado of mysteries and some science fiction, and an occasional good novel. I fall asleep a lot when I pick up books about management. I didn't fall asleep reading *Flying Fox*. I bought the book last year as one of a selection of books to read before I went off to talk smartly about management skills. I started it and couldn't put it down. I reread it after I volunteered to write a review of it for CAUSE/EFFECT. It was as good and as quick a read the second time.

*Flying Fox* is a business novel. Its hero and narrator is Ron Delaney, who volunteers to be the leader of a cross-functional team. With Ron, we live through the forming, storming, norming, and performing of team Flying Fox. We get to see clearly how team members bring not only their talents and skills to the work of a team, but also their bumps and warts.

As you read this book, it is very easy to look at how we do our work in information resources organizations and gain clear insights into what we do that works and what doesn't. We are being
expected more and more to work in cross-functional teams, Flying Fox teams. The group of people we bring together from our MIS group, our network group, the human resources department, and the finance department to plan for the implementation of a new human resources information system is the nucleus of a cross-functional team. The book helps us examine issues such as how much autonomy our team has, how much authority the team has, how communications within the team work, how the team solves problems, how it acquires resources, how team performance is measured, and how individual performance as part of a team is recognized.

One of my staff members says that in this information age, there is no way to manage information and communication vertically; it’s horizontal, no matter what the organization chart looks like. This book affirms that position and celebrates it. Openness, collaboration, and consensus decision-making are the tools of the team.

This book is an “Ah-ha, that’s what’s going on in my group right now!” kind of a book. As I reread it, I knew that I was going to buy multiple copies, give one to each of the managers in our organization who are frequently asked to pull together cross-functional teams, and put a couple of copies in our department library for the rest of the folks to look at.

Reviewed by Ann Studden, Director of Academic Computing and Network Services at Northwestern University in Evanston, Illinois. She is responsible for user support services, instructional technology services, network services, and network applications development at Northwestern.

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**Bringing Out the Best in People: How to Apply the Astonishing Power of Positive Reinforcement**

by Aubrey C. Daniels  

Every successful information technology organization is a collection of successful people, and so a primary responsibility of every IT manager should be the development of successful people—staff who want to come to work on Monday and who feel fulfilled at the end of each day. It is the people who will make the information revolution happen, not the technology.

But sometimes it seems that managers are being asked to adopt the “management system du jour,” switching between systems such as quality circles, management by walking around, and intrapreneuring. These management systems claim to encourage people to act in a desired way, but according to author Aubrey C. Daniels, these systems, excellent though they all are, do not encourage people to *repeat* the actions desired. In his well written book, Daniels details ways to manage our most important resource—staff—in a way that will cause them to repeat the actions we want to encourage.

Daniels claims that the key to getting repeated action is to set up a reward system that encourages the desired behavior. These rewards must be immediate, positive, and certain. Often we set up reward systems that work *against* the management system we are trying to implement, but through effectively pairing actions with their proper reward, managers can improve staff performance.

A good example of pairing a desired activity with a positive outcome is “Grandma’s Law”: “Eat your vegetables or you don’t get dessert.” Grandma’s Law is an example of encouraging a desired activity by promising a particular outcome. Children don’t want to eat their vegetables, but they certainly want their dessert. The reward is immediate, certain, and positive. In an IT organization, such an action/reward combination might consist of telling a programmer, “When you finish your documentation, then you can work on developing the University home page.”

When setting up reward systems, it is important for managers to remember that every person within an organization is unique and responds to rewards and goals in different ways. What is a reward to one person could be a punishment to another. What may be a reachable goal for one person may not be for the person at the next desk. And any rewards should be set up in such a way as to encourage everyone to be a winner.

In this day and age of rightsizing and reduced budgets, IT managers are being asked to do more with less. People are the key to meeting the demands that are placed on us. Setting up positive reinforcement plans such as Daniels proposes is an easy way not only to produce more, but to have a more contented staff. An organization with well managed and motivated people will be a successful organization, and it is much more fun to manage people well than to change your organization to conform to the management philosophy of the day.

Reviewed by Jim Scanlon, Director of Information Technology at Santa Clara University. He is responsible for academic computing, administrative computing, and telecommunications.
Leadership and the New Science: Learning about Organizations from an Orderly Universe
by Dr. Margaret Wheatley
(Berrett-Koehler Publishers, 1992. 151 pages, $15.95)

Leadership and the New Science
(CRM Films, 1993. VHS, 22 minutes, $604 – special educator’s price – includes book)

We are trying to manage in unmanageable times. New versions, reorganizations, new developments, new tools, reengineered processes, new applications; once you have it “just the way you like it,” someone shows up and changes it. “The thing we’re trying to control, CHAOS,” says Dr. Margaret Wheatley, author of Leadership and the New Science, “seems to be controlling us.”

In this book (and 22-minute video by the same name), Dr. Wheatley, a social scientist and expert in organizational behavior, applies her long-term study of “New Science” (chaos theory, evolutionary biology, field theory, and quantum physics) to organizations. “Most of us work in organizations that are the product of seventeenth-century thinking,” she says. Guided by Newtonian-science mechanized models, we have fragmented, compartmentalized, over-complicated, and over-controlled our organizational systems and stifled the people who work within them.

In the video (as well as in greater detail in the book) she makes the following points and emphasizes their relationship to the principles of New Science.

Order can emerge out of chaos. “Open systems use disequilibrium to avoid deterioration.” In the past, we have feared chaos and seen it as the negative result of a lack of control. Instead, she says, chaos theory tells us to embrace chaos as a natural process by which we renew and revitalize ourselves and our organizations. Perhaps you have seen this in meetings, where an unfocused or “off-the-wall” discussion suddenly produced an energizing new idea or direction.

Information informs us and forms us. People in organizations see information as something to hoard, to control, to dole out in carefully monitored packets. In the new biology, “many scientists now treat information as the primary organizing force of the universe,” she says. Information informs us and forms us (and our universities). Many in information technology provider roles have long understood and have tried to explain to our customers the enabling and potentially transforming power of information flowing through integrated technologies.

Relationships are all there is. From quantum physics we are shown how “at the very foundation of the universe, we find not building blocks, but relationships.” Many of us have already been working cross-functionally to build teams within our divisions and universities, partnering with each other and with customers. We have seen the power of diverse points of view—enabled by good communication—to solve complex problems. In our organizations, we must build team members who know how to work effectively with many types of people, how to listen and speak up, and how to support each other.

Vision is the invisible field. Think about your own experience with the “field” generated by systems: families, communities, organizations. When we walk in, we can immediately recognize its field qualities: friendly or distant, warm or cool, service-oriented or disinterested, coherent or fragmented, arrogant or welcoming, etc. From field theory, Dr. Wheatley tells us that as employees, we all create this field, and the more coherent our united positive vision (which cannot be imposed, she says) the more our organization can be successful. How many of us can clearly articulate an energizing vision for our organizations or work groups?

I recommend Leadership and the New Science as an enjoyable (even if somewhat theoretical) “must read” for any information technology provider or manager who is struggling with the issues of structure and organization and the pace of change. By reading this book (or even watching the video as an introduction) one not only becomes acquainted with the principles of New Science in understandable terms, but also gains a much better understanding of why our current systems aren’t working. I hope that the courageous among us may find inspiration in some of these New Science principles and some support for new approaches that we may already be trying.

Reviewed by Catherine Lilly, an Organization Development Specialist who works with the Information Technology Division at the University of Michigan. She has been working to develop and improve organizations in both the public and private sector for twelve years.
Technopoly: The Surrender of Culture to Technology
by Neil Postman
(Vintage Books, Random House, 1993. 222 pages, paperback $11.00)

Point

In this provocative work, Postman warns us that, “because of its lengthy, intimate, and inevitable relationship with culture, technology does not invite a close examination of its own consequences.” While many of us are using, enjoying, and making a living from technology (a technology whose benefits the author readily acknowledges), this book takes us on a guided tour of the “dark side to this friend”—a side that Postman claims has the potential to undermine the moral, intellectual, and social foundations of our culture. He asserts, for example, that computing technology defines our most serious problems, personal and public, in terms of lack of information, and sets out to solve those problems by deluging us with more and more information of greater and greater granularity. The result? “We have devalued the singular human capacity to see things whole in all their psychic, emotional and moral dimensions,” we have replaced “confidence in human judgment and subjectivity” with “faith in the powers of technical calculation.” He asks us to “keep in mind the story of the statistician who drowned while trying to wade across a river with an average depth of four feet.” Nonsense? Extreme? Outrageous? Atavistic? Or does the temptation to say so simply make Postman’s point for him? It’s worth the reader’s while to explore Postman’s examples drawn from advertising, poll taking, television, politics, the academy, etc., not in order to reject technology, but to decide for him/herself how seriously the consequences of technology threaten to divorce human meaning from mere information.

Counterpoint

Methinks that Postman doth protest too much, and he also argues from both sides of the fence. He states his concern that “the computer claims sovereignty over the whole range of human experience …,” that “the computer argues … that the most serious problems confronting us at both personal and public levels require technological solutions through fast access to information otherwise unavailable.” Who in these statements is giving such power to what is merely a tool? The computer is not making these claims; it is the author himself.

The subtitle of Technopoly is The Surrender of Culture to Technology. This sets the tone for the reader without even opening the cover. The book has been described as provocative. Perhaps “attempts to be provocative” would describe it better. There are interesting points made throughout the book for information resources professionals in higher education to consider, but the effort to wade through this material written in such a doomsday tone may overshadow any possible value the book has for the reader.

Discussed and reviewed by members of the University of California at Davis Information Technology Book Group.
Readers Respond

**Question:** Is your campus using or planning to use electronic data interchange (EDI) to change any business processes? If so, what are the applications in use or planned?

**Pima Community College** is planning to implement EDI in an upgrade to Pima’s “Just-in-Time” office supply program. This program is an agreement established between Pima and our vendor in which the vendor delivers office supplies (including large items such as desks, file cabinets, etc.) within twenty-four hours of our sending an order. The system that supports this is a remote entry system running on a PC in the purchasing office. Our orders are placed with the company from this PC and we receive a tape on a periodic basis which we then use as a transaction file to our FIS (financial information system). Some problems have arisen that would be lessened by our having an EDI connection with the vendor’s host, which would allow both the order from us and a “transaction” record that we could immediately use to update our FIS accounts.

We have had some discussions with this vendor about their ability to support EDI. They can, but only through a private network exchange. We have decided to wait till the vendor can support EDI via the Internet.

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At **Yeshiva University** we have developed an Electronic Purchase Order System for certain vendors that we have engaged in yearly contracts. The orders are entered online into our mainframe computer by the requesting department. At the end of the day the orders are downloaded from the mainframe to a microcomputer. We then transmit the orders to an EDI trading partner in EDI format so that they can be picked up by the vendors for processing. The vendors send us EDI, diskette, or manual invoices. This is based on their capabilities. The reason we transmit and receive EDI on the micro is that the EDI software is much less expensive for the micro. This system has been running over a year and has eliminated thousands of purchase orders. In addition, accounts payable data entry has been eliminated for those vendors that send us invoices by EDI or diskette.

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The **University of Miami** currently has a project under way to use EDI for electronic posting of invoices. We have selected several vendors from whom we receive a high volume of relatively low-dollar-amount invoices. We compared the current cost of manual processing of those invoices with the EDI transaction cost and determined that we could reduce cost by converting to EDI. An additional incentive was that we were able to negotiate favorable discount terms with the vendors as a result of the conversion. Our accounts payable system is the first to utilize EDI. We are looking at various student functions for implementations, such as transcripts, test scores, etc. In addition, we will be implementing EDI for purchasing, for those vendors to whom we currently send high volumes of purchase orders.

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At the **Ohio State University**, we have put the EDI infrastructure in place. A translation software package is installed, and a VAN (Value Added Network) relationship has been established. We completed a pilot project sending purchase orders to a vendor and receiving purchase order acknowledgments from the vendor. The appropriate buyer receives a report which indicates any changes the vendor may have sent in the acknowledgment.

We are also receiving health care claim payment/advice. Reports are being developed using these data. The reports will be used in parallel with the current paper process. Once the electronic data have been authenticated by the parallel process, the paper system will be discontinued.

An invoice application is also under way. The invoice transaction is received and the information fed into the accounts payable system and

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processed there. Departments are able to view the invoice online.

Our telephone system plans to use the “consolidated service invoice/statement” transaction to receive long distance carrier billing information.

Requests for Quotations now specify EDI when appropriate.

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The San Diego Community College District has started technical development on a project to implement an electronic data interchange for student transcripts. The District currently sends transcript data to the San Diego State University on magnetic tape through their Computer-Assisted Record Evaluation (CARE) program. The CARE program will be replaced with an electronic data interchange. Transcript data in SPEEDE format will be distributed via the Internet using EDI Smart software. The District plans to pilot the implementation in September 1995 with San Diego State University and the University of California at San Diego, with potential expansion to other colleges and universities.

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The University of Michigan utilizes EDI for the transmission of purchase order data, and development is under way for invoice data. Other applications being planned include transcripts and admission data. The translation and communication software for the purchase order data resides on a Banyan server. The mainframe-based purchasing system was modified to write a text file to the Banyan network, where the file is translated into EDI ANSI X12.850 format. The software then transmits it to IBM’s Advantis Network Service, where the transactions are placed in the trading partner’s mailbox.

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Harvard University has been using EDI in the following applications:

- sending requests to an information utility and getting results back;
- automated report distribution;
- accounts payables’ transaction processing; and
- automated invoice distribution.

HEDI (HarvardEDI) is a protocol created by Harvard as a common way to exchange information objects between application programs running on a variety of platforms using e-mail, FTP, or interactive mechanisms such as OSF DCE pipes.

Objects are represented as lines of text and can be structured to allow representation of complex data. The general framework of an object consists of information in a strictly specified, tagged-format header, followed by an optional object body composed of repeating groups of information in a variety of formats. The text is human-readable and self-describing. HEDI, which is a very flexible structure and is object-oriented, has been a very productive protocol to use in application development, both new and reengineered.

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UC Berkeley’s Campuswide Accounts Payable (CAP) system has been enhanced to accept and manage procurement credit card invoices received through electronic data interchange (EDI). The new purchasing credit cards are used by Berkeley campus administrative support staff to acquire goods and services (under $2,500) directly from the credit card participating vendors. This eliminates the need for departments to type forms for the purchases, and for disbursements personnel to key the invoices into CAP. The purchase amount and the accounting distribution information captured at the point of sale are passed through various financial institutions, then back into CAP via EDI. Credit card activity reports from CAP are sent by e-mail to participating departments, creating an almost paperless system. Three campus departments are now using the new procurement credit cards in pilot production.

UC Berkeley plans to use EDI to receive invoices and send remittances electronically from and to other vendors. We have successfully received, translated, and loaded invoices in test from Federal Express. Testing with Pacific Gas and Electric will begin in March 1995.

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Linn-Benton Community College is in the process of implementing EDI via SCT’s EDI Smart product. As part of the State of Oregon’s SPEEDE/ExPRESS Working Group, Linn-Benton continues to work with its primary trading partners (Oregon State University, Western Oregon State College, Chemeketa Community College, and nearby K-12 school districts) in an effort to acquire reliable hardware and software for electronic receipt and
transmission of student transcripts. The solution we are working towards will be integrated with our existing student system (SCT’s Banner product). We expect to be sending and receiving transcripts by the end of 1995.

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The University of Oregon is currently using EDI to send and receive academic transcripts from K-12 and postsecondary institutions. This is in cooperation with the American Association of Collegiate Registrars and Admissions Officers (AACRAO) SPEEDE project. (Yet another acronym—SPEEDE: Standardization of Postsecondary Education Electronic Data Exchange). At this point, we are in complete production mode with only a handful of other institutions, but there is a statewide commitment to fully implement this technology. In addition to transcripts, we are exploring other EDI transaction sets to automate enrollment verification, applications for enrollment, and the exchange of current course catalog information (course inventories). We look to these new technologies to enhance our productivity, especially in the areas of admissions and transfer articulation.

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A few electronic data interchange (EDI) applications have recently emerged at Florida State University. These newly automated business processes include both electronic data and fund transfers.

We currently interchange student loan data with some of the lenders that provide Government Student Loans (GSL). In the near future, we will also electronically interchange funds with these lenders, thus eliminating paper records exchange and check processing.

Additionally, students may receive their financial aid and GSL proceeds via EFT to their FSUCard debit account (associated with the campus multi-purpose student photo ID), thus eliminating the need to stand in distribution lines and deal with checks. Students can use the FSUCard at both on- and off-campus merchants and can obtain cash through bank ATMs.

The Florida Automated System for Transferring Educational Records (FASTER) provides school districts, community colleges, and universities with the means to exchange transcripts and other official student records electronically. It is an electronic document exchange which addresses both requests for transcripts and the responses to these requests. Both requests and responses must follow predefined record formats and edit specifications. Currently, the system can be used to transfer three kinds of student records: interdistrict records, secondary transcripts, and postsecondary transcripts.

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Loyola University Chicago is incorporating EDI into its vendor and banking relationships. The first project that we will bring into production is the electronic posting of Medicare’s benefits payments for our Medical Center, using the ANSI standard 835 transaction set. We are planning to use EDI for payroll funds transfer to our bank, and for federal and state tax payments. We are also investigating the transmission of purchase orders, the receipt of lock box remittance transfers for tuition and alumni donations, and the transmission of transcripts. We have licensed Sterling Software’s GENTRAN and SUPERTRACS for these projects.

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Selected responses to the Summer 1995 Readers Respond question will be printed in the next issue of CAUSE/EFFECT, space permitting, while all replies will be included in the online edition available on the CAUSE Gopher and Web servers.

Summer 1995 Readers Respond Question

How is your institution handling chargebacks for network access and use?

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